E - T E N D E R S P E C I F I C A T I O N

NO: BHE/PW/PUR/WNT-DM PLANT PGTEST-U8/2402

FOR

Resolution of pending technical issues and Expert/ Consulting services for DM Plant PG test at Wanakbori Extn Unit-08 Set-01 at GSECL 1X800MW project.

VOLUME – IA

TECHNICAL BID

- **Notice Inviting Tender,**
- **Volume-IA : Technical Conditions of Contract-,**
- **Volume-IB : Special conditions of Contract,**
- **Volume-IC : General conditions of Contract**
- **Volume-ID : Forms & Procedures**

Bharat Heavy Electricals Limited
(*A Government of India Undertaking*)
Power Sector - Western Region
345-Kingsway, Nagpur-440001

CONTENTS

2402

NOTICE INVITING TENDER

Bharat Heavy Electricals Limited

Ref: BHE/PW/PUR/WNT-DM PLANT PGTEST-U8/2402 Date: 26/03/2021

NOTICE INVITING E-TENDER (NIT)

NOTE: BIDDER MAY DOWNLOAD/ UPLOAD THE TENDER/ OFFER FROM/ON BHEL E-PROCUREMENT PORTAL → https://eprocurebhel.co.in

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To,

Dear Sir/Madam,

Sub : NOTICE INVITING E-TENDER

Sealed offers in two part bid system (National competitive bidding (NCB) ~~or International Competitive Bidding (ICB~~ are invited from reputed & experienced bidders (meeting PRE QUALIFICATION CRITERIA as mentioned in Annexure-1) for the subject job by the undersigned on the behalf of BHARAT HEAVY ELECTRICALS LIMITED as per the tender document. Following points relevant to the tender may please be noted and complied with.

1.0 Salient Features of NIT

S No.	ISSUE	DESCRIPTION	
i	**E-TENDER NUMBER**	**BHE/PW/PUR/WNT-DM PLANT PGTEST-U8/2402**	
ii	**Broad Scope of job**	**Resolution of pending technical issues and Expert/ Consulting services for DM Plant PG test at Wanakbori Extn Unit-08 Set-01 at GSECL 1X800MW project.**	
iii	**DETAILS OF TENDER DOCUMENT**		
A	Volume-IA	*Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc.*	*Applicable*
B	Volume-IB	*Special Conditions of Contract (SCC)*	*Applicable*
C	Volume-IC	*General Conditions of Contract (GCC)*	*Applicable*
D	Volume-ID	*Forms and Procedures*	*Applicable*
F	Volume-II	*Price Bid as specified in E-Procurement Portal*	*Applicable*
iv	**Issue of Tender Documents**	**Tender documents will be available for downloading from BHEL website (www.bhel.com) or e-procurement portal (https://eprocurebhel.co.in) as per schedule below:** ***Start : 26/03/2021 , Time : 16:00*** ***Closes : 05/04/2021 , Time : 11:00*** Brief information of the tenders shall also be available at central public procurement portal. *(https://eprocure.gov.in/epublish/app)*	*Applicable*
v	**DUE DATE & TIME OF OFFER SUBMISSION**	***Date: 05/04/2021, Time: 11.00 Hrs*** • ***Place: on E-Tender Portal https://eprocurebhel.co.in***	*Applicable*
vi	**OPENING OF TENDER (Techno-Commercial Bid)**	***Date: 05/04/2021, Time: 17.00 Hrs*** *Notes:* *~~(1) In case the due date of opening of tender becomes a non-working day, then the due date & time of offer submission and~~*	*Applicable*

S No.	ISSUE	DESCRIPTION	
		~~opening of tenders get extended to the next working day.~~ ~~(2) Bidder may depute representative to witness the opening of tender. For e-Tender, Bidder may witness the opening of tender through e-Procurement portal only.~~	
vii	**EMD AMOUNT**	***₹18,000/-*** ***(Rupees Eighteen Thousand Only)*** ***Important Note: Bidders kindly to take note that EMD (Earnest Money Deposit) shall be furnished by MSE bidders as well, as per the amount and procedure indicated in the NIT/GCC.***	*Applicable*
viii	**COST OF TENDER**	*Free*	
ix	**LAST DATE FOR SEEKING CLARIFICATION**	One day before due date of offer submission. Along with soft version also, addressing to undersigned & to others as per contact address given below: 1) Name: P R Chiwarkar Designation: AGM Deptt: Purchase Address: Floor no. 5 & 6,Shree Mohini Complex, 345 Kingsway, Nagpur-440001 Phone: Landline: +91-712-2858-633 Email :prchiwarkar@bhel.in Fax:+91-712-2858600 2) Name: Shubhangi Tembhurne Designation: Dy Manager Deptt: Purchase Address: Floor no. 5 & 6,Shree Mohini Complex, 345 Kingsway, Nagpur-440001 Phone: Land Line: +91-712-2858742 Email :shubh@bhel.in Fax:+91-712-2858600	*Applicable*
x	**SCHEDULE OF Pre Bid Discussion (PBD)**	-	Not Applicable
xi	**INTEGRITY PACT & DETAILS OF INDEPENDENT EXTERNAL MONITOR (IEM)**	-	Not Applicable
xii	**Latest updates**	Latest updates on the important dates, Amendments, Correspondences, Corrigenda, Clarifications, Changes, Errata, Modifications, Revisions, etc to Tender Specifications will be hosted in BHEL webpage (www.bhel.com-->Tender Notifications →View Corrigendum), Central Public Procurement portal (https://eprocure.gov.in/epublish/app) & on e-tender portal https://eprocurebhel.co.in **and not in the newspapers**. Bidders to keep themselves updated with all such information.	

2.0 The offer shall be submitted as per the instructions of tender document and as detailed in this NIT. Bidders to note specifically that all pages of tender document, including these NIT pages of this particular tender together with subsequent correspondences shall be submitted by them, duly signed

digitally using Class III DSC & uploaded in E-Procurement Portal, as part of offer. **Rates/Price including discounts/rebates, if any, mentioned anywhere/in any form in the techno-commercial offer other than the Price Bid, shall not be entertained.**

3.0 Not Used

4.0 Unless specifically stated otherwise, bidder shall deposit EMD as per clause 1.9 of General Conditions of Contract.

For Electronic Fund Transfer the details are as below-:

NAME OF THE BENEFICIARY	BHARAT HEAVY ELECTRICALS LTD
ADDRESS OF THE COMPANY	SHREE MOHINI COMPLEX 345, KINGSWAY,NAGPUR
NAME OF BANK	STATE BANK OF INDIA
NAME OF BANK BRANCH AND BRANCH CODE	SBI,KINGSWAYBRANCH,BRANCH CODE-00432
CITY	NAGPUR
ACCOUNT NUMBER	31380025872
ACCOUNT TYPE	CURRENT A/C
IFSC CODE OF THE BENEFICIARY BANK BRANCH	SBIN0000432
MICR CODE OF THE BANK BRANCH	440002002

(Note -: In case of E-Tenders, proof of remittance of EMD should be uploaded in the E-Procurement Portal and originals, as applicable, shall be sent to the officer inviting tender within a reasonable time, failing which the offer is liable to be rejected.

5.0 **Procedure for Submission of Tenders**:

This is an E-tender floated online through our E-Procurement Site (**https://eprocurebhel.co.in**). The bidder should respond by submitting their offer online only in our e-Procurement platform at (**https://eprocurebhel.co.in**)**.** Offers are invited in two-parts only.

Documents Comprising the e-Tender

The tender shall be submitted online ONLY EXCEPT EMD (in physical form) as mentioned below:

a. Technical Tender (UN priced Tender)

All Technical details (e.g. Eligibility Criteria requested (as mentioned below)) should be attached in e-tendering module, failing which the tender stands invalid & may be REJECTED. Bidders shall furnish the following information along with technical tender (preferably in pdf format):

- **i.** Earnest Money Deposit (EMD) furnished in accordance with NIT Clause 4.0. ~~Alternatively, documentary evidence for claiming exemption as per clause 29 of NIT.~~
- **ii.** Technical Bid (without indicating any prices).

b. Price Bid:

i. Prices are to be quoted in the attached Price Bid format online on e-tender portal.
ii. The price should be quoted for the accounting unit indicated in the e-tender document.
iii. Note: It is the responsibility of tenderer to go through the Tender document to ensure furnishing all required documents in addition to above, if any. Any deviation would result in REJECTION of tender and would not be considered at a later stage at any cost by BHEL.
iv. A person signing (manually or digitally) the tender form or any documents forming part of the contract on behalf of another shall be deemed to warrantee that he has authority to bind such other persons and if, on enquiry, it appears that the persons so signing had no authority to do so, the purchaser may, without prejudice to other civil and criminal remedies, cancel the contract and hold the signatory liable for all cost and damages.

v. A tender, which does not fulfil any of the above requirements and/or gives evasive information/reply against any such requirement, shall be liable to be ignored and rejected.

DO NOT'S

Bidders are requested NOT to submit the hard copy of the Bid. In case offer is sent through hard copy/fax/telex/cable/electronically in place of e-tender, the same shall not be considered. **Also, uploading of the price bid in prequalification bid or technical bid may RESULT IN REJECTION of the tender**.

Digital Signing of e-Tender

Tenders shall be uploaded with all relevant PDF/zip format. The relevant tender documents should be uploaded by an authorized person having Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION digital signature certificate (DSC).

The Requirement:

1. A PC with Internet connectivity &
2. DSC (Digital Signature Certificate) (**Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION**)

BHEL has finalized the e-procurement service Provider-:
NIC PORTAL (https://eprocurebhel.co.in)

For E-PROCUREMENT ASSISTANCE & TRAINING, NIC PORTAL HELPDESK CONTACTS AS PER FOLLOWING:

For any technical related queries, please call at 24 x 7 Help Desk Number
0120-4001 002
0120-4200 462
0120-4001 005
0120-6277 787
1. Peter Raj, NIC, Ph: 9942069052
Email Support: support-eproc@nic.in
Other details/update yourself from : https://eprocurebhel.co.in

The process of utilizing e-procurement necessitates usage of **DSC (Digital Signature Certificate) (Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION)** and you are requested to procure the same immediately, if not presently available with you. Please note that only with DSC, you will be able to login the e-procurement secured site and take part in the tendering process.

The contact details of the DSC certifying authority:-
please refer http://www.mca.gov.in/ →MCA SERVICES → DSC SERVICES

Vendors are requested to go through seller manual available on https://eprocurebhel.co.in.

~~**Procedure for Submission of Tenders (To be used in case of Paper bid only):** The Tenderers must submit their Tenders to Officer inviting Tender, as detailed below:~~

- ~~PART-I consisting of 'PART-I A (Techno Commercial Bid)' & 'PART-I B (EMD)' in two separate sealed and superscribed envelopes (ENVELOPE-I & ENVELOPE-II)~~
- ~~PART-II (Price Bid) in sealed and superscribed envelope (ENVELOPE-III)~~
- ~~One set of tender documents shall be retained by the bidder for their reference~~

~~6.0 The contents for ENVELOPES and the superscription for each sealed cover/Envelope are as given below. **(All pages to be signed and stamped) (To be used in case of Paper bid only):**~~

Sl. no.	Description	Remarks
	Part-I A	
	ENVELOPE – I superscribed as: PART-I (TECHNO COMMERCIAL BID) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: **CONTAINING THE FOLLOWING**:	
i.	Covering letter/Offer forwarding letter of Tenderer.	
ii.	Duly filled-in `No Deviation Certificate' as per prescribed format to be placed after document under sl no (i) above. **Note:** a. In case of any deviation, the same should be submitted separately for technical & commercial parts, indicating respective clauses of tender against which deviation is taken by bidder. The list of such deviation shall be placed after document under sl no (i) above. It shall be specifically noted that deviation recorded elsewhere shall not be entertained. b. BHEL reserves the right to accept/reject the deviations without assigning any reasons, and BHEL decision is final and binding. i). In case of acceptance of the deviations, appropriate loading shall be done by BHEL ii). In case of unacceptable deviations, BHEL reserves the right to reject the tender	
iii.	Supporting documents/ annexure/ schedules/ drawing etc. as required in line with Pre-Qualification criteria. It shall be specifically noted that all documents as per above shall be indexed properly and credential certificates issued by clients shall distinctly bear the name of organization, contact ph. no, FAX no, etc.	
iv.	All Amendments/Correspondences/Corrigenda/Clarifications/Changes/ Errata etc. pertinent to this NIT.	
v.	Integrity Pact Agreement (Duly signed by the authorized signatory)	If applicable
vi.	Duly filled-in annexures, formats etc. as required under this Tender Specification/NIT	
vii.	Notice inviting Tender (NIT)	
viii.	Volume – I A : Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc.	
ix.	Volume – I B : Special Conditions of Contract (SCC)	
x.	Volume – I C : General Conditions of Contract (GCC)	
xi.	Volume – I D : Forms & Procedures	
xii.	Volume – II (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item	
xiii.	Any other details preferred by bidder with proper indexing.	

	PART-I B	
	ENVELOPE – II superscribed as: PART-I (EMD) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: **CONTAINING THE FOLLOWING:-**	
	Earnest Money Deposit (EMD) in the form as indicated in this Tender	

	PART-II	
	PRICE BID consisting of the following shall be enclosed	
	ENVELOPE-III superscribed as: PART-II (PRICE BID) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: **CONTAINING THE FOLLOWING**	
i	Covering letter/Offer forwarding letter of Tenderer enclosed in Part-I	
ii	Volume II – PRICE BID (Duly Filled in Schedule of Rates – rate/price to be entered in words as well as figures)	

	OUTER COVER	
	ENVELOPE-IV (MAIN ENVELOPE / OUTER ENVELOPE) superscribed as: TECHNO-COMMERCIAL BID, PRICE BID & EMD TENDER NO: NAME OF WORK: PROJECT: DUE DATE OF SUBMISSION: **CONTAINING THE FOLLOWING:**	
i	○ Envelopes I ○ Envelopes II ○ Envelopes III	

- **SPECIAL NOTE: All documents/ annexures to be submitted should be uploaded in respective places in the E-Tender portal as per the list mentioned given in this NIT. BHEL shall not be responsible for any in-complete documents.**

7.0 Deviation with respect to tender clauses and additional clauses/suggestions in Techno-commercial bid / Price bid shall NOT be considered by BHEL. Bidders are requested to positively comply with the same.

8.0 BHEL reserves the right to accept or reject any or all Offers without assigning any reasons thereof. BHEL also reserves the right to cancel the Tender wholly or partly without assigning any reason thereof. Also BHEL shall not entertain any correspondence from bidders in this matter (except for the refund of EMD).

9.0 **Assessment of Capacity of Bidders**: NA

Bidder's capacity for executing the job under tender shall be assessed 'LOAD' wise and 'PERFORMANCE' wise as per the following:

I. **LOAD**: Load takes into consideration **ALL** the contracts of the Bidder under execution with BHEL Regions, irrespective of whether they are similar to the tendered scope or not. The cut off month for reckoning 'Load' shall be the 3rd Month preceding the month corresponding to the 'latest date of bid submission', in the following manner -
(**Note:** For example, if latest bid submission is in Jan 2017, then the 'load' shall be calculated up to and inclusive of Oct 2016)

Total number of Packages in hand = Load (P)

Where 'P' is the sum of all unit wise identified packages (refer table-1) under execution with BHEL Regions as on the cut off month defined above, including packages yet to be commenced, excepting packages which are on Long Hold.

II. **PERFORMANCE**: Here 'Monthly Performance' of the bidder for all the packages (under execution/ executed during the 'Period of Assessment' in all Power Sector Regions of BHEL) **SIMILAR** to the packages covered under the tendered scope, excepting packages not commenced shall be taken into consideration. The 'Period of Assessment' shall be 6 months preceding and including the cut off month. The cut off month for reckoning 'Period of Assessment' shall be the 3rd Month preceding the month corresponding to 'latest date of bid submission', in the following manner:
(**Note**: For example, if 'latest date of bid submission' is in Jan 2017, then the 'performance' shall be assessed for a 6 months' period up to and inclusive of Oct 2016 (i.e. from May 2016 to Oct 2016), for all the unit wise identified packages (refer Table I))

i). Calculation of Overall 'Performance Rating' for 'Similar Package/Packages' for the tendered scope under execution at Power Sector Regions for the 'Period of Assessment':

This shall be obtained by summing up the 'Monthly Performance Evaluation' scores obtained by the bidder in all Regions for all the similar Package/packages', divided by the total number of Package months for which evaluation should have been done, as per procedure below:

a) $P_1, P_2, P_3, P_4, P_5, \ldots P_N$ etc. be the packages (under execution/ executed during the 'Period of Assessment' in all Regions of BHEL) **SIMILAR** to the packages covered under the tendered scope, excepting packages not commenced. Total number of similar packages for all Regions = $\mathbf{P_T}$ (i.e. $P_T = P_1 + P_2 + P_3 + P_4 + \ldots P_N$)

b) Number of Months 'T_1' for which 'Monthly Performance Evaluation' as per relevant formats, should have been done in the 'Period of Assessment' for the corresponding similar package P_1. Similarly T_2 for package P_2, T_3 for package P_3, etc. for the tendered scope. Now calculate cumulative total months '$\mathbf{T_T}$' for total similar Packages '$\mathbf{P_T}$' for all Regions (i.e. $\mathbf{T_T} = T_1 + T_2 + T_3 + T_4 + \ldots T_N$)

c) Sum 'S_1' of 'Monthly Performance Evaluation' Scores ($S_{1\text{-}1}, S_{1\text{-}2}, S_{1\text{-}3}, S_{1\text{-}4}, S_{1\text{-}5} \ldots S_{1\text{-}T1}$) for similar package P_1, for the 'period of assessment' 'T_1' (i.e. $S_1 = S_{1\text{-}1} + S_{1\text{-}2} + S_{1\text{-}3} + S_{1\text{-}4} + S_{1\text{-}5} + \ldots S_{1\text{-}T1}$). Similarly, S_2 for package P_2 for period T_2, S_3 for package P_3 for period T_3 etc. for the tendered scope for all Regions. Now calculate cumulative sum 'S_T' of 'Monthly Performance Evaluation' Scores for total similar Packages '$\mathbf{P_T}$' for all Regions (i.e. 'S_T' = $S_1 + S_2 + S_3 + S_4 + S_5 + \ldots S_N$.)

d) **Overall Performance Rating 'R_{BHEL}' for the Similar Package/Packages** (under execution/ executed during the 'Period of Assessment') in all the Power Sector Regions of BHEL

$$= \frac{\text{Aggregate of Performance scores for all similar packages in all the Regions}}{\text{Aggregate of months for each of the similar packages for which performance should have been evaluated in all the Regions}}$$

$$= \frac{S_T}{T_T}$$

e) Bidders to note that the risk of non-evaluation or non-availability of the 'Monthly Performance Evaluation' reports as per relevant formats is to be borne by the Bidder.

f) Table showing methodology for calculating 'a', 'b' and 'c' above

Sl. No.	**Item Description**	**Details for all Regions**							**Total**
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
1	Similar Packages for all Regions → (under execution/ executed during period of assessment)	P_1	P_2	P_3	P_4	P_5	…	P_N	Total No. of similar packages for all Regions = P_T i.e. Sum (Σ) of columns (iii) to (ix)
2	Number of Months for which 'Monthly Performance Evaluation' as per relevant formats should have been done in the 'period of assessment' for corresponding Similar Packages (as in row 1)	T_1	T_2	T_3	T_4	T_5	…	T_N	Sum (Σ) of columns (iii) to (ix) = T_T
3	Monthly performance scores for the corresponding period (as in Row 2)	$S_{1\text{-}1}$, $S_{1\text{-}2}$, $S_{1\text{-}3}$, $S_{1\text{-}4}$, … $S_{1\text{-}T1}$	$S_{2\text{-}1}$, $S_{2\text{-}2}$, $S_{2\text{-}3}$, $S_{2\text{-}4}$, … $S_{2\text{-}T2}$	$S_{3\text{-}1}$, $S_{3\text{-}2}$, $S_{3\text{-}3}$, $S_{3\text{-}4}$, … $S_{3\text{-}T3}$	$S_{4\text{-}1}$, $S_{4\text{-}2}$, $S_{4\text{-}3}$, $S_{4\text{-}4}$, … $S_{4\text{-}T4}$	$S_{5\text{-}1}$, $S_{5\text{-}2}$, $S_{5\text{-}3}$, $S_{5\text{-}4}$, … $S_{5\text{-}T5}$	.. … … … …	$S_{N\text{-}1}$, $S_{N\text{-}2}$, $S_{N\text{-}3}$, $S_{N\text{-}4}$, … $S_{N\text{-}TN}$	-------
4	Sum of Monthly Performance scores of the corresponding Package for the corresponding period (as in row 3)	S_1	S_2	S_3	S_4	S_5	…	S_N	Sum (Σ) of columns (iii) to (ix) = S_T

ii). Calculation of Overall 'Performance Rating' (R_{BHEL}) in case at least 6 evaluation scores for 'similar Package/Packages' for the tendered scope ARE NOT AVAILABLE, during the 'Period of Assessment':

This shall be obtained by summing up the 'Monthly Performance Evaluation' scores obtained by the bidder in all Regions for ALL the packages, divided by the total number of Package months for which evaluation should have been done. 'R_{BHEL}' shall be calculated subject to availability of 'performance scores' for at least 6 'package months' in the order of precedence below:

a) 'Period of Assessment' i.e. 6 months preceding and including the cut-off month
b) 12 months preceding and including the cut-off month
c) 24 months preceding and including the cut-off month

In case, R_{BHEL} cannot be calculated as above, then Bidder shall be treated as 'NEW VENDOR'. Further eligibility and qualification of this bidder shall be as per definition of 'NEW VENDOR' described in 'Explanatory Notes'.

iii). Factor "L" assigned based on Overall Performance Rating (R_{BHEL}) at Power Sector Regions:

Sl. no.	Overall Performance Rating (R_{BHEL})	Corresponding value of 'L'
1	=60	NA
2	> 60 and ≤ 65	0.4
3	> 65 and ≤ 70	0.35
4	> 70 and ≤ 75	0.25
5	> 75 and < 80	0.2
6	≥ 80	NA

III. 'Assessment of Capacity of Bidder':

'Assessment of Capacity of Bidder' is based on the Maximum number of packages for which a vendor is eligible, considering the performance scores of similar packages, as below:

Max number of packages P_{Max}= (R_{BHEL} - 60) divided by corresponding value of 'L', i.e. (R_{BHEL}-60)/L

Note:
i). In case the value of P_{Max} results in a fraction, the value of P_{Max} is to be rounded off to next whole number
ii). For R_{BHEL} = 60, P_{Max} = '1'
iii). For R_{BHEL} ≥ 80, there will be no upper limit on P_{Max}

The Bidder shall be considered 'Qualified' as per 'Assessment of Capacity of Bidder' for the subject Tender if $P \leq P_{Max}$
(Where P is calculated as per clause 'I' above)

IV. **Explanatory note**:

i). Similar package means Boiler or ESP or Piping or Turbine or Civil or Structure or Electrical or C&I etc. at the individual level irrespective of rating of Plant and irrespective of whether the subject tender is a single package or as part of combined/composite packages. Normally Boiler, ESP, Piping, Turbine, Electrical, C&I, Civil, Structure etc. is considered individual level of package. For example, in case the tendered scope is a Boiler Vertical Package comprising of Boiler, ESP and Power Cycle Piping (i.e. the 'identified packages as per Table 1 below), the 'PERFORMANCE' part against sl.no. II above, needs to be evaluated considering all the identified packages (i.e. Boiler, ESP and Power Cycle Piping) and finally the Bidder's capacity to execute the tendered scope is assessed in line with III above.

ii). Identified Packages (Unit wise)

~~Table-1~~

~~Civil~~	~~Electrical and C&I~~	~~Mechanical~~
~~i). Enabling works~~ ~~ii). Pile and Pile Caps~~ ~~iii). Civil Works including foundations~~ ~~iv). Structural Steel Fabrication & Erection~~ ~~v). Chimney~~ ~~vi). Cooling Tower~~ ~~vii). Others (Civil)~~	~~i). Electrical~~ ~~ii). C&I~~ ~~iii). Others (Elect. and C&I)~~	~~i). Boiler & Aux (All types including CW Piping if applicable)~~ ~~ii). Power Cycle Piping/Critical Piping~~ ~~iii). ESP~~ ~~iv). LP Piping~~ ~~v). Steam Turbine Generator set & Aux~~ ~~vi). Gas Turbine Generator set & Aux~~ ~~vii). Hydro Turbine Generator set & Aux~~ ~~viii). Turbo Blower (including Steam Turbine)~~ ~~ix). Material Management~~ ~~x). FGD~~ ~~xi). ACC~~ ~~xii). Others (Mechanical)~~

~~iii). Bidders who have not been evaluated for at least six package months in the last 24 months preceding and including the Cut-off month in the online BHEL system for contractor performance evaluation in BHEL PS Regions, shall be considered "NEW VENDOR".~~

~~A 'NEW VENDOR' shall be considered qualified subject to satisfying all other tender conditions.~~

~~A 'NEW VENDOR' if awarded a job (of package/packages identified under this clause) shall be tagged as "FIRST TIMER" on the date of first LOI from BHEL.~~

~~The "FIRST TIMER" tag shall remain till completion of all the contracts against which vendor has been tagged as First Timer or availability of 6 evaluation scores within last 24 months preceding and including the Cut-off month in the online BHEL system for contractor performance evaluation in BHEL PS Regions.~~

~~A Bidder shall not be eligible for the next job as long as the Bidder is tagged as "FIRST TIMER" excepting for the Tenders which have been opened on or before the date of the bidder being tagged as 'FIRST TIMER'.~~

~~After removal of 'FIRST TIMER' tag, the Bidder shall be considered 'QUALIFIED' for the future tenders subject to satisfying all other tender conditions including 'Assessment of Capacity of Bidders'.~~

~~iv). Consequent upon applying the criteria of 'Assessment of Capacity of Bidders' detailed above on all the bidders qualified against Technical and Financial Qualification criteria, if the number of qualified bidders reduces to less than minimum no. of bidders required for conducting RA as per extant RA Guidelines, then for further processing of the Tender, BHEL at its discretion reserves the right to also consider the bidders who are "not qualified" as per criteria of 'Assessment of Capacity of Bidders' and for this, procedure described in following three options shall be followed:~~

~~a) All the bidders having Overall Performance Rating ('R_{BHEL}') ≥60 shall be considered qualified against criteria of 'Assessment of Capacity of Bidders'.~~

b) If even after using option "a", the number of qualified bidders remains less than minimum no. of bidders required for conducting RA as per extant RA Guidelines, then in addition to bidders considered as per option "a", "First timer" bidders having average of available performance scores ≥60 upto and including the Cut Off month shall also be considered qualified against criteria of 'Assessment of Capacity of Bidders'.

c) If even after using option "a" and "b", the number of qualified bidders remains less than minimum no. of bidders required for conducting RA as per extant RA Guidelines, then in addition to bidders considered as per option "a" and "b", "First timer" bidders for whom no performance score is available in the system upto and including the Cut Off month, shall also be considered qualified against criteria of 'Assessment of Capacity of Bidders'.

Note:- In case, the number of bidders qualified against Technical and Financial Qualification criteria itself is less than minimum no. of bidders required for conducting RA as per extant RA Guidelines, then all bidders (a)- having Overall Performance Rating ('R_{BHEL}') ≥60, (b)- First timer" bidders having average of available performance scores ≥60 upto and including the Cut Off month, (c)- "First timer" bidders for whom no performance score is available in the system upto and including the Cut Off month, shall be considered qualified against criteria of 'Assessment of Capacity of Bidders' for further processing of tender.

v). 'Under execution' shall mean works in progress as per the following:

a. Up to execution of 90% of anticipated Contract Value in case of Civil, MM, Structural and Turbo Blower Packages

b. Up to Steam Blowing in case of Boiler/ESP/Piping Packages

c. Up to Synchronization in all Balance Packages

Note: BHEL at its discretion can extend (or reduce in exceptional cases in line with Contract conditions) the period defined against (a), (b) and (c) above, depending upon the balance scope of work to be completed.

vi). Contractor shall provide the latest contact details i.e. mail-ID and Correspondence Address to SCT Department, so that same can be entered in the Contractor Performance Evaluation System, and in case of any change/discrepancy same shall be informed immediately. Login Details for viewing scores in Contractor Performance Evaluation System shall be provided to the Contractor by SCT Department.

vii). Performance Evaluation for Activity Month shall be completed in Evaluation Month (i.e. month next to Activity Month) or in rare cases in Post Evaluation Month (i.e. month next to Evaluation Month) after approval from Competent Authority. In case scores are not acceptable, Contractor can submit Review Request to GM Site/ GM Project latest by 25th of Evaluation Month or 3 days after approval of score, whichever is later. However, acceptance/rejection of 'Review Request' solely depends on the discretion of GM Site/GM Project. After acceptance of Review Request, evaluation score shall be reviewed at site and the score after completion of review process shall be acceptable and binding on the contractor.

viii). Project on Hold due to reasons not attributable to bidder -

a. **Short hold:** Evaluation shall not be applicable for this period, however Loading will be considered.

b. **Long hold:** Short hold for continuous six months and beyond or hold on account of Force Majeure shall be considered as Long Hold. Evaluation as well as Loading shall not be considered for this period.

ix). Performance evaluation as specified above in this clause is applicable to Prime bidder and Consortium partner (or Technical tie up partner) for their respective scope of work.

10.0 Since the job shall be executed at site, bidders must visit site/ work area and study the job content, facilities available, availability of materials, prevailing site conditions including law & order situation, applicable wage structure, wage rules, etc. before quoting for this tender. They may also consult this office before submitting their offers, for any clarifications regarding scope of work, facilities available at sites or on terms and conditions.

11.0 For any clarification on the tender document, the bidder may seek the same in writing or through e-mail and/or through e-procurement portal, as per specified format, within the scheduled date for seeking clarification, from the office of the undersigned. BHEL shall not be responsible for receipt of queries after due date of seeking clarification due to postal delay or any other delays. Any clarification / query received after last date for seeking clarification may not be normally entertained by BHEL and no time extension will be given.

12.0 BHEL may decide holding of pre-bid discussion [PBD] with all intending bidders as per date indicated in the NIT. The bidder shall ensure participation for the same at the appointed time, date and place as may be decided by BHEL. Bidders shall plan their visit accordingly. The outcome of pre-bid discussion (PBD) shall also form part of tender.

13.0 In the event of any conflict between requirement of any clause of this specification/ documents/drawings/data sheets etc. or requirements of different codes/standards specified, the same to be brought to the knowledge of BHEL in writing for clarification before due date of seeking clarification (whichever is applicable), otherwise, interpretation by BHEL shall prevail. Any typing error/missing pages/ other clerical errors in the tender documents, noticed must be pointed out before pre-bid meeting/submission of offer, else BHEL's interpretation shall prevail.

14.0 Unless specifically mentioned otherwise, bidder's quoted price shall deemed to be in compliance with tender including PBD.

15.0 Bidders shall submit Integrity Pact Agreement (Duly signed by authorized signatory who signs in the offer), **if applicable**, along with techno-commercial bid. This pact shall be considered as a preliminary qualification for further participation. **The names and other details of Independent External Monitor (IEM) for the subject tender is as given at point (1) above.**

~~**"Integrity Pact (IP)"**~~

~~(a) 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. Following Independent External Monitors (IEMs) on the present panel have been appointed by BHEL with the approval of CVC to oversee implementation of IP in BHEL.~~

~~Sl. No.~~	~~IEM~~	~~Email~~
~~1.~~	~~Shri Arun Chandra Verma, IPS (Retd.)~~	~~acverma1@gmail.com~~
~~2.~~	~~Shri Virendra Bahadur Singh, IPS (Retd.)~~	~~vbsinghips@gmail.com~~

~~(b) The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory) along with techno-commercial bid (Part-I, in case of two/ three part 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.~~

~~(c) 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 any of the above IEM(s). All correspondence with the IEMs shall be done through email only.~~

~~*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's officials whose contact details are provided below:*~~

~~Details of contact person(s):~~

~~**Name**: (1) P R Chiwarkar/ AGM (Purchase) 2) Shubhangi Tembhurne / Dy Manager (Purchase)~~
~~**Dept.**: Purchase Department~~
~~**Address**: Floor No. 5 & 6, Shreemohini Complex, 345 Kingsway, Nagpur-440001~~
~~**Phone**: (LL/ Mobile) (1) 0712-2858633 0712-2858742~~
~~**Email**: prchiwarkar@bhel.in shubh@bhel.in~~
~~**Fax**: 0712-2858699~~

16.0 The Bidder has to satisfy the Pre-Qualifying Requirements stipulated for this Tender in order to be qualified. The Price Bids of only those bidders will be opened who will be qualified for the subject job on the basis of satisfying the Pre-Qualification Criteria specified in this NIT as per Annexure-I (as applicable), past performance etc. and date of opening of price bids shall be intimated to only such bidders. BHEL reserves the right not to consider offers of parties under HOLD.

17.0 In case BHEL decides on a `Public Opening', the date & time of opening of the sealed PRICE BID shall be intimated to the qualified bidders and in such a case, bidder may depute one authorized representative to witness the price bid opening. BHEL reserves the right to open 'in-camera' the 'PRICE BID' of any or all Unsuccessful/Disqualified bidders under intimation to the respective bidders.

18.0 Validity of the offer shall be for **six months** from the latest due date of offer submission (including extension, if any) unless specified otherwise.

19.0 **Reverse Auction:** Applicable. "BHEL shall be resorting to Reverse Auction (RA) (Guidelines as available on www.bhel.com on "**supplier registration page".**) for this tender. RA shall be conducted among the techno-commercially qualified bidders.

Price Bids of all the techno-commercially qualified bidders shall be opened and same shall be considered as initial bids of bidders in RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope price bid along with applicable loading, if any, shall be considered for ranking.

20.0 On submission of offer, further consideration will be subject to compliance to tender & qualifying requirement and customer's acceptance, as applicable.

21.0 In case the bidder is an "Indian Agent of Foreign Principals", 'Agency agreement has to be submitted along with Bid, detailing the role of the agent along with the terms of payment for agency commission in INR, along with supporting documents.

22.0 The bidders shall not enter into any undisclosed M.O.U. or any understanding amongst themselves with respect to tender.

~~23.0 Consortium Bidding (or Technical Tie up) shall be allowed only if specified in Pre-Qualifying Requirement (PQR) criteria, and in such a case the following shall be complied with:~~

~~23.1 Prime Bidder and Consortium Partner or partners are required to enter into a consortium agreement for the said contract with a validity period of six months initially. In case bidder becomes L1, Consortium Agreement valid till contractual completion period~~

~~shall be submitted to BHEL before signing the contract. Consortium Agreement shall be kept valid till scope of work awarded to consortium partner(s) as per contract is completed.~~

~~23.2 'Standalone' bidder cannot become a '**Prime Bidder' or a 'Consortium bidder' or 'Technical Tie up bidder' in a consortium (or Technical Tie up) bidding**. Prime bidder shall neither be a consortium partner to other prime bidder nor take any other consortium partners. However, consortium partner may enter into consortium agreement with other prime bidders. In case of non-compliance, consortium bids of such Prime bidders will be rejected.~~

~~23.3 Number of partners for a Consortium Bidding (or Technical Tie up) including Prime Bidder shall be NOT more than 3 (three).~~

~~23.4 Prime Bidder shall be as specified in the Pre-Qualification Requirement, else the bidder who has the major share of work.~~

~~23.5 In order to be qualified for the tender, Prime Bidder and Consortium partner or partners shall satisfy (i) the Technical 'Pre-Qualifying Requirements' specified for the respective package, (ii) "Assessment of Capacity of Bidder' as specified in clause 9.0.~~

~~23.6 Prime Bidder shall comply with additional 'Technical' criteria of PQR as defined in 'Explanatory Notes for the PQR'.~~

~~23.7 Prime Bidder shall comply with all other Pre Qualifying criteria for the Tender unless otherwise specified~~

~~23.8 In case customer approval is required, then Prime Bidder and Consortium Partner or partners shall have to be individually approved by Customer for being considered for the tender.~~

~~23.9 Prime Bidder shall be responsible for the overall execution of the contract.~~

~~23.10 In case of award of job, Performance shall be evaluated for Prime Bidder and Consortium Partner or partners for their respective scope of work(s) as per prescribed formats.~~

~~23.11 In case the Consortium partner or partners back out, their SDs shall be encashed by BHEL and BHEL shall take necessary action as per extant guidelines. In such a case, other consortium partner or partners meeting the PQR have to be engaged by the Prime Bidder, and if not, the respective work will be withdrawn and executed on risk and cost basis of the Prime Bidder. The new consortium partner or partners shall submit fresh SDs as applicable.~~

~~23.12 In case Prime Bidder withdraws or insolvency / liquidation / winding up proceedings have been initiated / admitted against the Prime Bidder, BHEL reserves the right to cancel, terminate or short close the contract or take any other action to safeguard BHEL's interest in the Project / Contract. This action will be without prejudice to any other action that BHEL can take under Law and the Contract to safeguard interests of BHEL.~~

~~23.13 After execution of work, the work experience shall be assigned to the Prime Bidder and the consortium partner or partners for their respective scope of work. After successful execution of one work with a consortium partner under direct order of BHEL, the Prime Bidder shall be eligible for becoming a 'standalone' bidder for works similar to that for which consortium partner was engaged, for subsequent tenders.~~

~~23.14 The consortium partner shall submit SD equivalent to 1% of the total contract value in addition to the SD to be submitted by the Prime Bidder for the total contract value. In case there are two consortium partners, then each partner shall submit SD equivalent to 0.5% of the total contract value in addition to the SD to be submitted by the Prime Bidder for the total contract value. However, Prime Bidder has also option for submission of SD on behalf of consortium partner (s).~~

~~SD submitted by Consortium Partner(s) may be released in case corresponding scope of work of the respective Consortium partner(s) has been completed upto the extent of 80% based on certification by Construction Manager and concurrence by the prime bidder.~~

~~23.15 In case of a Technical Tie up, all the clauses applicable for the Consortium partner shall be applicable for the Technical Tie up partner also.~~

24.0 The bidder shall submit/upload documents in support of possession of 'Qualifying Requirements' duly self-certified and stamped by the authorized signatory, indexed and properly linked in the format for PQR. In case BHEL requires any other documents/proofs, these shall be submitted immediately.

25.0 The bidder may have to produce original document for verification if so decided by BHEL.

26.0 The consultant / firm (and any of its affiliates) shall not be eligible to participate in tender(s) for the related works or services for the same project, if they were engaged for the consultancy services.

27.0 Guidelines/rules in respect of Suspension of Business dealings, Vendor evaluation format, Quality, Safety & HSE guidelines, Experience Certificate, etc. may undergo change from time to time and the latest one shall be followed. The abridged version of extant 'Guidelines for suspension of business dealings with suppliers/ contractors' is available on www.bhel.com on "**supplier registration page**".

28.0 The offers of the bidders who are on the banned/ hold list and also the offer of the bidders, who engage the services of the banned/ hold firms, shall be rejected. The list of **banned/ hold firms** is available on BHEL web site www.bhel.com.

28.1 Integrity commitment, performance of the contract and punitive action thereof:

28.1.1 **Commitment by BHEL:**

BHEL commits to take all measures necessary to prevent corruption in connection with the tender Process and execution of the contract. BHEL will during the tender process treat all Bidder(s) in a transparent and fair manner, and with equity.

28.1.2 **Commitment by Bidder/ Supplier/ Contractor:**

(i) The bidder/ supplier/ contractor commit to take all measures to prevent corruption and will not directly or indirectly influence any decision or benefit which he is not legally entitled to nor will act or omit in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India.

(ii) The bidder/ supplier/ contractor 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 and shall adhere to relevant guidelines issued from time to time by Govt. of India/ BHEL.

(iii) The bidder/ supplier/ contractor will perform/ execute the contract as per the contract terms & conditions and will not default without any reasonable cause, which causes loss of business/ money/ reputation, to BHEL.

If any bidder/ supplier/ contractor during pre-tendering/ tendering/ post tendering/ award/ execution/ post-execution stage indulges in mal-practices, cheating, bribery, fraud or and other misconduct or formation of cartel so as to influence the bidding process or influence the prices or acts or omits in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India, then, action may be taken against such bidder/ supplier/ contractor as per extent guidelines of the company available on www.bhel.com and / or under applicable legal provisions.

~~**29.0 Micro and Small Enterprises (MSE)**~~

~~Any Bidder falling under MSE category, shall furnish the following details & submit documentary evidence/ Govt. Certificate etc. in support of the same along with their techno-commercial offer.~~

~~Type under MSE~~	~~SC/ST owned~~	~~Women owned~~	~~Others (excluding SC/ ST & Women~~
~~Micro~~			
~~Small~~			

~~**Note: -** If the bidder does not furnish the above, offer shall be processed construing that the bidder is not falling under MSE category.~~

~~*a)* MSE suppliers can avail the intended benefits in respect of the procurements related to the Goods and Services only (Definition of Goods and Services as enumerated by Govt. of India vide Office Memorandum F. No. 21(8)/2011-MA dtd. 09/11/2016 office of AS & DC, MSME) only if they submit along with the offer, attested copies of either Udyam Registration Certificate or EM-II certificate having deemed validity (five years from the date of issue of acknowledgement in EM-II) or valid NSIC certificate or Udyog Aadhar Memorandum (UAM) & Acknowledgement or EM-II Certificate along with attested copy of a CA certificate (**format enclosed as Annexure – 3**) where deemed validity of EM-II certificate of five years has expired applicable for the relevant financial year (latest audited). Date to be reckoned for determining the deemed validity will be the last date of Technical Bid submission. Non submission of such documents will lead to consideration of their bids at par with other bidders. No benefits shall be applicable for this enquiry if the above required documents are not submitted before price bid opening. If the tender is to be submitted through e-procurement portal, then the above required documents are to be uploaded on the portal. Documents should be notarized or attested by a Gazetted officer. Documents submitted by the bidder may be verified by BHEL for rendering the applicable benefits.~~

30.0 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.

31.0 **PREFERENCE TO MAKE IN INDIA:**

For this procurement, the local content to categorize a supplier as a Class I local supplier/ Class II local Supplier/Non-Local Supplier and purchase preferences to Class I local supplier, is as defined I Public Procurement (Preference to Make in India), Order 2017 dated 04.06.2020 issued by DPIIT. In case of subsequent orders issued by the nodal ministry, changing the definition of local content for the items of the NIT, the same shall be applicable even if issued after issue of this NIT, but before opening of Part-II bids against this NIT.

31.1 ***Compliance to Restrictions under Rule 144 (xi) of GFR 2017***

I. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority. The Competent Authority for the purpose of this Clause shall be the Registration Committee constituted by the Department for Promotion of Industry and Internal Trade (DPIIT).

II. *"Bidder" (including the term 'tenderer', 'consultant' or 'service provider' in certain contexts) means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process.*

III. *"Bidder from a country which shares a land border with India" for the purpose of this Clause means: -*

a. *An entity incorporated established or registered in such a country; or*
b. *A subsidiary of an entity incorporated established or registered in such a country; or*
c. *An entity substantially controlled through entities incorporated, established or registered in such a country; or*
d. *An entity whose beneficial owner is situated in such a country; or*
e. *An Indian (or other) agent of such an entity; or*
f. *A natural person who is a citizen of such a country; or*
g. *A consortium or joint venture where any member of the consortium or joint venture falls under any of the above*

IV. *The beneficial owner for the purpose of (III) above will be as under:*

1. *In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together or through one or more juridical person, has a controlling ownership interest or who exercises control through other means.*

   Explanation

   a. *"Controlling ownership interest" means ownership of or entitlement to more than twenty-five per cent of shares or capital or profits of the company.*
   b. *"Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue of their shareholding or management rights or shareholders agreements or voting agreements.*

2. *In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership.*
3. *In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person has ownership of or entitlement to more than fifteen percent of the property or capital or profits of the such association or body of individuals.*
4. *Where no natural person is identified under (1) or (2) or (3) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;*
5. *In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.*

V. *An Agent is a person employed to do any act for another, or to represent another in dealings with third person.*

VI. The successful bidder shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority.

Note:

(i) The bidder shall provide undertaking for their compliance to this Clause, in the Format provided in Annexure-11.

(ii) Registration of the bidder with Competent Authority should be valid at the time of submission as well as acceptance of the bids.

32.0 Bid should be free from correction, overwriting, using corrective fluid, etc. Any interlineation, cutting, erasure or overwriting shall be valid only if they are attested under full signature(s) of person(s) signing the bid else bid shall be liable for rejection.
All overwriting/cutting, etc., will be numbered by bid opening officials and announced during bid opening.

33.0 In the course of evaluation, if more than one bidder happens to occupy L-1 status, effective L-1 will be decided by soliciting discounts from the respective L-1 bidders.

In case more than one bidder happens to occupy the L-1 status even after soliciting discounts, the L-1 bidder shall be decided by a toss/ draw of lots, in the presence of the respective L-1 bidder(s) or their representative(s).

Ranking will be done accordingly. BHEL's decision in such situations shall be final and binding.

34.0 The Bidder declares that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). 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.

In case, the Bidder is found having indulged in above activities, suitable action shall be taken by BHEL as per extant policies/ guidelines.

35.0 Order of Precedence:
In the event of any ambiguity or conflict between the Tender Documents, the order of precedence shall be in the order below:

a. Amendments/Clarifications/Corrigenda/Errata etc. issued in respect of the tender documents by BHEL
b. Notice Inviting Tender (NIT)
c. Price Bid
d. Technical Conditions of Contract (TCC)—Volume-1A
e. Special Conditions of Contract (SCC) —Volume-1B
f. General Conditions of Contract (GCC) —Volume-1C
g. Forms and Procedures —Volume-1D

It may please be noted that guidelines/ circulars/ amendments/ govt. directives issued from time to time shall also be applicable.

For BHARAT HEAVY ELECTRICALS LTD

(Addl. General Manager - Purchase)

Enclosure:

01. Annexure-1: Pre Qualifying Requirements.
02. Annexure-2: Check List.
~~03. Annexure-3: Certificate by Chartered Accountant~~
04. Annexure-4: Reverse Auction Process Compliance Form
05. Annexure-5: Authorization of representative who will participate in the online Reverse Auction Process
06. Annexure-6: RA Price Confirmation and Breakup
~~07. Annexure-7: Integrity Pact~~
08. Annexure-8: Undertaking for insolvency
09. Annexure-9: Declaration reg. Related Firms & their areas of Activities
010. Other Tender documents as per this NIT.
011. Annexure-10: DECLARATION REGARDING MINIMUM LOCAL CONTENT IN LINE WITH REVISED PUBLIC PROCUREMENT (PREFERENCE TO MAKE IN INDIA), ORDER 2017 DATED 04TH JUNE, 2020 AND SUBSEQUENT ORDER(S)
012. Annexure 11: DECLARATION REGARDING COMPLIANCE TO RESTRICTIONS UNDER RULE 144 (xi) OF GFR 2017
013. Annexure 12: Important information.

ANNEXURE - 1

PRE QUALIFYING CRITERIA

JOB	**Resolution of pending technical issues and Expert/ Consulting services for DM Plant PG test at Wanakbori Extn Unit-08 Set-01 at GSECL 1X800MW project.**
TENDER NO	**BHE/PW/PUR/WNT-DM PLANT PGTEST-U8/2402**

SL NO	PRE QUALIFICATION CRITERIA	~~Bidders claim in respect of fulfilling the PQR Criteria~~ Applicability	
A	Submission of Integrity Pact duly signed (if applicable) (Note: To be submitted by Prime Bidder & Consortium /Technical Tie up partner jointly in case Consortium bidding is permitted, otherwise by the sole bidder)	**Not APPLICABLE**	
B	**Technical PQR** B.1) Not Applicable B.2) Bidder must have executed the following in last seven years as on the latest date of offer Submission: The bidder should have commissioned/provided consultancy services in at-least one Resin or RO (Reverse Osmosis) based DM (De-Mineralization) Plant. Bidder to submit LOI/LOA/Work order and commissioning certificate/protocol as a proof of execution towards the same.	**APPLICABLE**	
C.1	**FINANCIAL TURNOVER:** Bidders must have achieved an average annual financial turnover (audited) of **Rs.2,70,000/- Only (Rupees Two Lakhs Seventy Thousand Only)** or more over last three Financial Years (FY) i.e. '2017-18, 2018-19 & 2019-20'	**APPLICABLE**	
C.2	**NETWORTH** (only in case of Companies) Net worth of the Bidder based on the latest Audited Accounts as furnished for 'C-1' above should be positive.	**APPLICABLE**	
C.3	**PROFIT** Bidder must have earned profit in any one of the three Financial Years as applicable in the last three Financial Years as furnished for 'C-1' above.	**APPLICABLE**	
C-4	Bidder must not be under Bankruptcy Code Proceedings (IBC) by NCLT or under Liquidation / BIFR, which will render him ineligible for participation in this tender, and shall submit	**APPLICABLE**	

	undertaking **(Annexure-8)** to this effect.		
D	Assessment of Capacity of Bidder: The "Assessment of Capacity of Bidders" for this Tender shall be carried out by considering the identified similar packages as "**.....**".	**NOT APPLICABLE**	
E	**Approval of Customer (if applicable)** **Note:** Names of bidders (including consortium/Technical Tie up partners in case consortium bidding is permitted) who stand qualified after compliance of criteria A to D shall be forwarded to customer for their approval	**NOT APPLICABLE**	
F	Price Bid Opening **Note:** Price Bids of only those bidders shall be opened who stand qualified after compliance of criteria A to E		**BY BHEL**
G	Consortium tie-ups	**NOT APPLICABLE**	

Explanatory Notes for the PQR (unless otherwise specified in the PQR):

Explanatory Notes for PQR B.1 (Technical)

- For the criteria (B.1), actual executed value shall be considered.
- Value of work is to be updated with indices for "All India Avg. Consumer Price index for industrial workers" and "Monthly Whole Sale Price Index for All Commodities" with base month as per last month of work execution and indexed up to three (3) months prior to the month of latest due date of bid submission as per following formula-

$$P = R + 0.425 \times R \times \frac{(X_N - X_0)}{X_0} + 0.425 \times R \times \frac{(Y_N - Y_0)}{Y_0}$$

Where
P = Updated value of work
R = Value of executed work
X_N = All India Avg. Consumer Price index for industrial workers for three months prior to the month of latest due date of bid submission (e.g. If latest bid submission date is 02-Mar-17, then bid submission month shall be reckoned as March'17 and index for Dec'2016 shall be considered).
X_0 = All India Avg. Consumer Price index for industrial workers for last month of work execution
Y_N = Monthly Whole Sale Price Index for All Commodities for three months prior to the month of latest due date of bid submission (e.g. If latest bid submission date is 02-Mar-17, then bid-submission month shall be reckoned as March'17 and index for Dec'2016 shall be considered).
Y_0 = Monthly Whole Sale Price Index for All Commodities for last month of work execution

- The evaluation currency for this tender shall be INR.

Explanatory Notes for Technical Criteria (B2):

1. VOID
2. Unless otherwise specified, for the purpose of "B2 Technical Criteria", the word 'EXECUTED' means achievement of milestones as defined below -
   a. "ACHIEVEMENT OF PHYSICAL QUANTITIES" as per PQRs.
   b. "READINESS FOR COAL FILLING" of at least one Bunker, in respect of Mill Bunker Structure.
   c. "CHARGING" in respect of Power Transformers/ Bus Ducts/ "HT/LT Switchgears" / "HT/LT Cabling".
   d. For C&I works: "SYNCHRONISATION" in case of power project / "WORK EXECUTION of the value as defined in PQR" in case of industry.

e. "BOILER LIGHT UP" in respect of Boiler / CFBC / ESP.
f. "CHARGING OF ATLEAST ONE PASS" in respect of ESP(R&M)
g. "GAS IN" in respect of HRSG.
h. "STEAM BLOWING" in respect of Power Cycle Piping.
i. "HYDRAULIC TEST"/ ANY OTHER EQUIVALENT TEST LIKE "100% RT/UT OF WELDED JOINTS" of the system in respect of Pressure parts/ LP Piping/CW Piping.
j. "FULL LOAD OPERATION OF THE UNIT" in respect of Insulation work.
k. "SYNCHRONISATION" in respect of STG / GTG.
l. "SPINNING" in respect of HTG.
m. "GAS IN" in respect of FGD

3. Boiler means HRSG or WHRB or any other types of Steam Generator.
4. Power Cycle piping means Main Steam, Hot Reheat, Cold Reheat, HP Bypass.
5. For the purpose of evaluation of the PQR, one MW shall be considered equivalent to 3.5 TPH where ever rating of HRSG/BOILER is mentioned in MW. Similarly, where ever rating of Gas Turbine is mentioned in terms of Frame size, ISO rating of the same in terms of MW shall be considered for evaluation.

Explanatory Notes for PQR -C (Financial):

C-1:

i. Bidder to submit Audited Balance Sheet and Profit and Loss Account for the respective years as indicated against C-1 above.
ii. Evaluation of Turnover criteria shall be calculated from the Audited Balance Sheet and Profit & Loss Account for the three Financial Years (FY).
iii. In case audited Financial statements have not been submitted for all the three years as indicated against C-1 above, then the applicable audited statements submitted by the bidders against the requisite three years, will be averaged for three years.
iv. If financial statements are not required to be audited statutorily, then instead of audited financial statements, financial statements are required to be certified by Chartered Accountant.

C-2: Net Worth (Only in case of companies) of the bidder should be positive.

Note: Net worth shall be calculated based on the latest Audited Accounts as furnished for 'C-1' above.

Net worth = Paid up share capital + Reserves

C-3: Bidder must have earned profit in any one of the three financial years as applicable in the last three financial years as furnished for 'C-1' above.

Note: PROFIT shall be PBT earned during any one year of last three financial years as in 'C-1' above.

C-4: Bidder must not be under Bankruptcy Code Proceedings (IBC) by NCLT or under Liquidation / BIFR, which will render him ineligible for participation in this tender, and shall submit undertaking to this effect.

Common Explanatory Notes:

1. ~~For evaluation of PQR, in case Bidder alone does not meet the pre-qualifying technical criteria B1 above, bidder may utilize the experience of its Parent/ Subsidiary Company along with its own experience, subject to following:~~
   a. ~~The parent company shall have a controlling stake of ≥50% in the subsidiary company (as per Format-1).~~
   b. ~~The Parent Company/ Subsidiary Company of which experience is being utilized for bidding shall submit Security Deposit(SD) equivalent to 1% of the total contract value~~
   c. ~~The parent/ subsidiary company and bidder shall provide an undertaking that they are jointly or severally responsible for successful performance of the contract (as per~~

~~Format-2).~~

d. ~~In case Bidder is submitting bid as a Consortium Partner, option of utilizing experience of parent/subsidiary Company can be availed by Prime Bidder only.~~

e. ~~Parent Company/ Subsidiary Company of which experience is being used for bidding, cannot participate as a 'Standalone Bidder' or as a 'Consortium bidder'.~~

2. Completion date for achievement of the technical criteria specified in the Common QR should be in the last 7 years ending on the 'latest date of Bid Submission' of Tender irrespective of date of the start of work.
3. "Executed" means the bidder should have achieved the technical criteria specified in the Common QR even if the Contract has not been completed or closed.
4. In case the Experience/PO/WO certificate enclosed by bidders do not have separate break up of prices for the E&C portion for Electrical and C&I works (i.e. the certificates enclosed are for composite order for supply and erection of Electrical and C&I and other works if any), then value of Erection & Commissioning for the Electrical and C&I portion shall be considered as 15% of the price for supply & erection of Electrical and C&I.
5. ~~Following shall be complied with in case of consortium:~~
   a. ~~The Prime Bidder and Consortium Partner(s) are required to enter in to a consortium agreement and certify to BHEL regarding existence and validity of their consortium agreement in line with validity period mentioned in NIT.~~
   b. ~~Prime Bidder and Consortium partners shall be approved by Customer for being considered for the tender (applicable if customer approval is required).~~
   c. ~~Number of partners including prime Bidder shall be NOT more than 3 (three).~~
   d. ~~Prime Bidder alone shall necessarily comply with "B1Technical Criteria" except for mechanical package where B1 criteria is not applicable.~~
   e. ~~Prime Bidder and Consortium Partner shall together comply with the 'Pre-Qualification Requirements' specified for the respective category of technical requirement as per "B2 technical criteria".~~
   f. ~~Prime Bidder shall comply with all other Pre Qualifying criteria for the Tender unless otherwise specified.~~
   g. ~~All other conditions shall be read in conjunction with clause no 23.0 of NIT.~~
   h. ~~Prime Bidder shall be the Bidder who has a major share of work.~~
   i. ~~Prime Bidder shall be responsible for the overall execution of the Contract.~~
   j. ~~Performance shall be evaluated for Prime Bidder and the Consortium partner for their respective scope of work.~~
   k. ~~In case the Consortium partner backs out, another consortium partner meeting the QRs, has to be engaged by Prime Bidder and if not, the respective work will be withdrawn and executed on risk and cost basis of the prime bidder.~~
   l. ~~In case Prime Bidder withdraws or insolvency / liquidation / winding up proceedings have been initiated / admitted against the Prime Bidder, BHEL reserves the right to cancel, terminate or short close the contract or take any other action to safeguard BHEL's interest in the Project / Contract. This action will be without prejudice to any other action that BHEL can take under Law and the Contract to safeguard interests of BHEL~~
   m. ~~After successful execution of one work with a consortium partner under direct orders of BHEL, the Prime Bidder shall be eligible for becoming a 'standalone' bidder for works similar to that for which consortium partner was engaged, for subsequent tenders.~~
   n. ~~The Consortium partner shall submit SD equivalent to 1% of the total contract value in addition to the SD to be submitted by the Prime Bidder for the total contract value.~~

BIDDER SHALL SUBMIT ABOVE PRE-QUALIFICATION CRITERIA FORMAT, DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT INCLUSIVE OF WORK ORDER AND WORK COMPLETION CERTIFICATE ETC IN THE RESPECTIVE ANNEXURES IN THEIR OFFER.

Credentials submitted by the bidder against "PRE QUALIFYING CRITERIAS" shall be verified for its authenticity. In case, any credential (s) is/are found unauthentic, offer of the bidder is liable to the rejection. BHEL reserves the right to initiate any further action as per extant guidelines for Suspension of Business Dealings.

Format-1

Not Applicable

Format-2

Not Applicable

ANNEXURE - 2

CHECK LIST

NOTE: - Tenderers are required to fill in the following details and no column should be left blank

1	Name and Address of the Tenderer		
2	Details about type of the Firm/Company		
3.a	Details of Contact person for this Tender	Name : Mr/Ms Designation: Telephone No: Mobile No: Email ID: Fax No:	
3.b	Details of alternate Contact person for this Tender	Name : Mr/Ms Designation: Telephone No: Mobile No: Email ID: Fax No:	
4	EMD DETAILS	DD No: Date : Bank : Amount: Please tick (√) whichever applicable:- ~~ONE TIME EMD /~~ ONLY FOR THIS TENDER	
5	Validity of Offer	TO BE VALID FOR SIX MONTHS FROM DUE DATE	
		APPLICABILITY (BY BHEL)	ENCLOSED BY BIDDER
6	Whether the format for compliance with **PRE QUALIFICATION CRITERIA** (ANNEXURE-I) is understood and filled with proper supporting documents referenced in the specified format	Applicable	YES / NO
7	Audited profit and Loss Account for the last three years	Applicable/~~Not Applicable~~	YES/NO
8	Copy of PAN Card	Applicable/~~Not Applicable~~	YES/NO
9	Whether all pages of the Tender documents including annexures, appendices etc. are read understood and signed	Applicable/~~Not Applicable~~	YES/NO
10	Integrity Pact	~~Applicable~~/Not Applicable	YES/NO
11	Declaration by Authorized Signatory	Applicable/~~Not Applicable~~	YES/NO
12	No Deviation Certificate	Applicable/~~Not Applicable~~	YES/NO
13	Declaration confirming knowledge about Site Conditions	Applicable/~~Not Applicable~~	YES/NO
14	Declaration for relation in BHEL	Applicable/~~Not Applicable~~	YES/NO
15	Non-Disclosure Certificate	Applicable/~~Not Applicable~~	YES/NO
16	Bank Account Details for E-Payment	Applicable/~~Not Applicable~~	YES/NO

17	Capacity Evaluation of Bidder for current Tender	~~Applicable~~/Not Applicable	YES/NO
18	Tie Ups/Consortium Agreement are submitted as per format	~~Applicable~~/Not Applicable	YES/ NO
19	Power of Attorney for Submission of Tender/Signing Contract Agreement ~~Power of Attorney of Consortium Partner~~.	Applicable/~~Not Applicable~~	YES/NO
20	Analysis of Unit rates	Applicable/~~Not Applicable~~	YES/NO

NOTE: STRIKE OFF 'YES' OR 'NO', AS APPLICABLE. TENDER NOT ACCOMPANIED BY THE PRESCRIBED **ABOVE APPLICABLE DOCUMENTS** ARE LIABLE TO BE SUMMARILY REJECTED.

DATE :

AUTHORISED SIGNATORY

(With Name, Designation and Company seal)

ANNEXURE-3

Certificate by Chartered Accountant on letter head

(applicable upto 31st March'2021 in line with MSME notification no. S.O. 2119 (E), dated 26th June'2020)

This is to Certify that M/S ....., (hereinafter referred to as 'company') having its registered office at ..... is registered under MSMED Act 2006, (Entrepreneur Memorandum No (Part II)/ Udyam Registration Certificate No. ..... dtd: ....., Category: .....(Micro/Small/Medium)). (Copy enclosed).

Further verified from the Books of Accounts that the investment of the company as per the latest audited financial year..... as per MSMED Act 2006 is as follows:

1. **For Manufacturing Enterprises:** Investment in plant and machinery (i.e. original cost excluding land and building and the items specified by the Ministry of Small Scale Industries vide its notification No. S.O.1722(E) dated October 5, 2006:
   Rs .....Lacs

2. **For Service Enterprises:** Investment in equipment (original cost excluding land and building and furniture, fittings and other items not directly related to the service rendered or as may be notified under the **MSMED** Act, 2006:
   Rs .....Lacs

3. **For Enterprises** (having EM-II Certificate/ valid NSIC Certificate or Udyog Aadhar Memorandum): Investment in plant and machinery or equipment is Rs..... Lacs and turnover is Rs. ..... Lacs (as notified in MSME notification no. S.O. 2119 (E) dated 26.06.2020)

4. **For Enterprises** (having EM-II Certificate/ valid NSIC Certificate or Udyog Aadhar Memorandum): Investment in plant and machinery or equipment is Rs..... Lacs and turnover is Rs. ..... Lacs (as notified in MSME notification no. S.O. 2119 (E) dated 26.06.2020)

(Strike off whichever is not applicable)

The above investment of Rs ....Lacs is within permissible limit of Rs ..... Lacs for .....Micro / Small/ Medium *(Strike off which is not applicable)* Category under MSMED Act 2006.

Or

The enterprise has been graduated upward from its original category (micro/small/medium) (*strike off which is not applicable*), the enterprise shall maintain its prevailing status till expiry of one year from the close of year of registration, as notified vide S.O. No. 2119 (E) dated 26.06.2020 published in the gazette notification dated 26.06.2020 by Ministry of MSME.

Or

The enterprise has been reverse graduated from its original category (micro/small/medium) (*strike off which is not applicable*), the enterprise will continue in its present category till the closure of the financial year and it will be given the benefit of the changed status only with effect from 1st April of the financial year following the year in which such change took place, as notified vide S.O. No. 2119 (E) dated 26.06.2020 published in the gazette notification dated 26.06.2020 by Ministry of MSME.

Date:
(Signature)
Name:
Membership Number:
Seal of the Chartered Accountant

ANNEXURE-4

Reverse Auction Process Compliance Form

(The bidders are required to print this on their company's letterhead and sign, stamp before RA)

To

- M/s. {*Service provider*
- *Postal address}*

Sub: Agreement to the Process related Terms and Conditions

Dear Sir,

This has reference to the Terms & Conditions for the Reverse Auction mentioned in the RFQ document for {Items} against BHEL enquiry/ RFQ no.{ ……..} dt. {…….}
This letter is to confirm that:

1) The undersigned is authorized official/ representative of the company to participate in RA and to sign the related documents.
2) We have studied the Reverse Auction guidelines (as available on www.bhel.com), and the Business rules governing the Reverse Auction as mentioned in your letter and confirm our agreement to them.
3) We also confirm that we have taken the training on the auction tool and have understood the functionality of the same thoroughly.
4) We also confirm that, in case we become L1 bidder, we will FAX/ email the price confirmation & break up of our quoted price as per *Annexure - 6* within **two** working days (of BHEL) after completion of RA event, besides sending the same by registered post/ courier both to M/s. BHEL and M/s. {*Service provider.}*

We, hereby confirm that we will honor the Bids placed by us during the auction process.

With regards

Signature with company seal
Name:
Company / Organization:
Designation within Company / Organization:
Address of Company / Organization:

Sign this document and FAX/ email it to M/s *{Service provider}* at *{……..}* prior to start of the Event.

ANNEXURE – 5

Authorization of representative who will participate in the on line Reverse Auction Process:

1	NAME OF THE BIDDER	
2	NAME & DESIGNATION OF OFFICIAL	
3	POSTAL ADDRESS (COMPLETE)	
4	TELEPHONE NOS. (LAND LINE & MOBILE BOTH)	
5	E-MAIL ADDRESS	
6	NAME OF PLACE/ STATE/ COUNTRY, WHEREFROM S/HE WILL PARTICIPATE IN THE REVERSE AUCTION	

ANNEXURE – 6

Reverse Auction price confirmation and breakup
(To be submitted by L1 bidder after completion of Reverse Auction)

To
- M/s. *Service provider*
- *Postal address*

CC: M/s BHEL *POWER SECTOR WESTERN REGION, Nagpur*

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. …… dtd ……

~~Total price of the items covered under above cited enquiries is inclusive of {*Packing & forwarding, GST, E.D., C.S.T., freight and insurance charges up to {……} District,{……..} State and Type Test Charges etc., (exclusive of service tax), 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~~. as mentioned in the subject tender.

Yours sincerely,
For _____
Name:
Company:
Date:
Seal:

ANNEXURE – 7

INTEGRITY PACT

Not Applicable

ANNEXURE – 8

UNDERTAKING

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir/Madam,

Sub: DECLARATION REGARDING INSOLVENCY/ LIQUIDATION/ BANKRUPTCY PROCEEDINGS

Ref: NIT/Tender Specification No: BHE/PW/PUR/WNT-DM PLANT PGTEST-U8/2402

I/We, _____ declare that, I/We am/are not under insolvency resolution process or liquidation or Bankruptcy Code Proceedings (IBC) as on date, by NCLT or any adjudicating authority/authorities, which will render us ineligible for participation in this tender.

Sign. of the AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

Place:
Date:

Annexure-9

DECLARATION

Date:_____

To _____

BHEL, _____
_____
_____

Email: _____

Sub: **Details of related firms and their area of activities**

Dear Sir/ Madam,

Please find below details of firms owned by our family members that are doing business/ registered for same item with BHEL,_____ (NA, if not applicable).

1	Material Category/ Work Description	
	Name of Firm	
	Address of Firm	
	Nature of Business	
	Name of Family Member	
	Relationship	
2	Material Category/ Work Description	
	Name of Firm	
	Address of Firm	
	Nature of Business	
	Name of Family Member	
	Relationship	
……		

Note: I certify that the above information is true and I agree for penal action from BHEL in case any of the above information furnished is found to be false.

Regards,
(_____)

From: M/s _____
Supplier Code: _____
Address: _____
_____
_____

Annexure-10

DECLARATION REGARDING MINIMUM LOCAL CONTENT IN LINE WITH REVISED PUBLIC PROCUREMENT (PREFERENCE TO MAKE IN INDIA), ORDER 2017 DATED 04TH JUNE, 2020 AND SUBSEQUENT ORDER(S)

(To be typed and submitted in the Letter Head of the Entity/Firm providing certificate as applicable)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub: Declaration reg. minimum local content in line with Public Procurement (Preference to Make in India), Order 2017-Revision, dated 04th June, 2020 and subsequent order(s).

Ref : 1) NIT/Tender Specification No: ……,
2) All other pertinent issues till date

We hereby certify that the items/works/services offered by…… *(specify the name of the organization here)* has a local content of _____ % and this meets the local content requirement for **'Class-I local supplier' / 'Class II local supplier' **** as defined in Public Procurement (Preference to Make in India), Order 2017-Revision dated 04.06.2020 issued by DPIIT and subsequent order(s).

The details of the location(s) at which the local value addition is made are as follows:

1. _____ 2. _____
3. _____ 4. _____

…
…
…

Thanking you,
Yours faithfully,

(Signature, Date & Seal of Authorized Signatory of the Bidder)

****** - *Strike out whichever is not applicable.*

Note:

1. Bidders to note that above format Duly filled & signed by authorized signatory, shall be submitted along with the techno-commercial offer.
2. In case the bidder's quoted value is in excess of Rs. 10 crores, the authorized signatory for this declaration shall necessarily be the statutory auditor or cost auditor of the company (in the case of companies) or a practising cost accountant or practicing chartered accountant (in respect of suppliers other than companies).
3. In the event of false declaration, actions as per the above order and as per BHEL Guidelines shall be initiated against the bidder.

Annexure-11

DECLARATION REGARDING COMPLIANCE TO RESTRICTIONS UNDER RULE 144 (xi) OF GFR 2017

(To be typed and submitted in the Letter Head of the Entity/Firm providing certificate as applicable)

To,

(*Write Name & Address of Officer of BHEL inviting the Tender*)

Dear Sir,

Sub: Declaration regarding compliance to Restrictions under Rule 144 (xi) of GFR 2017

Ref : 1) NIT/Tender Specification No: ……,
2) All other pertinent issues till date

I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India and on sub-contracting to contractors from such countries. I certify that _____ *(specify the name of the organization here)*, is not from such a country / has been registered with the Competent Authority *(attach valid registration by the Competent Authority, i.e., the Registration Committee constituted by the Dept. for Promotion of Industry and Internal Trade (DPIIT))*; and will not sub-contract any work to a contractor from such countries unless such contractor is registered with the Competent Authority. *(attach relevant valid registration, if applicable)*

I hereby certify that we fulfil all requirements in this regard and is eligible to be considered.

Thanking you,
Yours faithfully,

(Signature, Date & Seal of
Authorized Signatory of the Bidder)

Note: Bidders to note that in case above certification given by a bidder, whose bid is accepted, is found to be false, then this would be a ground for immediate termination and for taking further action in accordance with law and as per BHEL guidelines.

Annexure-12: IMPORTANT INFORMATION

E -Tender for this work is invited by BHEL PSWR NAGPUR and offer shall be submitted through BHEL e-procurement portal only. All correspondences regarding this tender shall be through E-procurement portal.

Postal Address:
AGM /Purchase BHEL PSWR,
SRIMOHINI COMPLEX, Floor No. 5 & 6, 345 KINGSWAY, NAGPUR 440001, INDIA

Following are the concerned BHEL officials to whom bidders can contact in case of any difficulty:

AGM Purchase, Email: prchiwarkar@bhel.in. Ph: +91 – 712 – 2858 – 633
Dy Manager Purchase, Email: shubh@bhel.in Ph: +91-712 – 2858 –742
Dy Manager Purchase, Email: svm@bhel.in Ph: +91 – 712 – 2858 –715

1. **Refer Chapter XII of Volume IB Special Conditions of Contract regarding Suspension of Business Dealings: The abridged version of extant 'Guidelines for suspension of business dealings with suppliers/ contractors' has now been uploaded on www.bhel.com on "supplier registration page" at the following link:** http://www.bhel.com/vender_registration/pdf/Suspension_guidelines_abridged.pdf

2. **All Statutory Requirements as applicable for this project shall be complied with.**

3. **Following clause shall form part of the HSE documents issued under Chapter IX of Volume IB 'Special Conditions of Contract'**

   "In case of any financial deduction made by Customer for lapses of safety other than what is provided elsewhere in the contract, the same shall be charged on back-to-back basis on the defaulting contractor without prejudice to any other right spelt anywhere in the tender /contract"

4. ~~**"Pradhan Mantri Kaushal Vikas Yojna:** The contractor shall, at all stages of work deploy skilled/semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute/Industrial Training Institute/ National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/ Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs.100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding".~~

~~**5. The clause 2.7.9.1 below is added under the heading "Rights of BHEL" of General Conditions of Contract Volume-IC GCC.**~~

~~**2.7.9.1** Provision of Penalty in case of slippage of Intermediate Milestones:~~

~~i) Two major Intermediate Milestones are mentioned as M1 & M2 in Chapter VI: Time Schedule of Vol IA Technical Conditions of Contract.~~
~~ii) In case of slippage of these identified Intermediate Milestones, Delay Analysis shall be carried out on achievement of each of these two Intermediate Milestones in reference to Form 14.~~
~~iii) In case delay in achieving M1 Milestone is solely attributable to the contractor, 0.5% per week of Executable Contract Value*, limited to maximum 2% of Executable Contract Value, will be withheld.~~
~~iv) In case delay in achieving M2 Milestone is solely attributable to the contractor, 0.5% per week of Executable Contract Value*, limited to maximum 3% of Executable Contract Value, will be withheld.~~
~~v) Amount already withheld, if any against slippage of M1 milestone, shall be released only if there is no delay attributable to contractor in achievement of M2 Milestone.~~
~~vi) Amount required to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone payment and balance amount (if any) shall be withheld @10% of RA Bill amount from subsequent RA bills.~~
~~vii) Final deduction towards LD (if applicable as per clause 2.7.9 above), on account of delay attributable to contractor shall be based on final delay analysis on completion / closure of contract. Withheld amount, if any due to slippage of identified intermediate milestone(s) shall be adjusted against LD or released as the case may be.~~
~~viii) In case of termination of contract due to any reason attributable to contractor before completion of work, the amount already withheld against slippage of intermediate milestones shall not be released and be converted into recovery.~~

~~* **Executable Contract Value** - Value of work for which inputs/ fronts were made available to contractor and were scheduled for execution till the date of achievement of that milestone.~~

6. The following paragraph has been added in clause 2.7.1 under clause 2.7 "Rights of BHEL" of General Conditions of Contract (Volume-IC GCC):

In case of inadequate manpower deployed by contractor, BHEL reserves the right to deploy additional manpower through any other agency for expediting activities in the interest of the project. Supplied manpower shall be put on job by the contractor and payments and other statutory compliances related to manpower shall be the contractor's responsibly. In case of contractor's failure to fulfil his obligations in respect of such manpower, BHEL reserves the right to take necessary action as per contract conditions

9. Delay in 1st submission of SDBG/ PBBG: SDBG/ PBG is to be furnished by the vendor before start of work. No payment will be released till SDBG/PBG is submitted by the vendor.

However if requested by the vendor, cash recovery equivalent to SDBG/ PBG value to be made from the running bills submitted by the vendor. In such case, recovery of interest calculated @SBI PLR +2% on amount equivalent to SDBG/ PBG value to be made for the gap period (difference between date of start of work and date of submission of BG/ cash recovery).

10. Compensation in case of Death/ Permanent Incapacitation of Person: BHEL shall recover the amount of compensation paid to victim (s) by BHEL towards loss of life/ permanent disability due to an accident which is attributable to the negligence of contractor, agency or firm or any of its employee as detailed below:

a) Victim: Any person who suffers permanent disablement of dies in an accident as defined below.

b) Accident: Any death or permanent disability resulting solely and directly from any unintended and unforeseen injurious occurrence caused during the manufacturing/ operation and works incidental thereto at BHEL factories/ offices and precincts thereof, project execution, erection and commissioning, services, repairs and maintenance, trouble shooting, serving, overhaul, renovation and retrofitting, trial operation, performance guarantee testing undertaken by the company or during any works/ during working at BHEL Units/ Offices/ townships and premises/ Project sites.

c) Compensation in respect of each of the victims:
- **(ii)** In the event of death or **permanent disability** resulting from **Loss of both limbs**: Rs 10,00,000/- (**Rs Ten Lakh**)
- **(iii)** In the event of **other permanent disability**: Rs 7,00,000/- (**Rs Seven Lakh**)

d) Permanent Disablement: A disablement that is classified as a permanent total disablement under the proviso to Section 2(I) of the Employee's Compensation Act, 1923.

11. Acceptance of Bank Guarantee (BG)

Revision in Acceptance of Bank Guarantee (BG) Clause no. 1.10.3 (iii) of Vol I C GCC:

Clause No. 1.10.3 (iii) of Vol IC GCC is revised as below: -

"Bank Guarantee issued by:

a. Any of the BHEL consortium bank listed below:
   State Bank of India
   ABN Amro Bank N.V.
   Bank of Baroda
   Canara Bank
   Citi Bank N.A.
   Corporation Bank
   Deutsche Bank
   HDFC Bank Ltd.
   The Hongkond and Shanghai Banking Corporation Ltd
   ICICI Bank Ltd.
   IDBI Ltd.
   Punjab National Bank
   Standard Chartered Bank

State Bank of Travancore
State Bank of Hyderabad
Syndicate Bank

b. Any public sector Bank (other than consortium banks) with a clause in the text of Bank Guarantee that "**It is enforceable at Nagpur, Maharashtra**".
c. Any private sector banks, with a clause in the text of Bank Guarantee that "**It is enforceable by being presented at any branch of the bank**".

Note: "Bank Guarantees issued by Co-operative Banks are not acceptable".

12. Broad Terms & Conditions of Reverse Auction:

In continuation to Clause 19.0 of NIT (Notice Inviting Tender) following are the broad terms and conditions of Reverse Auction:

"BHEL shall be resorting to Reverse Auction (RA) (Guidelines as available on www.bhel.com**) (https://www.bhel.com/guidelines-reverse-auction-2021)** for this tender. RA shall be conducted among the techno-commercially qualified bidders.

Price bids of all techno-commercially qualified bidders shall be opened and same shall be considered for RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope price bid along with applicable loading, if any, shall be considered for ranking."

Note:-
1. No benefits to MSE bidders w.r.t Reverse Auction Guidelines as available on www.bhel.com against works contract.
2. In case of enquiry through e-procurement the sealed electronic price bid (e-bid) is to be treated as sealed envelope price bid.

13. Bidders kindly to take note that EMD (Earnest Money Deposit) shall be furnished by MSE bidders as well, as per the amount and procedure indicated in the NIT/GCC.

14. Clause no. 2.24 of GCC PERFORMANCE GUARANTEE FOR WORKMANSHIP: Not Applicable

15. PRICE VARIATION COMPENSATION Clause no. 2.17 of Vol I C GCC: Not Applicable

16. Overrun compensation clause no. 2.12 of standard GCC shall not be applicable

17. Quantity variation clause No 2.14 of Vol-IC General Conditions of Contract:
Not Applicable

18. Progress Monitoring, Monthly Review and Performance Evaluation of Vol-I BCD is not applicable.

19. Interest bearing recoverable advances is not applicable.

20. Retention Amount (Clause no 2.22 of GCC): Not applicable

21. **Cl 1.2.1 of '1.2 Submission of Tenders' of Chapter -1 of VOL IC- GCC (General Conditions of Contract) is amendment as below:**

Existing	Amended/To be read as
1.2.1) The tenderers must submit their tenders to Officer inviting tender (**Or upload on E portal website https://bhel.abcprocure.com in case of E tender**) **as per instructions in the NIT**.	1.2.1) The tenderers must submit their tenders to Officer inviting tender (**Or upload on E portal website https://eprocurebhel.co.in in case of E tender**) **as per instructions in the NIT**.

NOTE / New:
E procurement portal for E tendering is: E portal website -
https://eprocurebhel.co.in All relevant clauses shall be read accordingly.

2402

TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED

TECHNICAL CONDITIONS OF CONTRACT (TCC)
CONTENTS

1.0	**Project Information**
1.1	1. Purchaser / Owner : **M/s GUJARAT STATE ELECTRICITY CORPORATION LIMITED (GSECL),** 2. Project Title : **1X800 MW WANAKBORI** **LOCATION AND APPROACH :** **Location :** Wanakbori, District-Kheda, Gujarat **Nearest Railway Station :** Sevaliya (8KM) – Anand-Godhra main line **Nearest Airport :** Vadodara (85 KM from site), Ahmadabad (100 KM from site) **Nearest Sea Port :** Kandla **Access By Road :** 10KM from Dakor-Godhra NH No. 8, 02 KM from Balasinor-Sevaliya SH No. 59 **Major Towns/Cities:** 13 KM from Balasinor and 10KM from sevaliya. **Land:** Within existing Thermal Power Station. North-East side of the existing plot. **Source Of Coal:** Indian coal sourced from captive mines Machha in Talchar, Orissa. **Source Of Water:** River Mahi, flowing by side of existing Wanakbori Power Station.
1.2	**METEOROLOGICAL DATA:** **Dry bulb temperature** **(Max & min.) : 40.8oC &10.8oC** **Humidity (min. & max.) : 42.5% to 81.5%** **Average Annual Rainfall : 750mm** **Wind speed : Basic wind speed of 39 m/sec as per IS -875(Part-3)** **Seismic Zone : Zone-III as per IS-1893**

	The Bidder shall visit site and get acquainted himself with the conditions prevailing at site before submission of the bid. The information's given here in under are for general guidance and shall not be contractually binding on BHEL/ Owner. All relevant site data/ information as may be necessary shall have to be obtained /collected by the Bidder. All costs for and associated with site visits shall be borne by the bidder. BHEL will not admit any claims whatsoever on account of Contractor's non-familiarization of local conditions.

Resolution of pending technical issues and Expert/ Consulting services for DM Plant PG test at Wanakbori Extn Unit-08 Set-01 at GSECL 1X800MW project.

A. Special condition of contract:

1. DM plant is presently being operated and maintained by GSECL. However few technical issues resolution and PG test is balance. Intent of this tender is to resolve these issues and complete DM plant PG test successfully.
2. Bidder to visit site, review the DM plant operation status, and get acquainted with site conditions.
3. During the working at site, bidder to coordinate with GSECL operation staff for any work in DM plant. Any work shall be done with permission from GSECL and BHEL shall facilitate for this with GSECL.
4. All chemicals required for operation of DM plant is in scope of GSECL.
5. Chemical laboratory is available for water parameter testing and facility can be utilized for water testing. If any testing is to be done outside plant bidder to consider it in their (bidder) scope. Online instruments availability and calibration as may require shall be in BHEL scope.
6. During the work assistance of skilled and un skilled labor for carrying out physical work like RESIN unloading/reloading/leakage attending/strainer cleaning/replacement/ valve operation (If required) shall be provided by BHEL.
7. RESIN Top-up, if any required shall be in BHEL scope.

B. Bidder scope of work:

1. Bidder to arrange technical experts as required for resolution of problem defined in Table-1 and arrange completion protocol from customer.
2. Bidder shall attend/resolve the points mentioned below.
3. If the requirement of change/replacement/ modification in acid/alkali/brine dosing system OR replacement of ejectors installed in dosing system, arises, it shall be in bidder's scope. Bidder to consider all relevant material (including replacement items) and manpower of this execution in their scope.
4. If replacement of pall rings/vessel internal nozzles is required for optimization/resolution of technical issues, it shall be in bidder scope. Bidder to consider all relevant material (including replacement items) and manpower of this execution in their scope.
5. Technical issues and present status about the same is mentioned below Table 01.

Table 01			
Sl No.	**Issue to be resolved**	**Status**	**% weightage allotted for payment w.r.t awarded prices, upon achievement of works**
1	During DM water generation SBA outlet conductivity crosses permissible limit of 5µS /cm before completing 18 hrs of service hours:	Problem is noticed from the initial stages of commissioning. As per Resin analysis report slight organic fouling observed in the resin. Brine treatment shall be carried out during shut-down in the presence of agency.	15
2	CO2 at De-Gasser tower outlet remains high: Limit allowed :05ppm. Achieved results : varying between 9-18 ppm.	We have checked all points of air leak out of the system & same was found to be Nil. Further media tower checking balance.	10
3	Minor resin leak still observed from middle collector	Fasteners used in Middle collector flanges were found to be of inferior Gr (SS304). Replaced fasteners used in all flanges of middle collector with SS316 [from SS304] and also checked for tightness of all middle collector flanges. After taking vessel into service, regeneration parameters such as Baume [Specific Gravity of liquid solution] of the Alkali solution and also chemical	5

		injection flow deteriorates in 2 months of service . Minor resin leak has been observed which necessitates flushing of middle collector to restore regeneration parameters .	
4	Resin Bed getting disturbed in MB frequently whenever generation is interrupted /stopped.	During interruption of generation process bed separation of Anion and Cation resin bed occurs and after few such interruptions /stoppages, bed separation height increases. This affects MB outlet conductivity during generation and requires frequent air scouring to set right the mixed bed resin.	5
5	Cumulative DM generation hours of MB vessel is not achieved as per design. As per design MB should give service life of 7 cycles (each cycle of 18 hrs duration i.e.18x105 CuM of DM water output per cycle) between two successive regenerations.	Currently MB exhausts before completing 7 cycles	10
6	Sodium slippage observed across SAC vessel	sodium slippage to the extent of 1-2 ppm has been observed	5
7	Successful PG test of DM plant as per approved procedure	a) Successful PG Test Conductance b) PG Test Report Submission c) PG Test Report Acceptance	a) 20 b) 10 c) 20

8. Bidder to quote Total lump sum Price considering above work in VOL II Price Bid at E portal and payment shall be as per allotted % mentioned in Table-01 above. Payment shall be made after submission of customer protocol against each point in Table-01 and invoice submission within 30 days. No other documents are required for payment.

9. BHEL shall arrange the gate pass for work in the plant area. Bidder to submit the Aadhar card copy, PAN Card copy for gate pass issuance. Medical certificate will be submitted if required for gate pass. No PF Challan, Labor license and WC policy will be required. Bidder to ensure the proper safety during work at site and follow customer guidelines as applicable for work execution.

10. Guest house/accommodation shall be provided on free basis (1 room) for maximum 2-month period (only lodging).

3.1 TIME SCHEDULE & MOBILIZATION

3.1.1 INITIAL MOBILIZATION

After receipt of **Letter of Intent (LOI),** Contractor shall discuss with Project Manager / Construction Manager regarding initial mobilization. Contractor shall mobilize necessary resources **within 1 week** of issue of letter of intent or as per the directive of Project Manager / Construction Manager. Such resources shall be progressively augmented to match the schedule of PG test.

3.1.2 CONTRACT PERIOD

The contract period for completion of entire work under scope shall be **2 months** from the “start of contract period”.

The date of clearance from site construction manager for the works shall be reckoned as “start of contract period” for the above purpose.

4.0 TAXES, DUTIES, LEVIES (Rev 14 dated 09/10/2020)

1) All taxes excluding GST, GST Cess **& BOCW** Cess **but including, Royalties, fees, license, deposits, commission, any State or Central Levy and other charges whatsoever, if any, shall be borne by you and shall not be payable extra.**
2) Any increase of the taxes excluding GST, GST Cess & BOCW **Cess**, at any stage during execution including extension of the contract shall have to be borne by the contractor. Quoted/ accepted rates/ price shall be inclusive of all such requirements. Please note that since GST on output will be paid by BHEL separately as enumerated below, your quoted rates/ price should be after considering the Input Credit under GST law at your end.
3) **GST :**

   The successful bidder shall furnish proof of GST registration .GST along with Cess (as applicable) legally leviable & payable by the successful bidder as per GST Law, shall be paid by BHEL. Hence Bidder shall not include GST along with Cess (as applicable) in their quoted price.
4) GST charged in the Tax Invoice/Debit note by the contractor shall be released separately to the contractor only after contractor files the outward supply details in GSTR-1 on GSTN portal and input tax credit of such invoice is matched with corresponding details of outward supply of the contractor and has paid the GST at the time of filing the monthly return
5) E-invoicing under GST has been implemented with effect from 1st October 2020 for all the taxable persons having turnover more than the threshold limit in any preceding financial year from 2017-18 onwards. Therefore, for all the taxable persons falling under the purview of E-invoice, it is mandatory to mention a valid unique Invoice Reference No. (IRN) and QR code as generated from E-Invoicing portal of the Government for the purpose of issuing a valid Tax Invoice. Only an E-invoice issued in the manner prescribed under rule 48(4) of CGST Rules shall be treated as valid invoice for reimbursement of GST amount.

   If the successful Bidder is not falling under the purview of E-Invoicing then he has to submit a declaration in that respect along with relevant financial statements.
6) Bidder shall note that the GST Tax Invoice complying with GST Invoice Rules (Section 31 of GST Act & Rules referred there under) wherein the 'Bill To' details will as below:

   BHEL GSTN – As per **Annexure -1**

   NAME -- Bharat Heavy Electricals Limited

   ADDRESS – Site address

7) Bidder to immediately intimate on the day of removal of Goods (in case of any supply of goods) to BHEL along with all relevant details and a scanned copy of Tax Invoice to below email ids to enable BHEL to meet its GST related compliances :-
   Email id ---- to be intimated later on.
   In case of delay in submission of the abovementioned documents on the date of dispatch, BHEL may incur penalty /interest for not adhering to Invoicing Rules under GST Law. The same will be liable to be recovered from the successful bidder, if such delay is not attributable to BHEL.
8) In case of raising any Supplementary Tax Invoice (Debit / Credit Note) Bidder shall issue the same containing all the details as referred to in Section 34 read with Rule 53.
9) Bidder shall note that in case GST credit is delayed/ denied to BHEL due to delayed / non receipt of goods and /or tax invoice or expiry of the timeline prescribed in GST Law for availing such ITC, or any other reasons not attributable to BHEL, GST amount shall be recoverable from the vendor along with interest levied / leviable on BHEL, as the case may be.
10) Bidder shall upload the Invoices raised on BHEL in GSTR-1 within the prescribed time as given in the GST Act. Bidder shall note that in case of delay in declaring such invoice in your return and GST credit availed by BHEL is denied or reversed subsequently as per GST Law , GST amount paid by BHEL towards such ITC reversal as per GST law shall be recoverable from the bidder along with interest levied / leviable on BHEL.
11) Way Bill: Successful Bidder to arrange for way bill / e-waybill for any transfer of goods for the execution of the contract.

    The Bidder has to make their own arrangement at their cost for completing the formalities, if required, with Issuing Authorities, for bringing materials, plants & machinery at site for execution of the works under this contract, Road Permit/ Way Bill, if required, shall be arranged by the contractor and BHEL will not supply any Road Permit/ Way Bill for this purpose.
12) **New taxes and duties**:-Any New taxes & duties, if imposed subsequent to due date of offer submission as per NIT & TCN, by statutory authority during contract period including extension, if the same is not attributable to you, shall be reimbursed by BHEL on production of relevant supporting document to the satisfaction of BHEL. However, you shall obtain prior approval from BHEL before depositing new taxes and duties.
    Benefits and/or abolition of all existing taxes must be passed on to BHEL against new Taxes, if any, proposed to be introduced at a later date.

In case any new tax/levy/duty etc. becomes applicable after the date of bidder's offer but before opening of the price bid, the bidder must convey its impact on his price duly substantiated by documentary evidence in support of the same before opening of the price bids. Claim for any such impact after opening the price bid will not be considered by BHEL for reimbursement of tax or reassessment of offer.

13) For transportation work, bidder shall declare in his quotation whether he is registered under GST, if yes, whether he intends to claim GST on forward charge basis. In absence of this declaration, BHEL will proceed further with the assumption that bidder intends not to claim GST on forward charge basis. However, in case of GST registered transporter, the amount to the extent of goods and service tax will be retained till BHEL avails the credit of GST. Further, transporter shall issue tax invoice which inter alia includes gross weight of the consignment, name of the consigner and the consignee, registration number of vehicle in which the goods are transported, details of goods transported, details of place of origin and destination, GSTIN of the person liable for paying tax whether as consigner, consignee or goods transport agency, and also containing other information as mentioned under rule 46.

14) **TDS under Income Tax shall be deducted at prevailing rates on gross invoice value from the running bills unless exemption certificate from the appropriate authority/ authorities is furnished.**

15) **TDS under GST shall be deducted at prevailing rates on applicable value from the running bills.**

16) **TCS under Income Tax 1961 has been implemented with effect from 1st October 2020 for every seller having turnover more than threshold limit during financial year immediately preceding financial year in which the sale of goods is carried out, who receives any amount as consideration for sale of any goods of the value or aggregate of such value exceeding threshold limit other than export of goods or who is already covered under other provision of section 206C, collect from the buyer, TCS as per applicable rates of the sale consideration exceeding threshold limit subject to following conditions**

   i. Buyer shall be as per clause (a) of section 206C- (1H)
   ii. Seller shall be as per clause (b) of section 206C- (1H)

iii. No TCS is to be collected, if the seller is liable to collect TCS under other provision of section 206C or the buyer is liable to deduct TDS under any provision of the Act and has deducted such amount.

If Successful Bidder is falling under the purview of TCS then he has to submit a declaration in that respect along with relevant financial statements before the start of work or if bidder is falling under preview of TCS during the work in progress then bidder is compulsorily required to submit relevant financial statement in the beginning of the respective FY.

For TCS claim, vendor has to submit relevant documents required as per Income Tax Act.

17) Refer Annexure – 2 for BOCW Act & Cess Act.

ANNEXURE-1

State wise GSTIN no.s of BHEL

Sl. No	Projects under state	GSTIN
1	Andhra Pradesh	37AAACB4146P7Z8
2	Bihar	10AAACB4146P1ZU
3	Chhattisgarh	22AAACB4146P1ZP
4	Gujarat	24AAACB4146P1ZL
5	Jharkhand	20AAACB4146P5ZP
6	Madhya Pradesh	23AAACB4146P1ZN
7	Maharashtra	27AAACB4146P1ZF
8	Orissa	21AAACB4146P1ZR
9	Telangana	36AAACB4146P1ZG

ANNEXURE-2

BOCW Act & Cess Act

Bidder may please note that the sub-contractor/bidder of BHEL engaging building or construction worker in connection with building or other construction work, are required to follow the procedures enumerated below:

1. It shall be the sole responsibility of the contractor as employer to ensure compliance of all the statutory obligations under the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 and the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder.

2. It shall be sole responsibility of the contractor engaging Building Workers in connection with the building or other construction works in the capacity of employer to apply and obtain registration certificate specifying the scope of work under the relevant provisions of the Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 from the appropriate Authorities.
3. It shall be responsibility of the contractor to furnish a copy of such Registration Certificate within a period of one month from the date of commencement of Work.
4. It is responsibility of the contractor to register under the Building and other Construction Workers' Welfare Cess Act, 1996 and deposit the required Cess for the purposes of the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 at such rate as the Central Government may , by notification in the Official Gazette, from time to time specify. However, before registering and deposit of Cess under the Building and other Construction Workers' Welfare Cess Act, 1996, the contractor will seek written prior approval from the Construction Manager.
5. It shall be sole responsibility of the contractor as employer to get registered every Building Worker, who is between the age of 18 to 60 years of age and who has been engaged in any building or other construction work for not less than ninety days during the preceding twelve months as Beneficiary under the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996.
6. It shall be sole responsibility of the contractor as employer to maintain all the registers, records, notices and submit returns under the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 and the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder.
7. It shall be sole responsibility of the contractor as employer to provide notice of poisoning or occupation notifiable diseases, to report of accident and dangerous occurrences to the concerned authorities under the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 and the rules made thereunder and to make payment of all statutory payments & compensation under the Employees' Compensation Act, 1923.
8. It shall be the responsibility of the sub-contractor as employer to make payment/deposit of applicable cess amount on the extent of work involving building or construction workers engaged by the sub-contractor within a period of one month from the receipt of payment. It shall also be responsibility of the Contractor to furnish BHEL on monthly basis, Receipts/ Challans towards Deposit of the Cess under the Building

and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder along with following statistics :

(i)Number of Building Workers employed during preceding one month.

(ii) Number of Building workers registered as Beneficiary during preceding one month.

(iii)Disbursement of Wages made to the Building Workers for preceding wage month.

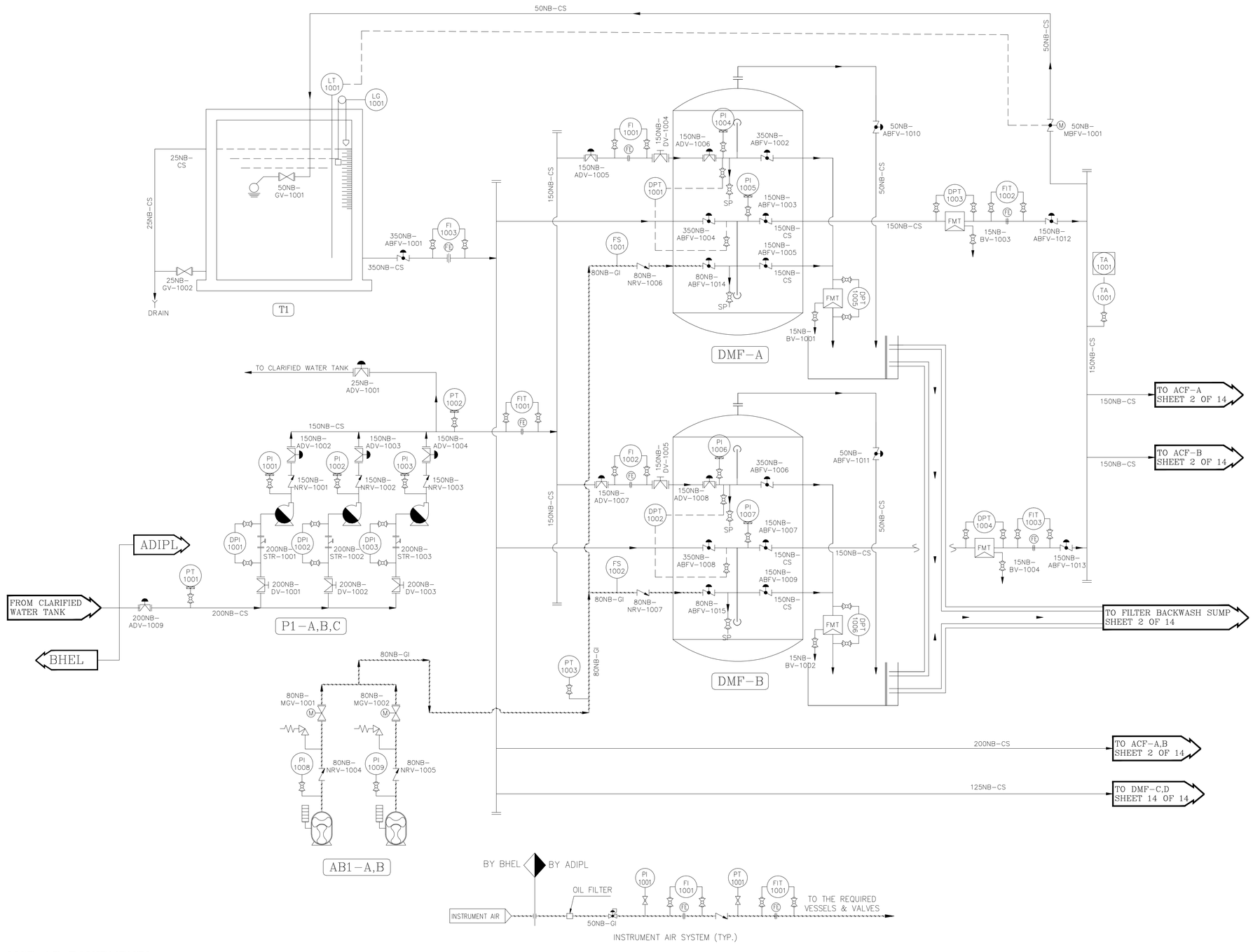
(iv) Remittance of Contribution of Beneficiaries made during the preceding month

9. BHEL shall reimburse the contractor the Cess amount deposited for the purposes of the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 under the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder. However, BHEL shall not reimburse the Fee paid towards the registration of establishment, fees paid towards registration of Beneficiaries and Contribution of Beneficiaries remitted.
10. It shall be responsibility of the Building Worker engaged by the Contractor and registered as a beneficiary under the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 to contribute to the Fund at such rate per mensem as may be specified by the State government by notification in the Official Gazette. Where such beneficiary authorizes the contractor being his employer to deduct his contribution from his monthly wages and to remit the same, the contractor shall remit such contribution to the Building and other construction Workers' Welfare Board in such manner as may be directed by the Board , within the fifteen days from such deduction.
11. Bidders may please note that though the quoted price is exclusive of BOCW (which will be reimbursed by BHEL as per sub-clause 9 above) , however, If at any point of time during the contract period, non-compliance of the provisions of the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 and the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder is observed, BHEL reserves the right to deduct the applicable cess (1%) on the contract value and penalty (if any, imposed by Cess Authorities) from the payables on account of non-compliance.
12. The contractor shall declare to undertake any liability or claim arising out of employment of building workers and shall indemnify BHEL from all consequences / liabilities / penalties in case of non-compliance of the provisions of the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 and the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder.

P&I DIAGRAM FOR DM PLANT REV 00

DWG. PE-V0-408-153-A001 NO.

REV. '1'



SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-1001 TO 1005
	AUTO DIAPHRAGM VALVE	ADV-1001 TO 1009
	AUTO BUTTERFLY VALVE	ABFV-1001 TO 1015
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
M	MOTORIZED BUTTERFLY VALVE	MBFV-1001
	BALL VALVE	BV-1001 TO 1004
	NON RETURN VALVE	NRV-1001 TO 1007
	'Y' TYPE STRAINER	STR-1001 TO 1003
	MANUAL GATE VALVE	GV-1001 TO 1002
M	MOTORIZED GATE VALVE	MGV-1001 TO 1002

LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY
T1	OVERHEAD B/W WATER STORAGE TANK	1 No.
P1-A,B,C	DM FEED PUMP	3 Nos(1W+2S)
AB1-A,B	AIR BLOWER FOR DMF-A,B	2 Nos(1W+1S)
DMF-A,B	DUAL MEDIA FILTER	2 Nos(1W+1S)

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

GSECL

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.

Aqua Designs India Pvt Limited
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Email: sales@aquadesigns.in. Web site: www.aquadesigns.in.

	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

TITLE : P&ID FOR DM-PLANT (SHEET 1 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 NO.

REV. '1'

FROM DMF-A,B SHEET 1 OF 14

FROM T1 SHEET 1 OF 14

150NB-ABFV-2001

150NB-CS

FI 2001 FE

150NB-BFV-2001

PI 2001

150NB-ABFV-2003

200NB-ABFV-2004

50NB-CS

50NB-ABFV 2013

200NB-CS

DPT 2001

PI 2002

200NB-ABFV-2005 SP

150NB-ABFV-2006

150NB-CS

150NB-ABFV-2007 SP

150NB-CS

200NB-ABFV-2017

200NB-CS

150NB-CS

ACF-A

FMT DPT 2003

15NB-BV-2001

DPT 2005 FMT

FIT 2001 FE

150NB-ABFV-2015

150NB-CS

15NB-BV-2003

150NB-CSRL

TO WAC-A SHEET 3 OF 14

RCA 2001

TO WAC-B SHEET 3 OF 14

150NB-CSRL

150NB-CS

50NB-CS

150NB-ABFV-2002

FI 2002 FE

150NB-BFV-2002

PI 2003

150NB-ABFV-2008

200NB-ABFV-2009

50NB-ABFV-2014

200NB-CS

DPT 2002

PI 2004

200NB-ABFV-2010 SP

150NB-ABFV-2011

200NB-CS

150NB-CS

150NB-ABFV-2012 SP

150NB-CS

ACF-B

FMT DPT 2004

15NB-BV-2002

DPT 2006 FMT

FIT 2001 FE

150NB-ABFV-2016

150NB-CS

15NB-BV-2004

ISOLATION GATE IG-2001

INLET CHAMBER

ISOLATION GATE IG-2002

FROM DMF-A,B SHEET 1 OF 14

FROM DMF-A,B SHEET 14 OF 14

TO STILLING CHAMBER OF PRE-TREATMENT PLANT

PT 2001 PT 2002

100NB-MGV-2006

100NB-CS

100NB-MGV-2005

100NB-MGV-2001

100NB-MGV-2002

LT 2001

100NB-CS

100NB-MGV-2003

100NB-MGV-2004

SAMPLING

SAMPLING

100NB-NRV-2001

100NB-NRV-2002

100NB-GV-2001

PG 2001

PG 2002

M

M

100NB-CS

100NB-CS

100NB-CS

LT 2003

LI 2001

FILTER BACK WASH SUMP-COMPARTMENT-A

ISOLATION GATE IG-2003

ISOLATION GATE IG-2005

ISOLATION GATE IG-2004

ISOLATION GATE IG-2006

LI 2003

P2-A,B

FILTER BACK WASH SUMP-COMPARTMENT-B

LT 2002

LI 2002

T2

FILTER BACKWASH SUMP

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-XXXX TO XXXX
	AUTO DIAPHRAGM VALVE	ADV-XXXX TO XXXX
	AUTO BUTTERFLY VALVE	ABFV-2001 TO 2017
	MANUAL BUTTERFLY VALVE	BFV-2001 TO 2002
	BALL VALVE	BV-2001 TO 2004
	NON RETURN VALVE	NRV-2001 TO 2002
	'Y' TYPE STRAINER	STR-XXXX TO XXXX
	MANUAL GATE VALVE	GV-XXXX TO XXXX
M	MOTORIZED GATE VALVE	MGV-2001 TO 2006
	ISOLATION GATE	IG-2001 TO 2006

LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY
T2	FILTER BACKWASH SUMP	1 No.
P2-A,B	BACKWASH WASTE WATER DISPOSAL PUMP	2 Nos(1W+1S)
ACF-A,B	ACTIVATED CARBON FILTER	2 Nos(1W+1S)

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
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Ph.: 91-44-37171717, Fax: 91-44-37171737.
Email: sales@aquadesigns.in. Web site: www.aquadesigns.in.

	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

TITLE : P&ID FOR DM-PLANT (SHEET 2 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 NO.

REV. '1'

FROM ACF-A,B SHEET 2 OF 14

150NB-CSRL

150NB-ADV-3001

65NB-ADV-3003

FI 3001

150NB-DV-3008

FE

PI 3001

150NB-ADV-3005

65NB-ADV-3006

SP

PI 3002

65NB-ADV-3007

150NB-ADV-3008

SP

150NB-ADV-3009

WAC-A

CE 3002A

CE 3002B

CT 3002

CC 3002

DPT 3001

RT

15NB-DV-3001

N-PIT

50NB-ADV-3015

CE 3001

CT 3001

150NB-CSRL

DPT 3002

RT

15NB-DV-3003

FIQ

FIT 3001

FE

Na 3001A

AE

SIA 3001-A

AE

150NB-ADV-3018

150NB-CSRL

TO SAC-A SHEET 4 OF 14

150NB-CSRL

TO SAC-B SHEET 4 OF 14

DI 3001

65NB-NRV-3001

FI 3004

FE

15NB-DV-3005

WASTE BLEED

15NB-DV-3006

SP

15NB-DV-3007

DI

ACID FROM SAC SHEET 4 OF 14

50NB-ADV-3017

FI 3005

FE

FROM DEGASSER TRANSFER PUMP DISCHARGE HEADER FROM SHEET 5 OF 14

50NB-ADV-3020

FROM SHEET 5 OF 14

65NB-ADV-3004

FI 3002

150NB-DV-3009

FE

PG 3001

150NB-ADV-3010

65NB-ADV-3011

SP

PG 3002

65NB-ADV-3012

150NB-ADV-3013

SP

150NB-ADV-3014

WAC-B

CE 3003A

CE 3003B

CT 3003

CC 3003

DPT 3003

RT

15NB-DV-3002

N-PIT

50NB-ADV-3016

CE 3004

CT 3004

150NB-CSRL

DPT 3004

RT

15NB-DV-3004

FIQ

FIT 3002

FE

Na 3001B

AE

AE

SIA 3001-B

150NB-ADV-3019

150NB-CSRL

150NB-CSRL

150NB-ADV-3002

FE

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-3001 TO 3009
	AUTO DIAPHRAGM VALVE	ADV-3001 TO 3020
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-3001
	'Y' TYPE STRAINER	STR-XXXX TO XXXX
M	MOTORIZED GATE VALVE	MGV-XXXX TO XXXX
	MANUAL GATE VALVE	GV-XXXX

LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY
WAC-A,B	WEAK ACID CATION	2 Nos(1W+1S)

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

GSECL

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.

Aqua Designs India Pvt Limited
Office: 200 Feet Road, Kalathur, Chennai - 600 099.
Ph : 91-44-37171717; Fax: 91-44-37171737.
Email: sales@aquadesigns.in. Web site: www.aquadesigns.in.

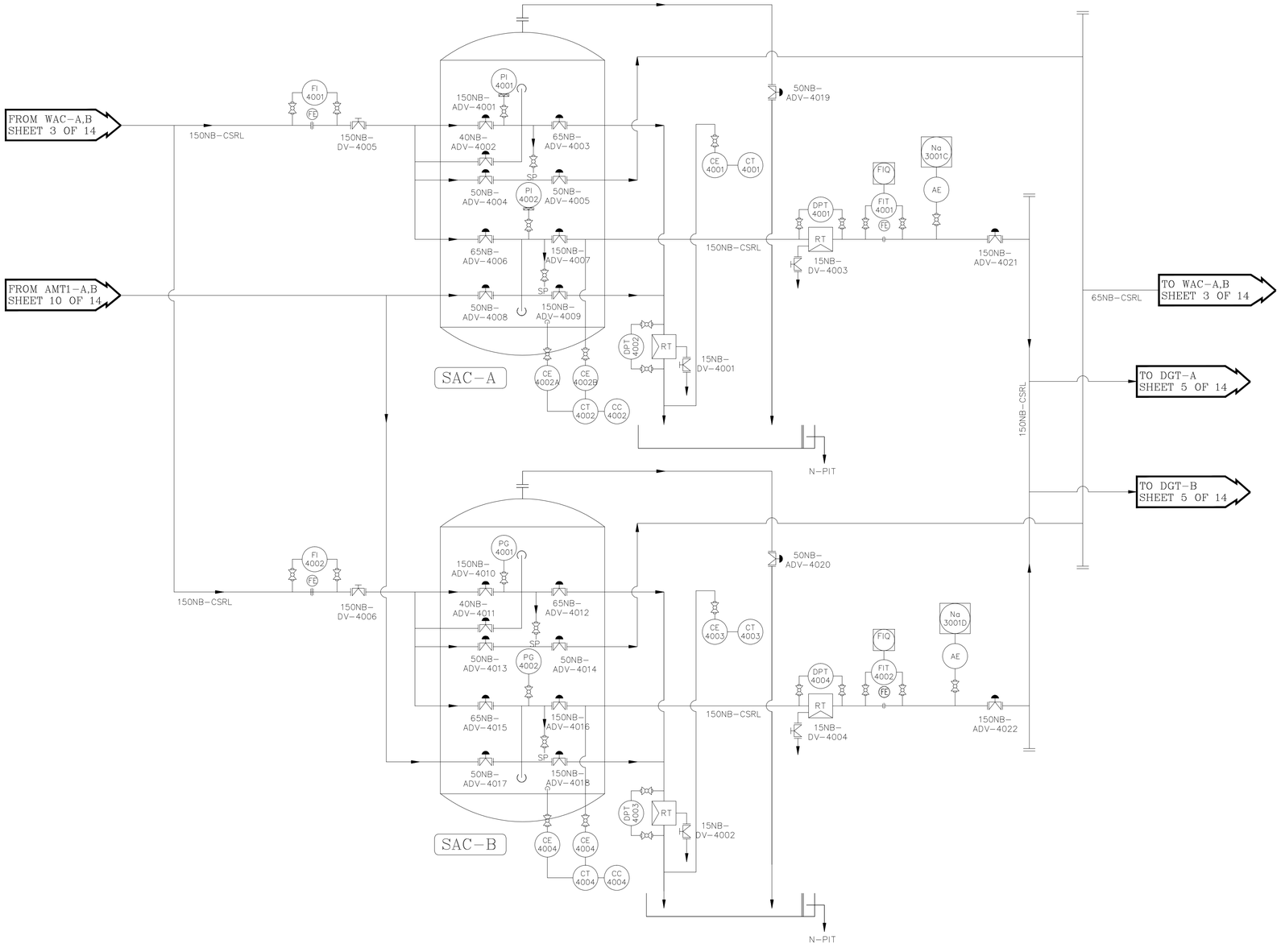
	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

TITLE : P&ID FOR DM-PLANT (SHEET 3 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) (841 x 594)

DWG. PE-V0-408-153-A001 NO.
REV. '1'



SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-4001 TO 4006
	AUTO DIAPHRAGM VALVE	ADV-4001 TO 4022
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-XXXX TO XXXX
	'Y' TYPE STRAINER	STR-XXXX TO XXXX
M	MOTORIZED GATE VALVE	MGV-XXXX TO XXXX
	MANUAL GATE VALVE	GV-XXXX

LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY
SAC-A,B	STRONG ACID CATION	2 Nos(1W+1S)

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

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Email: sales@aquadesigns.in, Web site: www.aquadesigns.in.

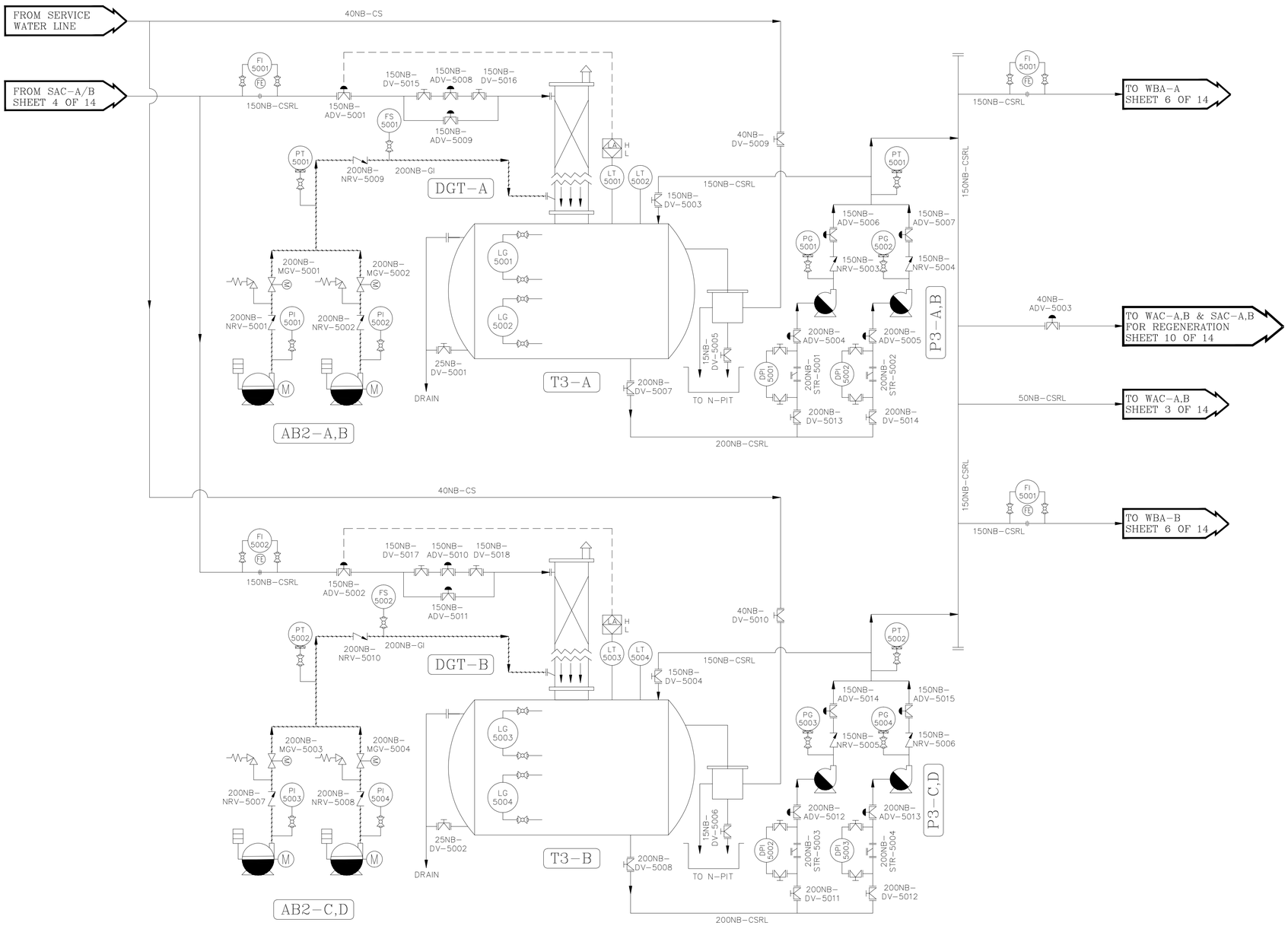
	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

TITLE : P&ID FOR DM-PLANT (SHEET 4 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 REV. '1'



SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-5001 TO 5018
	AUTO DIAPHRAGM VALVE	ADV-5001 TO 5015
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-5001 TO 5010
	'Y' TYPE STRAINER	STR-5001 TO 5004
M	MOTORIZED GATE VALVE	MGV-5001 TO 5004
	MANUAL GATE VALVE	GV-XXXX TO XXXX

LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY
T3-A,B	DG WATER STORAGE TANK	2 Nos
P3-A,B,C,D	DG WATER TRANSFER PUMP	4 Nos(2W+2S)
AB2-A,B,C,D	AIR BLOWER FOR DGT-A,B	4 Nos(2W+2S)
DGT-A,B	DEGASSER TOWER	2 Nos

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

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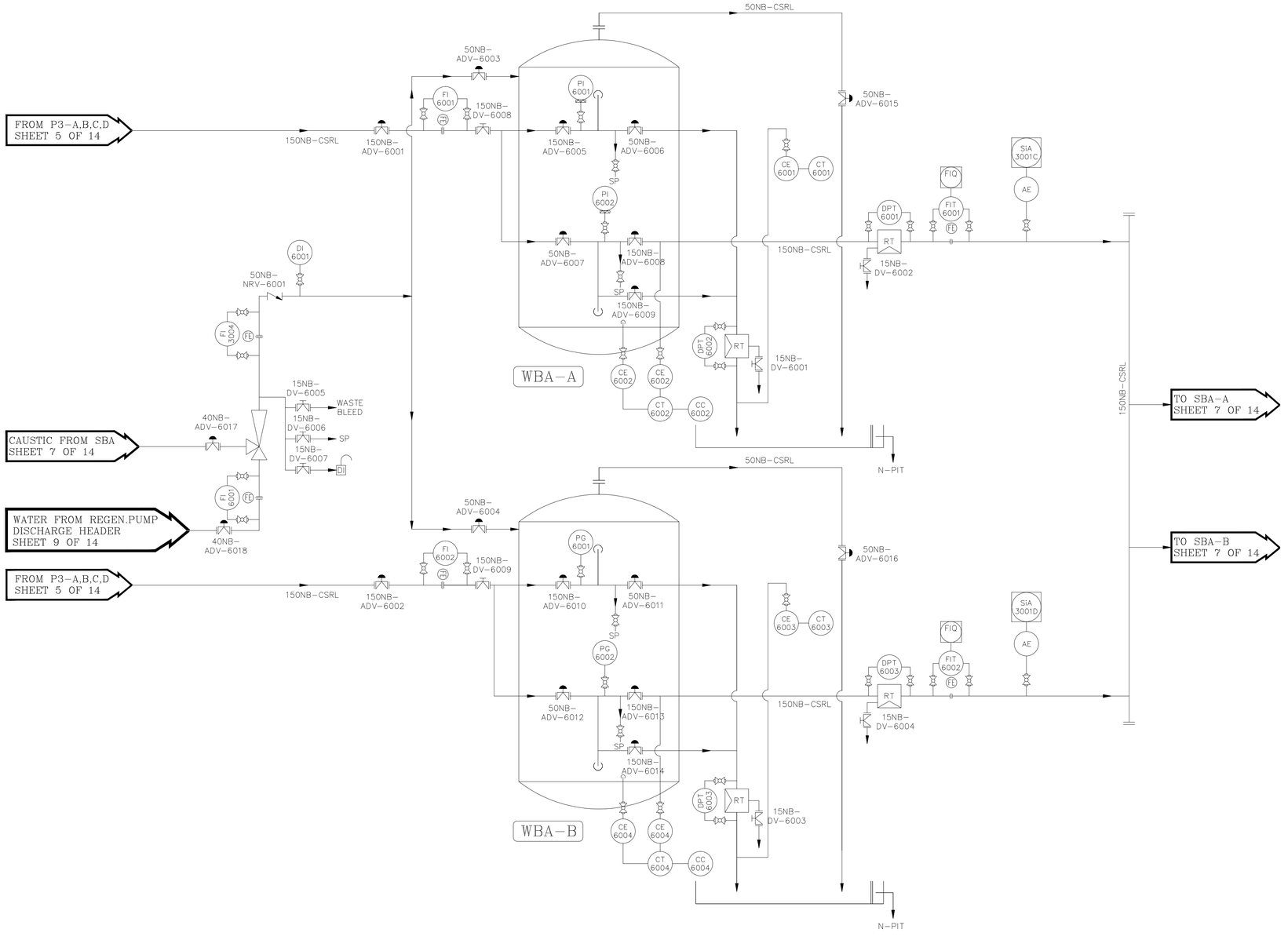
	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

TITLE : P&ID FOR DM-PLANT (SHEET 5 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 REV. '1'



LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY
WBA-A,B	WEAK BASE ANION	2 Nos(1W+1S)

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-6001 TO 6009
	AUTO DIAPHRAGM VALVE	ADV-6001 TO 6018
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-6001
	'Y' TYPE STRAINER	STR-XXXX TO XXXX
M	MOTORIZED GATE VALVE	MGV-XXXX TO XXXX
	MANUAL GATE VALVE	GV-XXXX TO XXXX

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

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	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

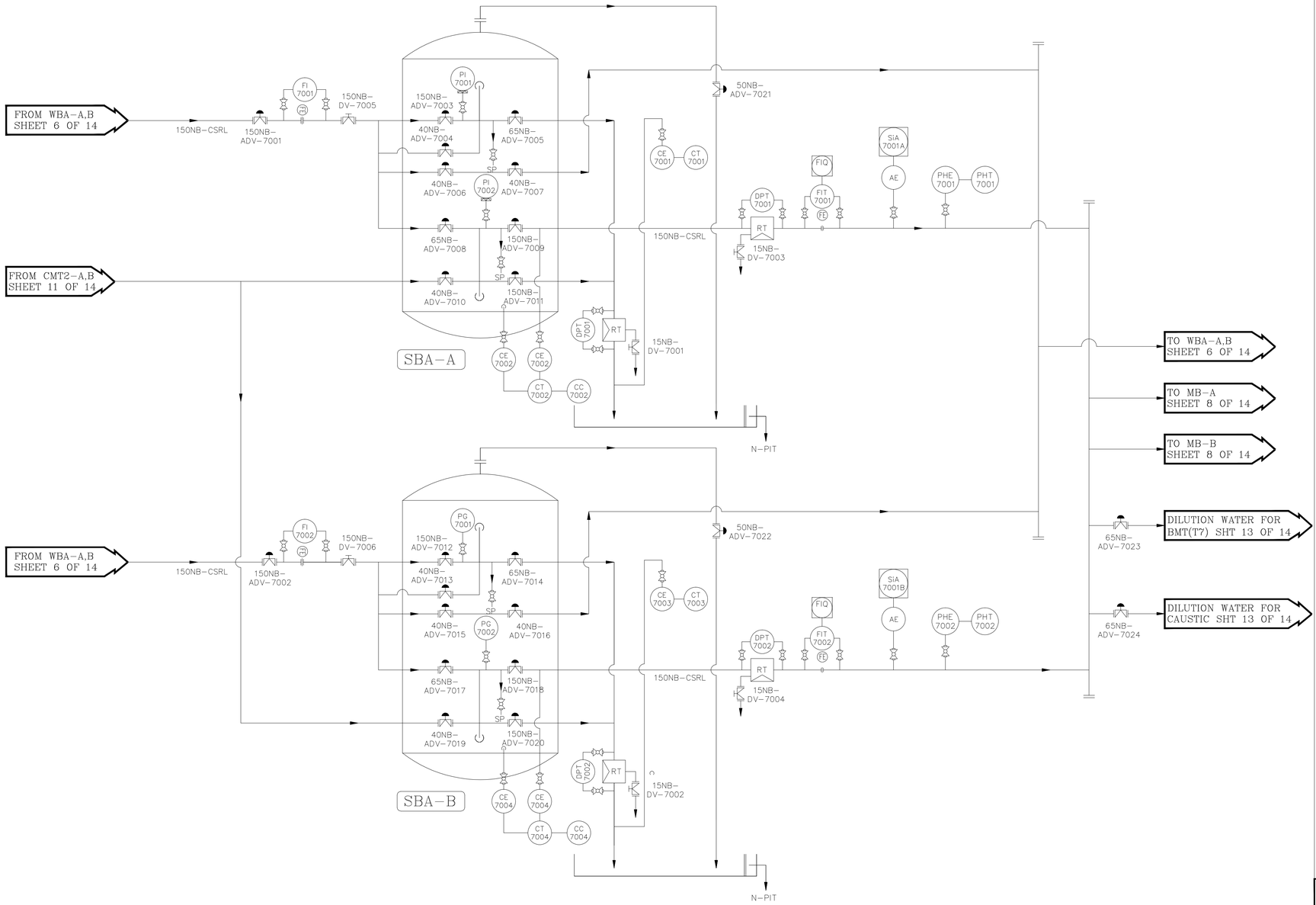
TITLE : P&ID FOR DM-PLANT (SHEET 6 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 NO.

REV. '1'



LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY
SBA-A,B	STRONG BASE ANION	2 Nos(1W+1S)

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-7001 TO 7006
	AUTO DIAPHRAGM VALVE	ADV-7001 TO 7024
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-XXXX TO XXXX
	'Y' TYPE STRAINER	STR-XXXX TO XXXX
M	MOTORIZED GATE VALVE	MGV-XXXX TO XXXX
	MANUAL GATE VALVE	GV-XXXX TO XXXX

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

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Email: sales@aquadesigns.in. Web site: www.aquadesigns.in.

	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

TITLE : P&ID FOR DM-PLANT (SHEET 7 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 REV. '1'

FROM CMT2-C
SHEET 13 OF 14

FROM SBA-A,B
SHEET 7 OF 14

FROM AMT1-C
SHEET 10 OF 14

40NB-ADV-8023
FI 8001 FE
150NB-DV-8005
150NB-ADV-8001
150NB-CSRL
PI 8001
SP
150NB-ADV-8003
65NB-ADV-8004
40NB-ADV-8025
50NB-ADV-8021
CE 8001
CT 8001
65NB-ADV-8005
PI 8002
65NB-ADV-8006
65NB-ADV-8007
150NB-ADV-8008
150NB-CSRL
DPT 8002
RT
15NB-DV-8002
FIQ
FIT 8001 FE
SIA 7001C
AE
PHE 8001
PHT 8001
FS 8001
40NB-ADV-8009
150NB-ADV-8010
80NB-GI
80NB-ADV-8011
DPT 8001
RT
15NB-DV-8001
MB-A
CE 8002
CE 8002
CC 8002
CT 8002
N-PIT

TO DMWST-B
SHEET 9 OF 14

40NB-ADV-8024
FI 8002 FE
150NB-DV-8006
150NB-ADV-8002
150NB-CSRL
PG 8001
SP
150NB-ADV-8012
65NB-ADV-8013
40NB-ADV-8026
50NB-ADV-8022
CE 8004
CT 8004
65NB-ADV-8014
PG 8002
65NB-ADV-8015
65NB-ADV-8016
150NB-ADV-8017
150NB-CSRL
DPT 8004
RT
15NB-DV-8004
FIQ
FIT 8002 FE
SIA 7001D
AE
PHE 8002
PHT 8002
FS 8002
40NB-ADV-8018
150NB-ADV-8019
80NB-GI
80NB-ADV-8020
DPT 8003
RT
15NB-DV-8003
PT 8001
100NB-NRV-8003
100NB-GV-8001
100NB-GV-8002
100NB-NRV-8001
PI 8003
100NB-NRV-8002
PI 8004
AB3-A,B
MB-B
CE 8003
CE 8003
CC 8003
CT 8003
N-PIT

50NB-GI

TO T4
SHEET 9 OF 14

LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY
MB-A,B	MIXED BED	2 Nos(1W+1S).
AB3-A,B	AIR BLOWER FOR MB-A,B	2 Nos(1W+1S).

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-8001 TO 8006
	AUTO DIAPHRAGM VALVE	ADV-8001 TO 8026
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-8001 TO 8003
	'Y' TYPE STRAINER	STR-XXXX TO XXXX
	MANUAL GATE VALVE	GV-8001 TO 8002

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
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Email: sales@aquadesigns.in. Web site: www.aquadesigns.in.

	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

TITLE : P&ID FOR DM-PLANT (SHEET 8 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 NO.

REV. '1'

FIQ
FIT
FE
PIT IS UNDER ADDPL ADDPL SCOPE
150NB-SS304
80NB-ADV-9001
80NB-CSRL
DRAIN
DMWST-A
(BY BHEL)
ADIPL
FROM MB-A,B SHEET 8 OF 14
UPTO 5.0 Meters FROM DM PLANT BUILDING 150NB-CSRL
BHEL
80NB-ADV-9002
PT 9001
FIT 9001
50NB-CSRL
TO WBA-A,B SHEET 6 OF 14
65NB-CSRL
TO AMT1-C SHEET 11 OF 14
50NB-ADV-9005
TO ALL CMT SHEET 12&13 OF 14
80NB-ADV-9006
TO T8 & ACP-C SHEET 13 OF 14
PI 9001
PI 9002
80NB-NRV-9001
80NB-ADV-9003
80NB-NRV-9002
80NB-ADV-9004
DPI 9001
DPI 9002
100NB-STR-9001
100NB-STR-9002
100NB-DV-9001
100NB-DV-9002
100NB-SS304
P4-A,B
100NB-ADV-9010
TO CENTRAL MONITORING BASIN
AE-PH 9001
AE-PH 9002
100NB-ADV-9007
100NB-ADV-9011
PT 9002
100NB-ADV-9008
100NB-ADV-9009
100NB-ADV-9012
100NB-ADV-9013
SP
100NB-NRV-9003
100NB-NRV-9004
100NB-NRV-9005
100NB-NRV-9006
PG 9001
PG 9002
PG 9003
PG 9004
100NB-DV-9006
100NB-DV-9010
P5-A,B,C,D
100NB-DV-9005
100NB-DV-9009
100NB-DV-9003
100NB-DV-9004
100NB-DV-9007
100NB-DV-9008
LT 9001
LT 9002
FROM SERVICE WATER HEADER
40NB-DV-9011
40NB-ADV-9020
40NB-DV-9012
40NB-ADV-9021
40NB-NRV-9007
40NB-ADV-9022
40NB-ADV-9023
40NB-ADV-9024
40NB-NRV-9008
40NB-ADV-9025
LI 9001
LI 9002
40NB-ADV-9014
40NB-ADV-9016
40NB-ADV-9018
ISOLATION GATE IG-9001
40NB-ADV-9015
40NB-ADV-9017
40NB-ADV-9019
ISOLATION GATE IG-9002
FROM AB3-A,B SHEET 8 OF 14
50NB-GI
FROM AMT1-D SHEET 11 OF 14
FROM CMT2-D SHEET 13 OF 14
T-4 (N-PIT)
DRAIN
DMWST-B
(BY BHEL)

LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY
T4	NEUTRALIZATION PIT	1 No.
P4-A,B	DM WATER TRANSFER PUMP	2 Nos(1W+1S)
P5-A,B,C,D	NEUTRALIZATION EFFLUENT DISPOSAL PUMPS	4 Nos(2W+2S)

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-9001 TO 9012
	AUTO DIAPHRAGM VALVE	ADV-9001 TO 9025
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-9001 TO 9006
	'Y' TYPE STRAINER	STR-9001 TO 9002
M	MOTORIZED GATE VALVE	MGV-XXXX TO XXXX
	MANUAL GATE VALVE	GV-XXXX
	ISOLATION GATE	IG-9001 TO 9002

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

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	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

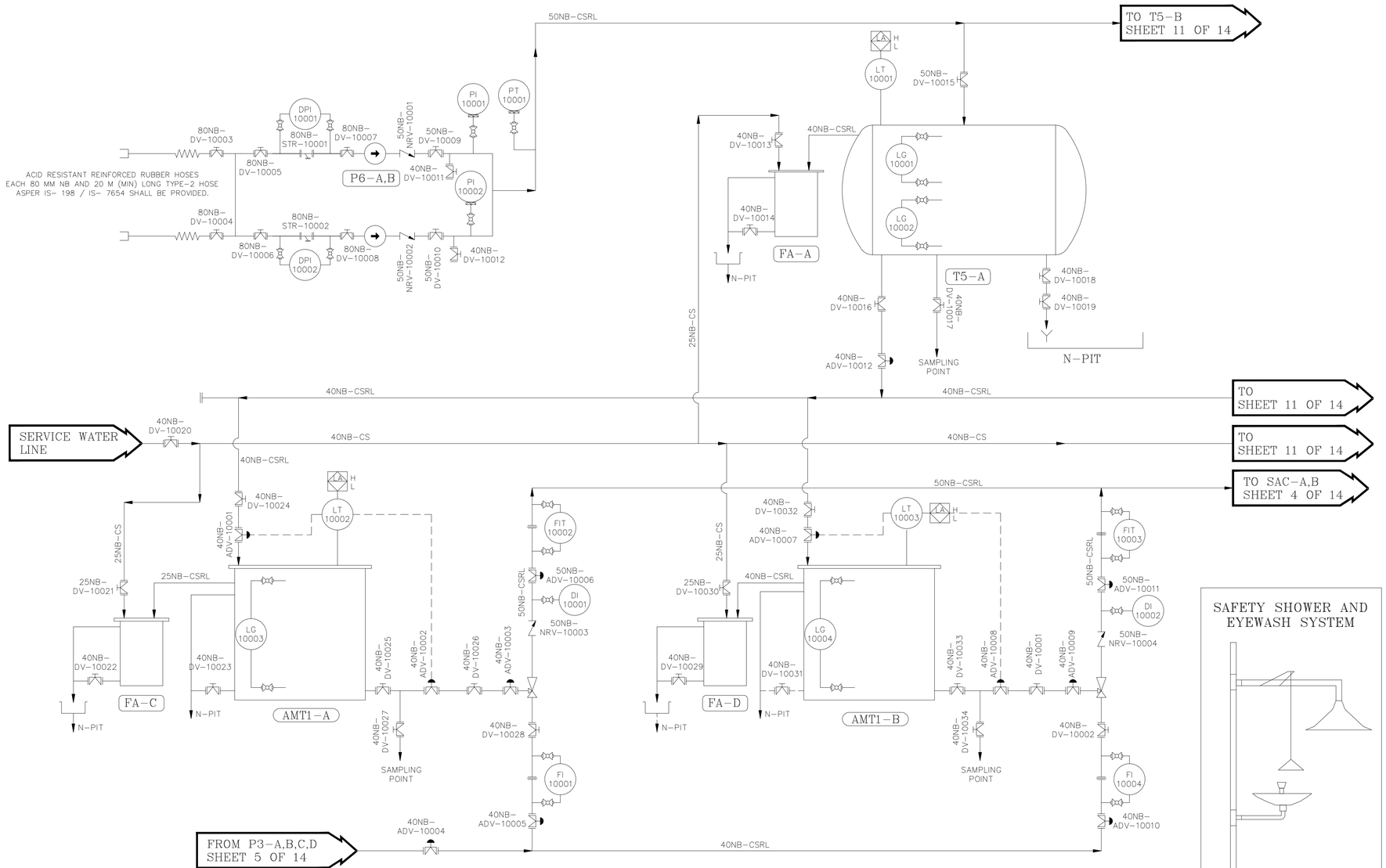
TITLE : P&ID FOR DM-PLANT (SHEET 9 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

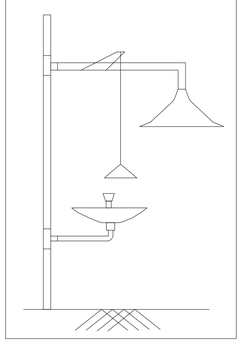
A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 REV. '1'

BULK ACID SYSTEM



SAFETY SHOWER AND EYEWASH SYSTEM



SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-10001 TO 10034
	AUTO DIAPHRAGM VALVE	ADV-10001 TO 10012
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-10001 TO 10004
	'Y' TYPE STRAINER	STR-10001 TO 10002
	MOTORIZED GATE VALVE	MGV-XXXX TO XXXX
	MANUAL GATE VALVE	GV-XXXX

LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY.
T5-A	BULK ACID STORAGE TANK	1 No.
AMT1-A,B	ACID MEASURING TANK-SAC	2 Nos.
P6-A,B	ACID UNLOADING PUMP	2 Nos (1W+1S)

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

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	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

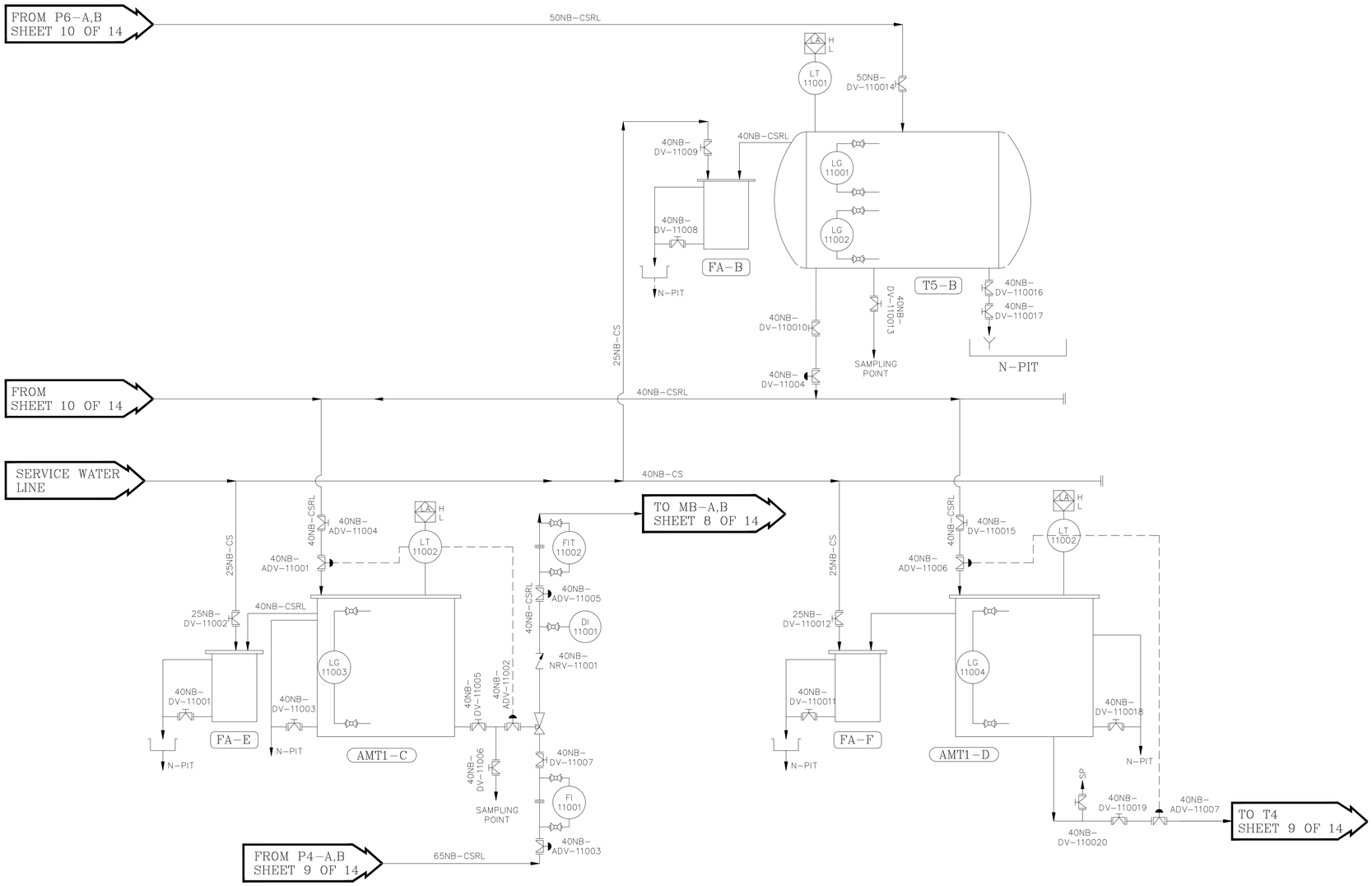
TITLE : P&ID FOR DM-PLANT (SHEET 10 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001
REV. '1'

BULK ACID SYSTEM



SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-11001 TO 110020
	AUTO DIAPHRAGM VALVE	ADV-11001 TO 11007
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-11001
	'Y' TYPE STRAINER	STR-XXXX TO XXXX
M	MOTORIZED GATE VALVE	MGV-XXXX TO XXXX
	MANUAL GATE VALVE	GV-XXXX

LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY.
T5-B	BULK ACID STORAGE TANK	1 No.
AMT1-C	ACID MEASURING TANK-MB	1 No.
AMT1-D	ACID MEASURING TANK-N-PIT	1 No.

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.

Aqua Designs India Pvt Limited
Office: 200 Feet Road, Kolathur, Chennai – 600 099.
Ph.: 91-44-37177172, Fax: 91-44-37177220.
Email: sales@aquadesigns.in Web site: www.aquadesigns.in

	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

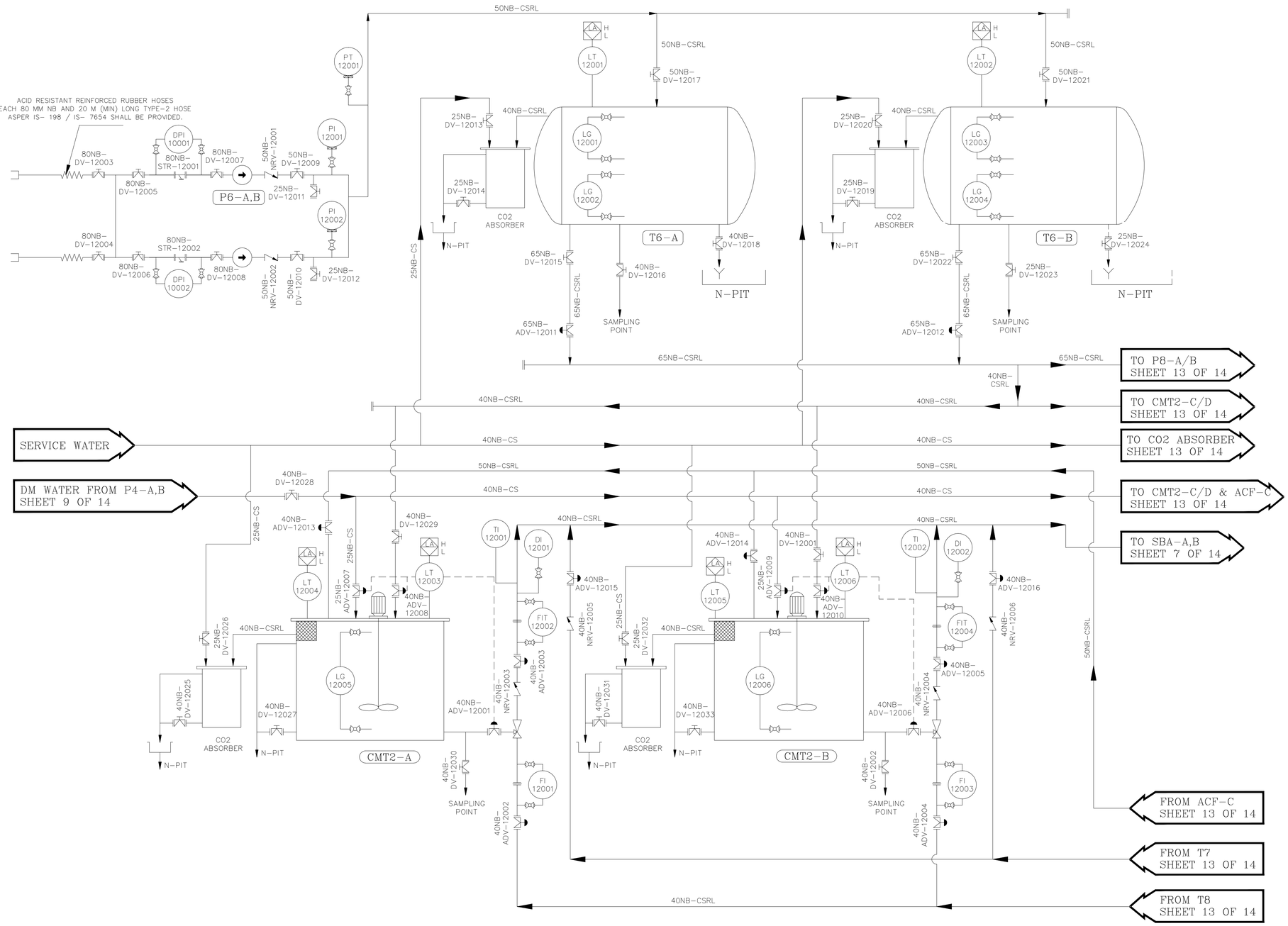
TITLE : P&ID FOR DM-PLANT (SHEET 11 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 REV. '1'

BULK CAUSTIC SYSTEM



LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY.
T6-A,B	BULK CAUSTIC STORAGE TANK	2 Nos.
P7-A,B	CAUSTIC UNLOADING PUMP	2 Nos(1W+1S).
CMT2-A,B	CAUSTIC MEASURING TANK-SBA	2 Nos.

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-12001 TO 12033
	AUTO DIAPHRAGM VALVE	ADV-12001 TO 12016
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-12001 TO 12006
	'Y' TYPE STRAINER	STR-12001 TO 12002
M	MOTORIZED GATE VALVE	MGV-XXXX TO XXXX
	MANUAL GATE VALVE	GV-XXXX

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

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Email: sales@aquadesigns.in. Web site:www.aquadesigns.in.

	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

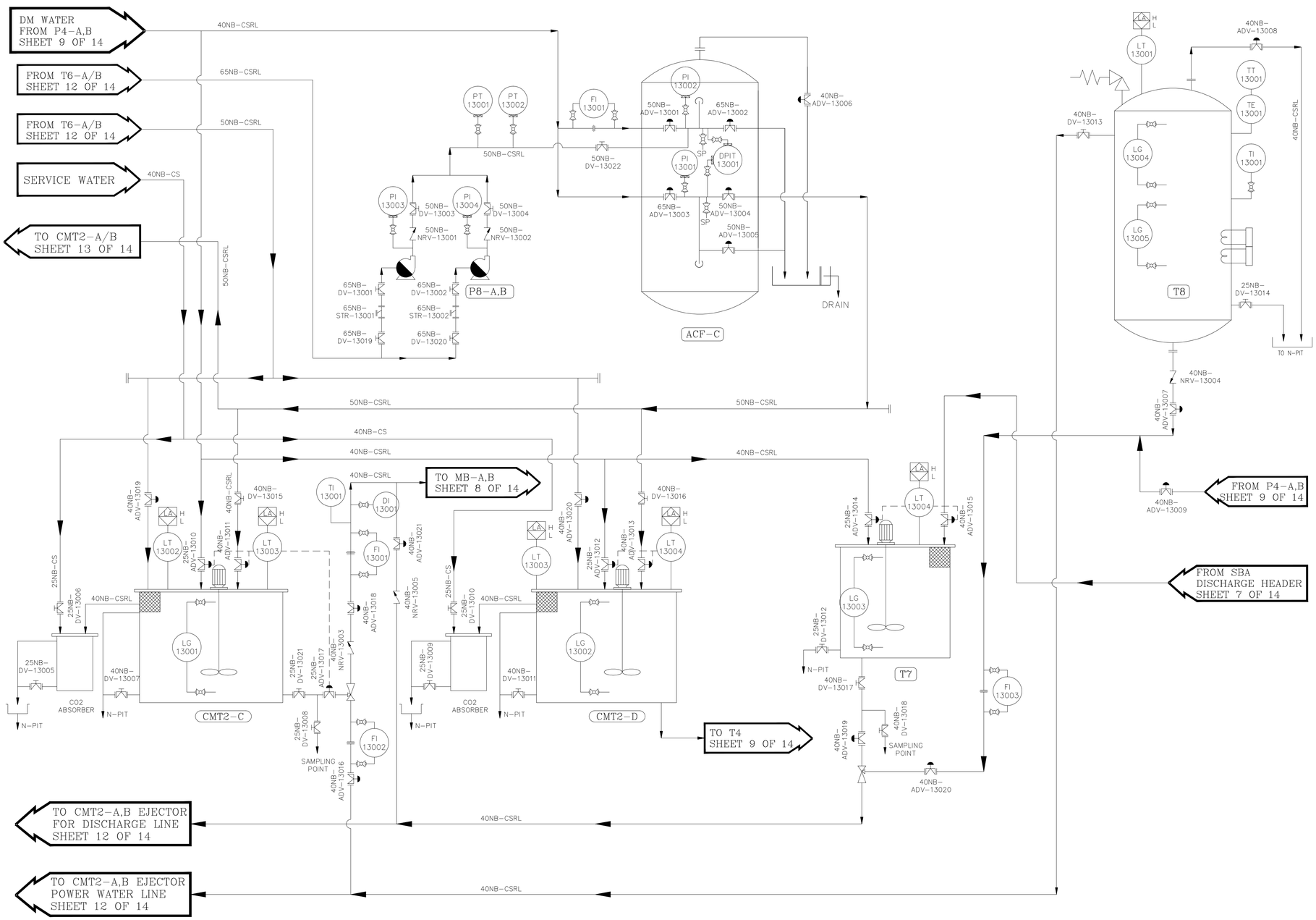
TITLE : P&ID FOR DM-PLANT (SHEET 12 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001
REV. '1'

BULK CAUSTIC SYSTEM



LIST OF EQUIPMENTS

T8	HOT WATER TANK	1 No.
CMT2-C	CAUSTIC MEASURING TANK-MB	1 No.
CMT2-D	CAUSTIC MEASURING TANK-N PIT	1 No.
P8-A,B	ALKALI TRANSFER CUM RECIRCULATION PUMP	2 Nos(1W+1S).
ACF-C	ACTIVATED CARBON FILTER	1 No.
T7	BRINE MEASURING TANK	1 No.

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-13001 TO 13022
	AUTO DIAPHRAGM VALVE	ADV-13001 TO 13021
	AUTO BUTTERFLY VALVE	ABFV-XXXX TO XXXX
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-XXXX TO XXXX
	NON RETURN VALVE	NRV-13001 TO 13005
	'Y' TYPE STRAINER	STR-13001 TO 13002
M	MOTORIZED GATE VALVE	MGV-XXXX TO XXXX
	MANUAL GATE VALVE	GV-XXXX

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
0			FOR APPROVAL	SK	SP	AJ	10.05.16

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1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

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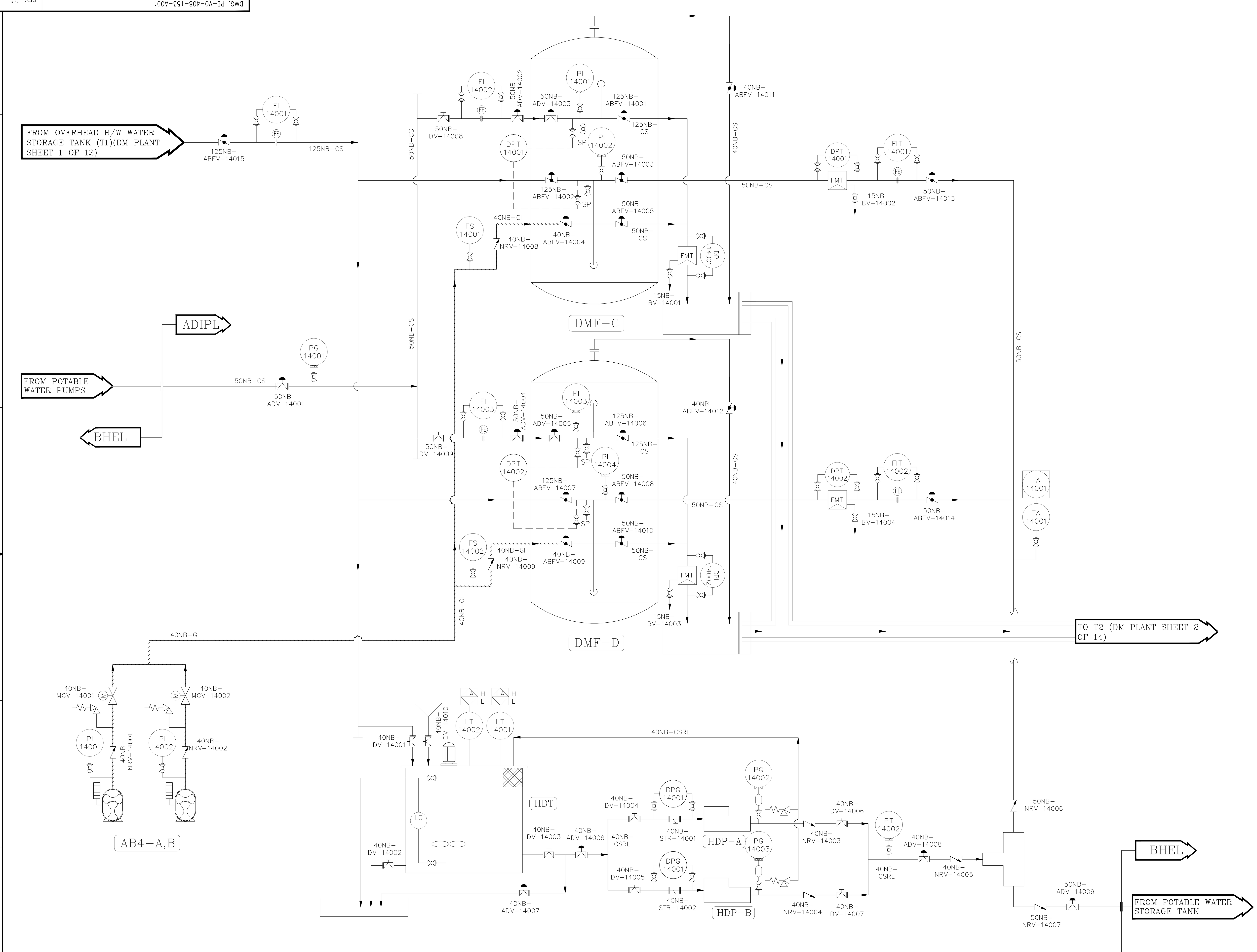
	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

TITLE : P&ID FOR DM-PLANT (SHEET 13 OF 14)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 NO. REV. '1'



LIST OF EQUIPMENTS

TAG	DESCRIPTION	QTY
HDT	HYPO DOSING TANK	1 No.
HDP-A,B	HYPO DOSING PUMP	2 Nos(1W+1S)
AB4-A,B	AIR BLOWER FOR DMF-C,D	2 Nos(1W+1S)
DMF-C,D	DUAL MEDIA FILTER	2 Nos(1W+1S)

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES	TAG NO.
	MANUAL DIAPHRAGM VALVE	DV-14001 TO 14010
	AUTO DIAPHRAGM VALVE	ADV-14001 TO 14009
	AUTO BUTTERFLY VALVE	ABFV-14001 TO 14015
	MANUAL BUTTERFLY VALVE	BFV-XXXX TO XXXX
	BALL VALVE	BV-14001 TO 14004
	NON RETURN VALVE	NRV-14001 TO 14009
	'Y' TYPE STRAINER	STR-14001 TO 14002
	MOTORIZED GATE VALVE	MGV-14001 TO 14002
	MANUAL GATE VALVE	GV-XXXX

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
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0			FOR APPROVAL	SK	SP	AJ	10.05.16

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1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

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BHARAT HEAVY ELECTRICALS LTD.

Aqua Designs India Pvt Limited

	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

TITLE : P&ID FOR POTABLE WATER PLANT (SHEET 14 OF 14)

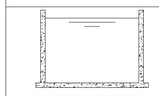
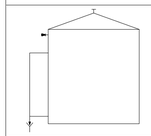
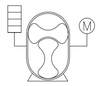
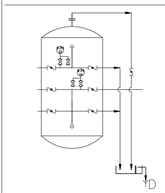
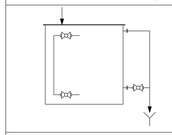
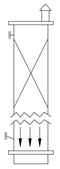
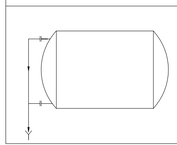
UNIT : SCALE : NTS BHEL DWG. NO. : PE-V0-408-153-A001 REV. 00

A1 (09-96) [841 x 594]

DWG. PE-V0-408-153-A001 NO.

REV. '1'

EQUIPMENT SYMBOL

	RCC TANK		CENTRIFUGAL PUMP
	STORAGE TANK		AIR BLOWER
	PRESSURE VESSELS		DOSING PUMP
			AGITATOR
	DOSING TANK		AIR VENT
	DEGASSER TOWER		TRENCH/DRAIN
			EJECTOR
	STORAGE TANK		CO2 ABSORBER

INSTRUMENT LEGENDS

FI	FLOW INDICATOR
FIT	FLOW INDICATOR CUM TRANSMITTER
FE	FLOW ELEMENT
PI/PG	PRESSURE INDICATOR / PRESSURE GAUGE
DPI/ DPG	DIFF. PRESSURE INDICATOR / DIFF. PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
DPT	DIFF. PRESSURE TRANSMITTER
DPS	DIFFERENTIAL PRESSURE SWITCH
LT	LEVEL TRANSMITTER
LG	LEVEL GAUGE
DI	DENSITY INDICATOR
pHT	pH TRANSMITTER
CC	CONDUCTIVITY COMPARATOR
CE	CONDUCTIVITY CELL
CT	CONDUCTIVITY TRANSMITTER
FS	FLOW SWITCH
TA	TURBITITY ANALYZER

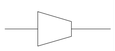
INSTRUMENT LEGENDS

RCA	RESIDUAL CHLORINE ANALYZER
SiA	SILICA ANALYSER
Na	SODIUM ANALYSER
TI	TEMPERATURE INDICATOR
TT	TEMPERATURE TRANSMITTER
TE	TEMPERATURE ELEMENT
LI	LEVEL INDICATOR

OTHER LEGENDS

SP	SAMPLING
FMT	FILTER MEDIA TRAP
RT	RESIN TRAP
M	MOTOR OPERATED

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	WATER SYSTEM
	OPEN DRAIN
	ECCCENTRIC REDUCER
	CONCENTRIC REDUCER
	FLANGED JOINT
	BLIND FLANGE
	DIAPHRAGM SEAL

SYMBOLS FOR MECHANICAL ITEMS

SYMBOLS	VALVES
	MANUAL DIAPHRAGM VALVE
	AUTO DIAPHRAGM VALVE
	AUTO BUTTERFLY VALVE
	MANUAL BUTTERFLY VALVE
	BALL VALVE
	NON RETURN VALVE
	'Y' TYPE STRAINER
	MOTORIZED GATE VALVE
	MANUAL GATE VALVE
	FLOAT OPERATED VALVE

NOTES:–

1) FLUSHING CONNECTIONS WITH VALVES SHALL BE PROVIDED FOR ALL THE PUMPS.
2) DIAPHRAGM SEALS WITH PRESSURE/DIFFERENTIAL MEASUREMENTS SHALL BE PROVIDED FOR ALL CORROSIVE/VISCOUS/SOLID BEARING/SLURRUY TYPE FLUID APPLICATIONS.
3) ALL SOLENOID OPERATED VALVES SHALL BE PROVIDED WITH SOLENOID VALVE, AIR LOCK RELAY ETC. AS REQUIRED BY PROCESS.
4) ALL THE TRANSMITTERS USED SHALL BE WITH DIAPHRAGM SEALS.

REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE
1			FOR APPROVAL	NS	SP	AJ	30.05.16
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GSECL

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

DEVELOPMENT CONSULTANTS PVT. LTD.
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	NAME	SIGN	DATE
DRN.	SK		10.05.16
CHD.	SP		10.05.16
APPD.	AJ		10.05.16

TITLE : P&ID FOR DM-PLANT (LEGENDS)

UNIT : | SCALE : NTS | BHEL DWG. NO. : PE-V0-408-153-A001 | REV. 00

A1 (09-96) [841 x 594]

PROCESS DESIGN & SIZING CALCULATIONS , RESIN DS, VESSEL THK etc

CLIENT

GUJARAT STATE ELECTRICITY CORPORATION LTD

PROCESS DESIGN & SIZING CALCULATIONS , RESIN DATASHEETS, VESSEL AND TANK THICKNESS & PRESSURE DROP CALCULATIONS FOR DM PLANT – 2 X 105 m3/hr AND POTABLE WATER SYSTEM – 2 x15 M3/HR

PREPARED BY

CONTRACTOR

	CLIENT :BHARAT HEAVY ELECTRICALS LIMITED END CLIENT: GUJARAT STATE ELECTRICITY CORPORATION LTD 1 X 800 MW WANAKBORI SUPER CRITICAL THERMAL POWER PROJECT CONSULTANT: DEVELOPMENT CONSULTANTS PVT.LTD DM PLANT ALONGWITH POTABLE WATER TREATMENT PLANT	

TITLE	**BASIC ENGINEERING PACKAGE**
OWNER	**BHEL –WANAKBORI**
CONTRACTOR	**M/s. AQUA DESIGNS INDIA PVT LTD**
PLANT	**DM PLANT ALONG WITH POTABLE WATER TREATMENT PLANT**
ADIPL JOB NO	**PLA 15001**
DOC NO	**PE-V0-408-163-A003**

REVISION STATUS					
1	**Approval**	**VB**	**PK**	**AJ**	**10.05.2016**
Rev. No	**Issued For**	**Prepared By**	**Checked By**	**Approved by**	**Date**

INDEX

Chapter 1 PROJECT INTRODUCTION

PROJECT DETAILS

a) END CLIENT – M/S. GUJARAT STATE ELECTRICITY CORPORATION LTD
b) CLIENT - M/S. BHARAT HEAVY ELECTRICALS LIMITED
c) CONTRACTOR – AQUADESIGNS INDIA PRIVATE LIMITED

The Scope of Work Includes Design, Engineering, Manufacture, fabrication, assembly, inspection & testing at Vendor's & Sub Vendor's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, properly packed for transportation, unloading/handling and storage at site, in site transportation, assembly, erection & Commissioning, trail run, preparation & Submission of " As built" drawings, site testing, carrying out performance guarantee tests at site and handover of DM Plant along with Potable Water Treatment Plant.

Chapter 2 PROCESS DESIGN BASIS

Water Source : Clarified Water from Pre Treatment Plant

Plant Capacity : 2 x105 m3/hr

INLET WATER CHARACTERISTICS:

S.NO	PARAMETER	UNIT	VALUE
1.	Ca as CaCO3	ppm	85
2.	Mg as CaCO3	ppm	94
3.	Sodium + Potassium as CaCO3	ppm	75
4.	Hydrogen (FMA) as CaCO3	ppm	NIL
5.	Iron in Solution	ppm	0.05
	Total Cations (Except iron) as CaCO3	ppm	254
6.	Bicarbonate as CaCO3	ppm	160
7.	Carbonate as CaCO3	ppm	NIL
8.	Hydroxide as CaCO3	ppm	NIL
9.	Sulphate as CaCO3	ppm	20
10.	Chloride as CaCO3	ppm	52
11.	Nitrate as CaCO3	ppm	22
12.	Phosphate as CaCO3	ppm	NIL
13.	Fluoride as CaCO3	ppm	NIL
	Total Anions as CaCO3	ppm	254
14.	Reactive Silica as SiO2	ppm	22
15.	Colloidal Silica	ppm	NIL
16.	Conductivity at 25 °C	µS/cm	440
17.	pH value at 25 °C		7.5-8
18.	Turbidity	NTU	Not to Exceed 15

TREATED WATER QUALITY:

S.NO	PARAMETER	UNIT	VALUE
	At the outlet of MB		
1.	Total Electrolyte	ppm	0.1 (Max)
2.	Reactive SiO2	ppm	<0.01 ppm of SiO_2
3.	Iron as Fe	ppm	Nil
4.	Free CO_2	ppm	Nil
5.	Total hardness	ppm	Nil
6.	pH value at 25 ^oC		6.8-7.2
7.	Conductivity	µS/cm	<0.1 at 25 ^oC
	At the outlet of SBA		
1.	SiO_2	ppm	<0.1 ppm of SiO_2
2.	Conductivity	µS/cm	<5 at 25 ^oC
	At the outlet of Degasser Tower		
1.	CO_2	ppm	<5
	At the outlet of SAC		
1.	Sodium	ppm as CaCO3	<1
2.	Hardness	ppm	Not Detectable
	At the outlet of DMF		
1.	TSS	ppm	<1

Chapter 3 PROCESS DESCRIPTION

The following are the major steps involved in the process.

Clarified water will be pumped from Clarified Water Reservoir (Located in pre-Treatment Plant Area) by 3 Nos (1W+2S) filter feed pumps to Dual media Filter

Dual Media Filter:

Clarified water will enter in to Dual Media Filters and Suspended Solids present in it will be removed.

Activated Carbon Filter:

Water from Dual media Filter enters the Activated Carbon Filter. Activated Carbon Filter will remove residual Chlorine present in the water.

Weak Acid Cation Exchanger (WAC):

Filtered water from Activated Carbon Filter will enter in to the Weak Acid Cation Exchanger where Temporary hardness ($HCO3^-$) will be removed.

Strong Acid Cation Exchanger (SAC):

Water from WAC is passed through the Strong Acid Cation Exchange unit for the removal of Cations. Cations Ca^{++}, Mg^{++}, Na^+, Fe^{++} and K^+ present in water get exchanged with H^+ ions. The resin will be exchanged as per the following reactions:

DURING SERVICE CYCLE:

$CaCl2 + R - H$ ------- > $R - Ca + HCl$

$MgCl_2 + R - H$ ------- > $R - Mg + HCl$

$CaSO_4 + R - H$ ------- > $R - Ca + H_2SO_4$

$MgSO_4 + R - H$ ------- > $R - Mg + H_2SO_4$

DURING REGENERATION CYCLE:

$R - Ca + HCl$ ------- > $R - H + CaCl_2$

$R - Mg + HCl$ ------- > $R - H + MgCl_2$

Treated Water from SAC that contains acids of Chloride, Sulphates and Bicarbonate, etc…. This water is then led to Degasser Tower where it enters at the top.
On exhaustion, Strong Acid Cation Exchanger unit is regenerated in Counter Current Mode with HCl in thoroughfare regeneration with WAC unit.

DEGASSER SYSTEM:

The degasser tower (DGT) is a packed column packed with PP rings. Air is forced from the bottom of the tower by centrifugal blowers, while the water flows down through the bed of PP rings. The carbonic acid present in the water splits up in to carbon dioxide gas and water.

This carbon dioxide gas is stripped off and escapes from the top of the tower. The degassed water is collected in the degassed water tank and is pumped and fed to the Weak Base Anion Unit.

In this unit the following reaction takes place.

H_2CO_3 ------- > $H_2O + CO_2$

WEAK BASE ANION EXCHANGE UNIT:

Degassed water from Degassed Water Storage tank is pumped to the Weak Base Anion Exchanger.Weak base anion will remove the EMA from the feed water and the treated water will be passed to SBA, the main purpose of the WBA is to reduce the load in the SBA and chemical consumption of the DM plant and it will help in maintaining the specific and surface flow rate within the range to increase the working of plant efficiency

STRONG BASE ANION:

WBA water is passed through the Strong Base Anion Exchange unit for the removal of Anions. Anions Cl^-, $SO4^{2-}$ and SiO_2^{2-} present in water get exchanged with OH^- ions. The resin will be exchanged as per the following reactions:

<u>DURING SERVICE CYCLE OF WBA & SBA:</u>

HCl + R – OH ------- > R – Cl + H2O

H2SO4 + R – OH ------- > R – SO4 + 2H2O

<u>DURING REGENERATION CYCLE OF WBA & SBA:</u>

R - Cl + NaOH ------- > R – OH + NaCl

R – SO4 + NaOH ------- > R – OH + Na2SO4

On exhaustion, Strong Base Anion Exchanger unit is regenerated in Counter Current Mode with NAOH in thoroughfare regeneration with WBA unit.

Hot Water tank with electrical heating arrangement is provided for heating the power water used for regeneration of SBA. This is to ensure the regeneration at elevated temperature for complete elution of silica from resin bed.

MIXED BED UNIT:

The slippage from Strong acid cation unit & Strong base anion Unit will be treated in Mixed Bed Unit which consists of mixture of Cation& Anion resins in the same vessel for fine polishing in order to achieve the required output water quality.

On exhaustion, mixed bed unit is regenerated using HCL and NaOH.

NEUTRALIZATION PIT

Neutralization pit shall be sized for holding the total regeneration effluent of DM plant for storage and neutralization of effluent.

Chapter 4 LIST OF EQUIPMENTS

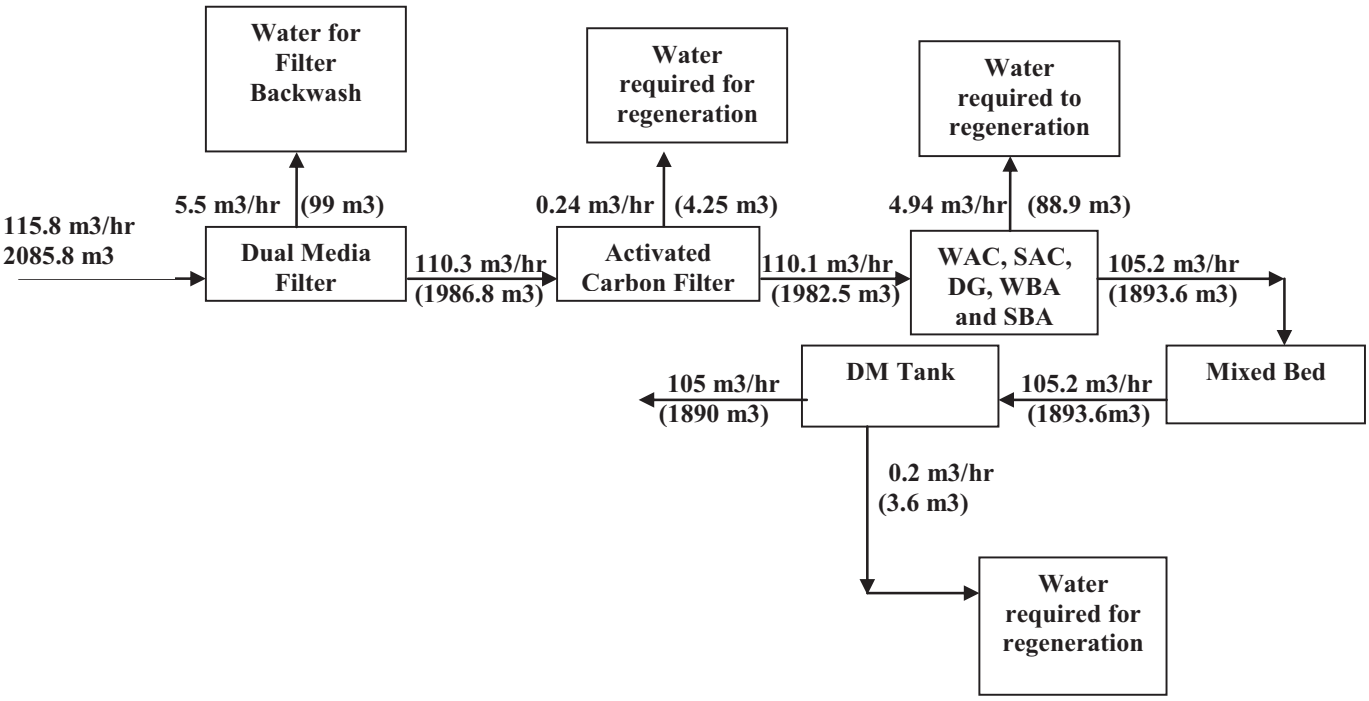
SL.NO	LIST OF EQUIPMENTS	DESCRIPTION	QUANTITY	MOC
1.	DM Feed Pump	120 m3/hr @ 50 mWC	3(1W+2S)	SS316
2.	Dual Media Pressure Filter	3.9 m Dia X 2.9 m Hos	2(1W+1S)	CSEP
3.	Air Blowers for Dual Media Pressure Filter	480 m3/hr @ 4000 mmWC	2(1W+1S)	CI
4.	Overhead Backwash Water Storage Tank	6 m (L) X 6 m (B) X 3 m (Ht) + 0.5 m (FB)	1 No	RCC
5.	Activated Carbon Filter	3.1 m Dia X 3.0 m Hos	2(1W+1S)	CSEP
6.	Weak Acid Cation Exchanger	1.9 m Dia X 2.0 m Hos	2(1W+1S)	CSRL
7.	Strong Acid Cation Exchanger	1.9 m Dia X 2.3 m Hos	2(1W+1S)	CSRL
8.	Degasser Tower	1.6 m Dia X 3.3 m Hos	2(1W+1S)	CSRL
9.	Degasser Air Blower per stream	2412 m3/hr @ 100 mmWC	2(1W+1S)	CI/CS
10.	Degassed Water Storage Tank	4.8 m (Dia) X 8.4 m (LOS)	2 Nos	CSRL
11.	Degassed Water Transfer Pump per stream	110 m3/hr @ 38 mWC	2(1W+1S)	SS316
12.	Weak Base Anion Exchanger	1.9 m Dia X 2.2 m Hos	2(1W+1S)	CSRL
13.	Strong Base Anion Exchanger	1.9 m Dia X 2.6 m Hos	2(1W+1S)	CSRL
14.	Mixed Bed Exchanger	1.6 m Dia X 2.1 m Hos	2(1W+1S)	CSRL
15.	Air Blower common for Mixed Bed & Neutralization Pit	390 m3/hr @ 4000 mmWC	2(1W+1S)	CI
16.	Regeneration Water	18 m3/hr @ 35 mWC	2(1W+1S)	SS316

	Transfer Pump			
17.	Acid Unloading Pump	15 m3/hr @ 20 mWC	2(1W+1S)	PP
18.	Bulk Acid Storage Tank	3.0 m Dia X 5.9 m Los	2 Nos	CSRL
19.	Acid Measuring Tank for SAC	1.3 m (Dia) X 1.25 m (Ht) + 0.2 m (FB)	2 Nos	CSRL
20.	Acid Measuring Tank for MB	0.8 m (Dia) X 0.8 m (Ht) + 0.2 m (FB)	1 No	CSRL
21.	Acid Measuring Tank for N-Pit	0.5 m (Dia) X 0.6 m (Ht) + 0.2 m (FB)	1 No	CSRL
22.	Caustic Unloading Pump	15 m3/hr @ 20 mWC	2(1W+1S)	SS316
23.	Bulk Caustic Storage Tank	2.2 m Dia X 3.3 m Los	2 Nos	CSRL
24.	Caustic Measuring Tank for SBA	1.0 m (Dia) X 1.2 m (Ht) + 0.3 m (FB)	2 Nos	CSRL
25.	Caustic Measuring tank for MB	0.8 m (Dia) X 0.8 m (Ht) + 0.3 m (FB)	1 No	CSRL
26.	Caustic Measuring Tank for N-Pit	0.5 m (Dia) X 0.6 m (Ht) + 0.3 m (FB)	1 No	CSRL
27.	Activated Carbon Filter for Alkali	1.0 m Dia X 2.7 m Hos	1 No	CSRL
28.	Alkali Brine Solution Preparation Tank	2.6 m (Dia) X 3.1 m (Ht) + 0.3 m (FB)	1 No	CSRL
29.	Dilution Water Heater for Alkali (Hot Water Tank)	2.0 m Dia X 2.5 m Hos	1 No	SS316
30.	Heater	28 KW	2 No	
31.	Neutralization Pit	7.5 m (L) X 7.5 m (B) X 2.5 m (Ht) + 0.5 m (FB) (each compartment)	1 No (In two compartments)	RCC
32.	Neutralized Effluent Disposal Pumps for each compartment	40 m3/hr @ 48 mWC	2(1W+1S)	SS316
33.	Filter Backwash Sump	5.5 m (L) X 5.5 m (B) X 3 m (Ht) + 0.5 m (FB) (each compartment)	1No (In two compartments)	RCC
34.	Backwash Waste	50 m3/hr @ 41 mWC	2(1W+1S)	Ni

	Water Disposal Pump			CI/SS316
35.	Dual Media Filter	1.4 m Dia X 2.7 m Hos	2(1W+1S)	CSEP
36.	Air Blower for Dual Media Filter	62 m3/hr @ 3000 mmWC	2(1W+1S)	CI
37.	Sodium Hypochlorite Dosing tank	0.5 m (Dia) X 0.6 m (Ht) + 0.3 m (FB)	1 No	CSRL
38.	Sodium Hypochlorite Solution Dosing Pump	0-4 LPH	2(1W+1S)	CI
39.	Alkali Transfer Cum Recirculation Pump	10 m3/hr @ 20 mWC	2(1W+1S)	SS316

Chapter 5 MASS BALANCE

Mass balance in m3/hr and (m3/18 hr) basis



Chapter 6 PROCESS DESIGN & SIZING CALCUALTION

DEMINERALISATION PLANT			
DM FEED PUMPS			
1.	Quantity	3 (1W + 2S)	Nos
2.	Capacity required (Please Refer mass balance)	115.8	m3/hr
3.	Capacity provided	120	m3/hr
4.	Head	50 (please refer attached pressure drop calculation)	mWC
5.	Type	Horizontal Centrifugal	
	Material of Construction		
1.	Casing	SS-316	
2.	Impeller	SS-316	
3.	Rated Speed	1500	rpm
DUAL MEDIA PRESSURE FILTERS			
1.	Quantity	2 (1W+1S)	Nos
2.	Type	Vertical Cylindrical with dished ends	
3.	Gross Flow rate required (Please refer mass balance)	115.8	m3/hr
4.	Design Flow Rate	116	m3/hr
5.	Net Flow rate at the outlet of MB	105	m3/hr
6.	Design Surface Flow rate	10	M3/m2/hr
7.	Area of Filter	11.5	M2

8.	Diameter	3.844	M
9.	Diameter provided	3.9	M
10.	Area of Filter provided	11.94	m2
11.	Type of Filter Media	Bed of Graded Sand and Anthracite Supported over Graded Gravel.	
12.	Bed Depth	Anthracite 350, sand 750	mm
13.	Supporting media - Gravel	500	mm
14.	Total Bed Depth Provided	1600	mm
15.	Free Board	80	%
16.	Height of Filter	2880	mm
17.	Height of Filter Provided	2900	mm
18.	B/w Velocity	24	m/hr
19.	B/w Flow	287	m3/hr
20.	B/w Time	15	Min
21.	B/W Volume	72	m3
22.	Air Scoring Velocity	40	m/hr
23.	Air Blower Flow rate	478	m3/hr
24.	Material of Construction	CSEP	
25.	Design Inlet TSS	20 (minimum)	ppm
26.	Outlet TSS	Not more than 1.0	ppm

AIR BLOWER FOR DUAL MEDIA PRESSURE FILTERS			
1.	Quantity	2 (1W + 1S)	Nos
2.	Blower Velocity	40	m/hr
3.	Blower Capacity Required	= (area of filter * blower velocity) =11.94*40 =478	m3/hr
4.	Blower Capacity Provided	480	m3/hr
5.	Head	4000 (please refer attached pressure drop calculation)	mmWC
6.	Type	Rotary Twin Lobe Oil Free	
	Material of Construction		
1.	Casing	CI as per IS-210, Gr FG260	
2.	Lobe	CI as per IS-210, Gr, FG260	
OVERHEAD BACKWASH WATER STORAGE TANK			
1.	Quantity	1	No
2.	Type	Rectangular and overhead	
3.	Water required for DMF backwash	72	m3
4.	Water required for one Potable Water Plant DMF backwash	10	m3
5.	Capacity required for single backwash of one (1) no. Dual Media Filters of DM Plant + single backwash of two (2) nos. Dual Media Filters of Potable Water Treatment Plant + 20 % overall margin.	108	m3
6.	Material of Construction	RCC	
7.	Dimensions	6 m (L) X 6 m (B) X 3 m (Ht) + 0.5 m (FB)	
8.	**Scope**	**By BHEL**	

9.	Minimum pressure required for Backwash	15	mWC
10.	Minimum water level has to be maintained in the overhead tank	0.5	m
11.	Elevation of tank required to meet the required backwash pressure	14.5	mWC
ACTIVATED CARBON FILTERS			
1.	Quantity	2 (1W+1S)	Nos
2.	Type	Vertical Cylindrical with dished ends	
3.	Gross Flow rate (Please refer Mass Balance)	110.3	m3/hr
4.	Design Flow Rate	111	m3/hr
5.	Net Flow rate at the outlet of MB	105	m3/hr
6.	Design Surface Flow rate	15	M3/m2/hr
7.	Area of Filter	7.4	m2
8.	Diameter	3.07	M
9.	Diameter provided	3.1	M
10.	Area of Filter provided	7.54	m2
11.	Type of Filter Media	Activated Carbon	
12.	Bed Depth	Activated Carbon 1200, Support Gravel 450	mm
13.	Total Bed Depth Provided	1650	mm
14.	Free Board	80	%
15.	Height of Filter	2970	mm
16.	Height of Filter Provided	3000	mm
17.	B/w Velocity	9	m/hr
18.	B/w Flow	68	m3/hr
19.	B/w Time	15	Min

20.	B/W Volume	17	m3
21.	Material of Construction	CSEP	
WEAK ACID CATION EXCHANGER			
1.	Quantity	2 (1W+1S)	Nos
2.	Type	Vertical Cylindrical with dished ends	
3.	Gross Flow rate (Please refer Mass Balance)	110.1	m3/hr
4.	Design Flow Rate	110.1	m3/hr
5.	Net Flow rate at the outlet of MB	105	m3/hr
6.	Operating hours	18	hrs
7.	Net OBR	1890	M3
8.	Design surface flow rate	38.9	M3/m2/hr
9.	Internal Dia (Excluding Rubber lining) Provided (Please refer attached Annexure-1)	1900	mm
10.	Bed Depth (Please refer attached Annexure-1)	1094	mm
11.	Resin Volume (Please refer attached Annexure-1)	3100	Ltrs
12.	Type of Resin	Cross linked Polyacrylic Acid Containing Carboxylic Acid Functional group	
13.	Free Board	80	%
14.	Height Provided	2000	mm
15.	Material Of Construction	CSRL	

STRONG ACID CATION EXCHANGER			
1.	Quantity	2 (1W+1S)	Nos
2.	Type	Vertical Cylindrical with dished ends	
3.	Gross Flow rate (Please refer Mass Balance)	110.1	m3/hr
4.	Design Flow Rate	110.1	m3/hr
5.	Net Flow rate at the outlet of MB	105	m3/hr
6.	Operating hours	18	hrs
7.	Net OBR	1890	M3
8.	Design surface flow rate	38.9	M3/m2/hr
9.	Internal Dia (Excluding Rubber lining) Provided (Please refer attached Annexure-1)	1900	mm
10.	Bed Depth (Please refer attached Annexure-1)	Effective Bed Depth 1138, Inert Bed Depth 150	mm
11.	Resin Volume (Please refer attached Annexure-1)	3225	Ltrs
12.	Inert resin	425	Ltrs
13.	Type of Resin	Strongly Acidic Polystyrene Resin with DBV cross linking	
14.	Free Board	80	%
15.	Height Provided	2400	mm
16.	Material Of Construction	CSRL	

DEGASSER TOWER			
1.	Quantity	2 (1W+1S)	Nos
2.	Gross Flow rate (Please refer Mass Balance)	110.1	m3/hr
3.	Design Flow Rate (120% of gross flow)	132	m3/hr
4.	Net Flow Rate at the outlet of MB	105	m3/hr
5.	Maximum and minimum capacity	20 % and 120 %	
6.	Surface Flow rate	60	m/hr
7.	Area required	2.2	m2
8.	Diameter Required	1.67	m
9.	Internal Dia (Excluding Rubber lining) Provided	1.7	M
10.	Packing Height	2.1	m
11.	Height of Tower with 50% free board	3.3	m
12.	Media Provided	PP Rings	
13.	Packing Volume/Tower	4.764	m3
14.	CO2 at the outlet of degasser tower	shall not be more than 5 ppm	
15.	Material of construction	CSRL	
DEGASSER AIR BLOWERS			
1.	Quantity	4 (1W + 1S for each stream)	Nos
2.	Type of Blower	Centrifugal, Oil free	
3.	Air Scouring Velocity	1200	m/hr
4.	Degasser Tower Area provided	2	M2
5.	Blower Capacity selected	2723	m3/hr

6.	Head	100 (please refer attached pressure drop calculation)	mmWC
	Material of Construction		
1.	Casing	CI/CS	
2.	Impeller	CI/CS	
DEGASSED WATER STORAGE TANK			
1.	Quantity	2 (1 No for Each stream)	Nos.
2.	Type	Horizontal Cylindrical with Dished Ends	
3.	Capacity with 20% margin (Please Refer annexure - 2 Table A.2.2)	175	m3
4.	Dimensions	4.8 m (Dia) X 8.4 m (LOS)	
5.	Material of Construction	CSRL	
DEGASSED WATER TRANSFER PUMPS			
1.	Quantity	4(1W + 1S for each stream)	Nos
2.	Capacity	110	m3/hr
3.	Head	38 (please refer attached pressure drop calculation)	mWC
4.	Type	Horizontal Centrifugal	
	Material of Construction		
1.	Casing	SS-316	
2.	Impeller	SS-316	
3.	Rated Speed	1500	rpm

WEAK BASE ANION EXCHANGER			
1.	Quantity	2 (1W+1S)	Nos
2.	Type	Vertical Cylindrical with dished ends	
3.	Gross Flow rate (Please refer Mass Balance)	110	m3/hr
4.	Design Flow rate	110	m3/hr
5.	Net Flow rate at the outlet of MB	105	m3/hr
6.	Operating hours	18	hrs
7.	Net OBR	1890	M3
8.	Design surface flow rate	38.9	M3/m2/hr
9.	Internal Dia (Excluding Rubber lining) Provided (Please refer attached Annexure-1)	1900	mm
10.	Bed Depth (Please refer attached Annexure-1)	1058	mm
11.	Resin Volume (Please refer attached Annexure-1)	3000	Ltrs
12.	Type of Resin	High Capacity macro porous polystyrene resin with DBV cross- linking and tertiary amine functional group having weak base capacity not less than 80%	
13.	Free Board	100	%
14.	Height Provided	2200	mm
15.	Material Of Construction	CSRL	

STRONG BASE ANION EXCHANGER			
1.	Quantity	2 (1W+1S)	Nos
2.	Type	Vertical Cylindrical with dished ends	
3.	Gross Flow rate (Please refer mass balance)	110	m3/hr
4.	Design Flow Rate	110	m3/hr
5.	Net Flow rate at the outlet of MB	105	m3/hr
6.	Operating hours	18	hrs
7.	Net OBR	1890	M3
8.	Design surface flow rate	38.9	M3/m2/hr
9.	Internal Dia (Excluding Rubber lining) Provided (Please refer attached Annexure-1)	1900	mm
10.	Bed Depth (Please refer attached Annexure-1)	Effective Bed Depth 1129, Inert bed Depth 150	mm
11.	Effective Resin Volume (Please refer attached Annexure-1)	3200	Ltrs
12.	Inert resin	425	Ltrs
13.	Type of Resin	High Capacity strongly basic Type-1 polystyrene resin with DBV cross linking and quaternary ammonium functional group.	
14.	Free Board	100	%
15.	Height Provided	2600	mm
16.	Material Of Construction	CSRL	

MIXED BED EXCHANGER			
1.	Quantity	2 (1W+1S)	Nos
2.	Type	Vertical Cylindrical with dished ends	
3.	Gross Flow rate (Please refer Mass Balance)	105.2	m3/hr
4.	Design Flow rate	105.2	m3/hr
5.	Net Flow rate at the outlet of MB	105	m3/hr
6.	Operating hours	126	hrs
7.	Net OBR	13230	M3
8.	Design surface flow rate	52.35	M3/m2/hr
9.	Internal Dia (Excluding Rubber lining) Provided (Please refer attached Annexure-1)	1600	mm
10.	Bed Depth (Please refer attached Annexure-1)	Cation Resin 510 & Anion Resin 510	mm
11.	Resin Volume (Please refer attached Annexure-1)	Cation Resin 1000 & Anion Resin 1000	Ltrs
12.	Type of Resin	Strongly Acidic Polystyrene Resin with DBV cross linking and High capacity strongly basic Type-1 Polystyrene resin with DBV cross linking and quaternary ammonium functional group.	
13.	Free Board	100	%
14.	Height Provided	2100	mm
15.	Material Of Construction	CSRL	

AIR BLOWER COMMON FOR MIXED BED AND NEUTRALIZATION PIT			
1.	Quantity	2 (1W + 1S)	Nos
2.	Type of Blower	Rotary, Twin Lobe	
3.	Air required for MB	=Area of MB Vessel * 120(air scouring Velocity) = 2.01 * 120 = 242	m3/hr
4.	Air required for MB	242	m3/hr
5.	Air required for NPIT	0.5 times the volume of NPIT for mixing = (0.5*280) = 140	m3/hr
6.	Air required for NPIT	140	m3/hr
7.	Blower capacity required	382	m3/hr
8.	Blower Capacity provided	390	m3/hr
9.	Head	4000 (please refer attached pressure drop calculation)	mmWC
	Material of Construction		
1.	Casing	CI to IS210 FG 260	
2.	Lobes	CS to BS 970, EN9 Forged	
REGENERATION WATER TRANSFER PUMP			
1.	Quantity	2 (1W + 1S)	Nos
2.	Capacity	=Area of MB Vessel * 9(Backwash Velocity) = 2.01 * 9 = 18	m3/hr
3.	Capacity	18	m3/hr
4.	Head	35 (please refer attached pressure drop calculation)	mWC
5.	Type	Horizontal Centrifugal	
	Material of Construction		
1.	Casing	SS-316	

2.	Impeller	SS-316	
3.	Rated Speed	1500	rpm
ACID MEASURING TANK FOR SAC			
1.	Quantity	2	Nos
2.	Type	Vertical Cylindrical with flat bottom	
3.	Chemical per Regeneration (Please refer attached Annexure-I)	452	Kg
4.	Chemical available Concentration	30	%
5.	Specific Gravity @ Available Concentration	1.14	Kg/l
6.	Capacity required with 20 % margin	= (kg req per regeneration /Sp.gravity /concentration)+20% margin =(452/1.14/30%)*1.2 =1573	Litres
7.	Capacity provided with 20 % margin	1600	Litres
8.	Dimensions	1.3 m (Dia) X 1.25 m (Ht) + 0.3 m (FB)	
9.	Material of Construction	CSRL	
ACID MEASURING TANK FOR MB			
1.	Quantity	1	No
2.	Type	Vertical Cylindrical with flat bottom	
3.	Chemical per Regeneration (Please refer attached Annexure-I)	100	Kg
4.	Chemical available Concentration	30	%
5.	Specific Gravity @ Available	1.14	Kg/l

	Concentration		
6.	Capacity required with 20 % margin	= (kg req per regeneration /Sp.gravity /concentration)+20% margin =(100/1.14/30%)*1.2 =348	Litres
7.	Capacity provided with 20 % margin	400	Litres
8.	Dimensions	0.8 m (Dia) X 0.8 m (Ht) + 0.3 m (FB)	
9.	Material of Construction	CSRL	
ACID MEASURING TANK FOR NEUTRALIZATION PIT (WHEN WAC, WBA, SAC, SBA ALONE ARE IN REGENERATION)			
1.	Quantity	1	No
2.	Type	Vertical Cylindrical with flat bottom	
3.	HCL Excess eq difference (Please refer attached Annexure-I)	= Excess NaOH – Excess HCL =2347-2303	Eq
4.	Neutralizing Chemical per Regeneration	= Excess eq difference * 36.5/1000 =1.606	Kg
5.	Chemical available Concentration	30	%
6.	Specific Gravity @ Available Concentration	1.14	Kg/l
7.	Capacity required with 20 % margin	= (kg req per regeneration /Sp.gravity /concentration)+20% margin =(1.6/1.14/30%)*1.2 =4.63	Litres
8.	Capacity provided with 20% margin	100	Litres

9.	Dimensions	0.5 m (Dia) X 0.6 m (Ht) + 0.3 m (FB)	
10.	Material of Construction	CSRL	
BULK ACID STORAGE TANK			
1.	Quantity	2	Nos
2.	Type	Horizontal Cylindrical with dished ends, over ground	
3.	Cycle Time for SAC	18	Hours
4.	Cycle Time for MB Cation	126	Hours
5.	Storage period	21	days
6.	Storage period in hours	= (21*24) = 504	hours
7.	No. of cycles for SAC	= (504/18) = 28	Nos.
8.	No. of cycles for MB Cation	= (504/126) = 4	Nos.
9.	No. of cycles for N-Pit Acid Requirement for neutralization (during WAC,SAC, WBA and SBA regeneration alone)	= (504/18) = 28	Nos.
10.	Chemical Requirement for 23 Cycles for SAC	= (kg req per regeneration /Sp.gravity /concentration) * 28 =(452/1.14/30%)*28 =36.68	m3
11.	Chemical Requirement for 4 Cycles for MB Cation	= (kg req per regeneration /Sp.gravity /concentration) * 4 =(100/1.14/30%)*4 =1.17	m3
12.	Chemical Requirement for 23 Cycles for N-Pit Acid Requirement(during WAC,SAC, WBA and SBA	= (kg req per regeneration /Sp.gravity /concentration) * 28 =(1.6/1.14/30%)*28	m3

	regeneration alone)	=0.132	
13.	Capacity of tank with 20% margin	46	m3
14.	Dimensions	3.0 m (Dia) X 5.9 m (Los)	
15.	Material of Construction	CSRL	
ACID UNLOADING PUMP			
1.	Quantity	2 (1W + 1S)	Nos
2.	Capacity	15	m3/hr
3.	Head	20	mWC
4.	Type	Horizontal Centrifugal Non Clog	
	Material of Construction		
1.	Casing	PP	
2.	Impeller	PP	
3.	Rated Speed	1500	rpm
CAUSTIC MEASURING TANK FOR SBA			
1.	Quantity	2	Nos
2.	Type	Vertical Cylindrical with dished ends	
3.	Chemical per Regeneration (Please refer attached Annexure-I)	288	Kg
4.	Chemical available Concentration	30	%
5.	Specific Gravity @ Available Concentration	1.3	Kg/l
6.	Capacity required with 20 % margin	= (kg req per regeneration /Sp.gravity /concentration)+20% margin =(288/1.3/30%)*1.2	Litres

		=887	
7.	Capacity provided with 20 % margin	900	Litres
8.	Dimensions	1 m (Dia) X 1.2 m (Ht) + 0.3 m (FB)	
9.	Material of Construction	CSRL	
CAUSTIC MEASURING TANK FOR MB			
1.	Quantity	1	No
2.	Type	Vertical Cylindrical with dished ends	
3.	Chemical per Regeneration (Please refer attached Annexure-I)	100	Kg
4.	Chemical available Concentration	30	%
5.	Specific Gravity @ Available Concentration	1.3	Kg/l
6.	Capacity required with 20 % margin	= (kg req per regeneration /Sp.gravity /concentration)+20% margin =(100/1.3/30%)*1.2 =308	Litres
7.	Capacity provided with 20 % margin	400	Litres
8.	Dimensions	0.8 m (Dia) X 0.8 m (Ht) + 0.3 m (FB)	
9.	Material of Construction	CSRL	

CAUSTIC MEASURING TANK FOR NEUTRALIZATION PIT (WHEN WAC, WBA, SAC, SBA AND MB ARE IN REGENERATION)			
1.	Quantity	1	No
2.	Type	Vertical Cylindrical with dished ends	
3.	NaOH Excess Eq difference (Please refer attached Annexure-I)	= Excess NaOH– Excess HCL =((2303+2477)-(2124+2347)) = 309	Eq
4.	Neutralizing Chemical per Regeneration	= Excess Eq difference * 40/1000 =12.36	Kg
5.	Chemical available Concentration	30	%
6.	Specific Gravity @ Available Concentration	1.3	Kg/l
7.	Capacity required with 20 % margin	= (kg req per regeneration /Sp.gravity /concentration)+20% margin =(12.36/1.3/30%)*1.2 =38	Litres
8.	Capacity provided with 20 % margin	100	Litres
9.	Dimensions	0.5 m (Dia) X 0.6 m (Ht) + 0.3 m (FB)	
10.	Material of Construction	CSRL	
BULK CAUSTIC STORAGE TANK			
1.	Quantity	2	Nos
2.	Type	Horizontal Cylindrical with dished ends	
3.	Cycle Time for SBA	18	Hours
4.	Cycle Time for MB Anion	126	Hours

5.	Storage period	21	days
6.	Storage period in hours	=21*24 =504	hours
7.	No. of cycles for SBA	=504/18 =28	Nos.
8.	No. of cycles for MB Anion	=504/126 = 4	Nos.
9.	No. of cycles for N-Pit Alkali Requirement (during SBA,WBA,MB anion regeneration)	=504/126 = 4	Nos.
10.	Chemical Requirement for 23 Cycles for SBA	= (kg req per regeneration /Sp.gravity /concentration) * 28 =(288/1.5/48%)*28 =11.2	m3
11.	Chemical Requirement for 4 Cycles for MB Anion	= (kg req per regeneration /Sp.gravity /concentration) * 4 =(100/1.5/48%)*4 =0.56	m3
12.	Chemical Requirement for 4 Cycles for N-Pit Alkali Requirement(during SBA,WBA, MB regeneration)	= (kg req per regeneration /Sp.gravity /concentration) * 4 =(12.36/1.5/48%)*4 =0.068	m3
13.	Capacity of tank with 20% margin	14.2	m3
14.	Dimensions	2.2 m (Dia) X 3.3 m (Los)	
15.	Material of Construction	CSRL	

CAUSTIC UNLOADING PUMP			
1.	Quantity	2 (1W + 1S)	Nos
2.	Capacity	15	m3/hr
3.	Head	20	mWC
4.	Type	Horizontal Centrifugal Non Clog	
	Material of Construction		
1.	Casing	SS316	
2.	Impeller	SS316	
3.	Rated Speed	1500	rpm
ALKALI TRANSFER CUM RECIRCULATION PUMPS			
1.	Quantity	2(1W + 1S)	Nos
2.	Capacity	10	m3/hr
3.	Head	20	mWC
4.	Type	Horizontal Centrifugal Non-Clog	
	Material of Construction		
1.	Casing	SS316	
2.	Impeller	SS316	
3.	Rated Speed	1500	rpm
ACTIVATED CARBON FILTER FOR ALKALI SERVICE			
1.	Quantity	1	No
2.	Type	Vertical Cylindrical with dished ends	
3.	Flow rate	10	m3/hr
4.	Design Surface Flow rate	15	m3/m2/hr
5.	Area of Filter	0.67	m2

6.	Diameter	0.922	m
7.	Diameter provided	1	m
8.	Area of Filter provided	0.785	m2
9.	Type of Filter Media	Activated Carbon	
10.	Bed Depth	Activated Carbon 1200, Support Gravel 300	mm
11.	Total Bed Depth Provided	1500	mm
12.	Free Board	75	%
13.	Height of Filter	2625	mm
14.	Height of Filter Provided	2700	mm
15.	Material of Construction	CSRL	
ALKALINE BRINE SOLUTION PREPARATION TANK			
1.	Quantity	1	No
2.	Type	Vertical Cylindrical with flat bottom	
3.	Capacity	=5 Bed Volumes of SBA =(5*3.2) =16	
4.	Capacity	16	M3
5.	Dimensions	2.6 m (Dia) X 3.1 m (Ht) + 0.3 m (FB)	
6.	Material of Construction	CSRL	
DILUTION WATER HEATER FOR ALKALI (HOT WATER TANK)			
1.	Quantity	1	No
2.	Type	Vertical Cylindrical with dished ends. Heater-Immersion Coil	
3.	Bed Warming	=1 Bed Volume of SBA =(1*3625)	Litres

		=3625	
4.	Hot water required for Slow Rinse	=1 Bed Volume of SBA =(1*3625) =3625	Litres
5.	Capacity with 20% margin	=Bed Warming + Hot water required for slow rinse = (3625+3265)*1.2 =9000	Litres
6.	Capacity with 20% margin	9	m3
7.	Dimensions	2 m (Dia) X 2.5 m (Ht)	
8.	Mass of water (m)	= Volume * Density = 9*1000 =9000	kg
9.	Specific Heat (Cp)	4.184	KJ/Kg/K
10.	Temperature increase required (dt)	30 (from 10 degree to 40 degree)	Degree Celsius or K
11.	Heating time	=6 =21600	hrs secs
12.	Heat required	= mCpdt/t = 9000*4.184*30/21600 = 52.3	KW
13.	Heater KW with 95%	=52.3/0.95 = 55	KW
14.	Capacity provided	=2 X 50 % = 2 X 28	KW
15.	Material of Construction	SS316	

NEUTRALIZATION PIT			
1.	Quantity	1 with two compartments	No
2.	Type	Underground and Rectangular in Cross-Section	
3.	Capacity with 20% margin for each compartment (for detailed calculation, Please refer Table A.2.1)	140	m3
4.	Dimensions	7.5 m (L) X 7.5 m (B) X 2.5 m (Ht) + 0.5 m (FB)	
5.	Material of Construction	RCC	
6.	**Scope**	**By BHEL**	
NEUTRALIZED EFFLUENT DISPOSAL PUMP			
1.	Quantity	4 (1W + 1S for each compartment)	Nos
2.	Volume of effluent to be disposed	140	m3
3.	Operating hours	24	hrs
4.	Capacity required	= 140/24 =5.83	m3/hr
5.	Capacity provided with 20 % margin	40	m3/hr
6.	Head	48 (please refer attached pressure drop calculation)	mWC
7.	Type	Horizontal Centrifugal Non Clog	
	Material of Construction		
1.	Casing	SS316	
2.	Impeller	SS316	
3.	Rated Speed	1500	rpm

FILTER BACKWASH SUMP			
1.	Quantity	1 with two compartments	No
2.	Type	Rectangular with flat bottom	
3.	Water required for DMF backwash	72	m3
4.	Water required for one Potable Water Plant DMF backwash	10	m3
5.	Suitable to hold backwash waste generated from single backwash of one (1) number Dual Media Filter in a day plus 20% margin or 50 m^3 Whichever is higher.	90	m3
6.	Material of Construction	RCC	
7.	Dimensions	5.5 m (L) X 5.5 m (B) X 3 m (Ht) + 0.5 m (FB)	
8.	**Scope**	**By BHEL**	
BACKWASH WASTE WATER DISPOSAL PUMP			
1.	Quantity	2(1W + 1S)	Nos
2.	Capacity	50	m3/hr
3.	Head	41 (please refer attached pressure drop calculation)	mWC
4.	Type	Vertical Centrifugal Non Clog	
	Material of Construction		
1.	Casing	Ni Hard CI as per ASTM 532	
2.	Impeller	Ni Hard CI as per ASTM 532	
3.	Rated Speed	1500	rpm

POTABLE WATER TREATMENT PLANT			
DUAL MEDIA FILTER			
1.	Quantity	2 (1W+1S)	Nos
2.	Type	Vertical Cylindrical with dished ends	
3.	Flow rate	15	m3/hr
4.	Design Surface Flow rate	10	M3/m2/hr
5.	Design Inlet Turbidity	15	NTU
6.	Design Outlet Turbidity	Not more than 1	NTU
7.	Area of Filter	1.5	M2
8.	Diameter	1.382	M
9.	Diameter provided	1.4	M
10.	Area of Filter provided	1.5386	m2
11.	Type of Filter Media	Bed of Graded Sand and Anthracite Supported over Graded Gravel.	
12.	Bed Depth	Anthracite 350, sand 750	mm
13.	Supporting media - Gravel	350	mm
14.	Total Bed Depth Provided	1450	mm
15.	Free Board	80	%
16.	Height of Filter	2610	mm
17.	Height of Filter Provided	2700	mm
18.	B/w Velocity	24	m/hr
19.	B/w Flow	37	m3/hr
20.	B/w Time	15	Min
21.	B/W Volume	10	m3
22.	Air Scoring Velocity	40	m/hr

23.	Air Blower Flow rate	62	m3/hr
24.	Material of Construction	CSEP	
AIR BLOWER FOR DUAL MEDIA PRESSURE FILTERS			
1.	Quantity	2 (1W + 1S)	Nos
2.	Blower Velocity	40	m/hr
3.	Blower Capacity	62	m3/hr
4.	Head	3000	mmWC
5.	Type	Rotary Twin Lobe Oil Free	
	Material of Construction		
1.	Casing	CI as per IS-210, Gr FG260	
2.	Lobe	CI as per IS-210, Gr, FG260	
SODIUM HYPOCHLORITE SOLUTION DOSING PUMP			
1.	Quantity	2(1W+1S)	Nos
2.	Type of Pump	Metering Pump	
3.	Water Flow rate	15	m3/hr
4.	Dosage ppm	3	ppm
5.	Dosage Rate	0.009	Kg/hr
6.	Specific Gravity	1.1	Kg/l
7.	Dosage Rate at 100%	= Dosage Rate/Specific gravity = 0.009/1.1 = 0.0086	LPH
8.	Dosing Rate at10%	=Dosage Rate at 100%/10% concentration =0.0086/10% =0.086	LPH
9.	Pump Capacity Provided	0-4	LPH
	Material of Construction		

1.	All wetted parts	CI to IS210 FG 260	
2.	Casing	CI as per IS-210, Gr. FG 260	
3.	Speed	1500	rpm
SODIUM HYPOCHLORITE DOSING TANK			
1.	Quantity	1	No.
2.	Type	Vertical Cylindrical With flat bottom	
3.	Retention Time	30	Days
4.	Capacity required	=Dosing Rate at 10% * 30 *24 =0.086*30*24 =62	Ltrs
5.	Capacity Provided	100	Ltrs
6.	Dimensions	0.5 m (Dia) X 0.6 m (Ht) + 0.3 m (FB)	
7.	Material of Construction	CSRL	

Chapter 7

RESIN DATASHEETS

LIST OF RESIN

S.NO	RESIN NAME	RESIN MODEL
1	WEAK ACID CATION	Purolite® C104Plus
2	STRONG ACID CATION	Purolite® C100
3	WEAK BASE ANION	Purolite® A100Plus
4	STRONG BASE ANION	Purolite® A400
5	MB - CATION	Purolite® C100
6	MB - ANION	Purolite® A400

Purolite® C104NaPlus

PRODUCT DATA SHEET

Porous Weak Acid Cation Exchange Resin

Typical Physical and Chemical Characteristics

Application	Softening of Water & Aqueous Organic Solutions - High Capacity
Polymer Structure	Porous crosslinked polyacrylic
Appearance	Spherical Beads
Functional Group	Carboxylic Acid
Ionic Form as Shipped	Na^+
Total Capacity (min.)	4.5 eq/l (98.3 Kgr/ft^3 (H^+ form))
Moisture Retention	45 - 55 % (H^+ form)
Particle Size Range	300 - 1600 µm
<300 µm (max.)	1 %
Reversible Swelling, $H^+ \rightarrow Ca^{2+}$ (max.)	20 %
Reversible Swelling, $H^+ \rightarrow Ca^{2+}$ (operating)	7 % (approx.)
Reversible Swelling, $H^+ \rightarrow Na^+$ (max.)	70 %
Specific Gravity	1.23
Shipping Weight (approx.)	770 - 810 g/l (48.1 - 50.6 lb/ft^3)
Temperature Limit	120°C (250°F)

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Purolite® C100C

PRODUCT DATA SHEET

Gel Strong Acid Cation Resin - Sodium Form

Purolite C100C is a high capacity, bead-form, conventional gel polystyrene sulfonate cation-exchange resin, used in industrial softening and demineralization applications. It is ideally suited for use at higher than average flow rates, or in any situation where lower than average pressure loss is necessary. Its high bead integrity, excellent chemical and physical stability, and low extractibles content play a large part in its successful employment in these areas. **Purolite C100C** is suitable for use in coflow operated plants and also in conventional counterflow systems.

Typical Physical and Chemical Characteristics

Application	Demineralization
Polymer Structure	Gel polystyrene crosslinked with divinylbenzene
Appearance	Spherical beads
Functional Group	Sulfonic acid
Ionic Form as Shipped	Na^+
Total Capacity (min.)	2.0 eq/l (43.7 Kgr/ft^3) (Na^+ form)
Moisture Retention	44 - 48 % (Na^+ form)
Particle Size Range	425 - 1200 µm
<425 µm (max.)	2 %
Uniformity Coefficient (max.)	1.6
Reversible Swelling, $Na^+ \rightarrow H^+$ (max.)	8 %
Specific Gravity	1.29 (Na^+ form)
Shipping Weight (approx.)	800 - 840 g/l (50 - 52.5 lb/ft^3)
Temperature Limit	120°C (250°F)

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Purolite® A100Plus

PRODUCT DATA SHEET

Macroporous Weak Base Anion Exchange Resin

Purolite A100Plus is a macroporous polystyrenic weak base anion resin having tertiary amine functionality.It is designed to exhibit high operating capacity in removing strong acids formed after decationizing water through a strong acid cation resin like Purolite C100H. Because of its special porosity characteristics **Purolite A100Plus** shows excellent properties for removal of naturally occurring organic species from waters along with superior elution efficiency of the organics during regeneration. **Purolite A100Plus** also shows excellent resistance to osmotic shock as well as being physically resistant to mechanical breakage. Regeneration with caustic soda requires only 125% of the stoichiometric equivalent when related to the ionic loading on the resin at the exhaustion point. The rinse characteristics are good and minimum volumes of decationized water are required to rinse down to a conductivity of 50 µS/cm.

Typical Physical and Chemical Characteristics

Application	Demineralization - Resistant to Organic Fouling
Polymer Structure	Macroporous Polystrene Crosslinked with Divinylbenzene
Appearance	Spherical beads
Functional Group	Tertiary Amine
Ionic Form as Shipped	Free Base
Total Capacity (min.)	1.3 eq/l (28.4 Kgr/ft^3) (Free Base form)
Moisture Retention	53 - 62 % (Cl^- form)
Particle Size Range	300 - 1200 µm
<300 µm (max.)	1 %
Uniformity Coefficient (max.)	1.7
Reversible Swelling, FB → Cl^- (max.)	25 %
Specific Gravity	1.04
Shipping Weight (approx.)	655 - 685 g/l (40.9 - 42.8 lb/ft^3)
Temp Limit, Cl^- Form	100°C (212°F)
Temp Limit, Free Base Form	60°C (140°F)

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Purolite® A400

PRODUCT DATA SHEET

Gel Type I Strong Base Anion Exchange Resin

Purolite A400 is a clear gel Type I strong-base anion exchanger with both high operating capacity and the ability to achieve low residual silica levels. Minimal quantities of caustic soda are required compared with those typical of the classical Type I (**Purolite A600**) quaternary ammonium structure based on polystyrene. It has a clear gel structure, showing excellent regeneration efficiency and rinse characteristics. **Purolite A400** functions well both in mixed bed and layered bed demineralizer systems, where specially tailored particle size ranges result in achieving or maintaining good separations. **Purolite A400** has exceptional physical stability for a conventional gel-type resin which permits a long life without the development of excessive pressure drop; it also shows good kinetics of exchange, enabling very low concentration levels of both strong and weak acid anions to be achieved at practical flowrates.

Typical Physical and Chemical Characteristics

Application	Regeneration Efficient Demineralization / Silica Removal
Polymer Structure	Gel polystyrene crosslinked with divinylbenzene
Appearance	Spherical beads
Functional Group	Type I Quaternary Ammonium
Ionic Form as Shipped	Cl^-
Total Capacity (min.)	1.3 eq/l (28.4 Kgr/ft^3) (Cl^- form)
Moisture Retention, Cl^- Form	48 - 54 %
Particle Size Range	300 - 1200 µm
<300 µm (max.)	1 %
Uniformity Coefficient (max.)	1.7
Reversible Swelling, $Cl^- \rightarrow OH^-$ (max.)	20 %
Specific Gravity	1.08
Shipping Weight (approx.)	680 - 715 g/l (42.5 - 44.7 lb/ft^3)
Temp Limit, Cl^- Form	100°C (212°F)
Temp Limit, OH^- Form	60°C (140°F)

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Chapter 8 VESSEL AND TANK THICKNESS CALCULATION

LIST OF VESSELS AND TANKS

S.NO.	VESSEL/TANK NAME
1	DMF VESSEL-A,B
2	ACF VESSEL-A,B
3	WAC VESSEL-A,B
4	SAC VESSEL-A,B
5	DG TOWER-A,B
6	DG STORAGE TANK-T3-A,B
7	WBA VESSEL-A,B
8	SBA VESSEL-A,B
9	MB VESSEL-A,B
10	BULK ACID TANK-T5-A,B
11	BULK CAUSTIC TANK-T6-A,B
12	BMT-T7
13	HOT WATER TANK-T8
14	ACF-ALKALI-C
15	POTABLE DMF-C,D

Vessel Design for DMF(A,B)

Client :	BHEL						07.05.2016
Project	0						
Equipment :	DMF						
Size :	3900	mm Dia		2000	mm LOS		
Design Calculation as per ASME VIII-D1 :-							
Design Data :			Material Data:-				
Design Pressure Kg/cm2 (P)		5.75	Allowable stress in Kg/mm^2 at -- Room temp.=				14.072
Operating Pressure Kg/cm^2. max		5			at --Design temp.=		14.072
Design Temp. Deg. Cel.		65	Material:-				
Corrosion Allowance, mm (CA)		2	--Shell =	IS2062			
Radiography			--Dish =	IS 2002			
Joint Efficiency (Shell) , J		0.85					
Joint Efficiency (Dish) , J		1	(milltolerance (MT) 0.3 mm)				
Calculation for Shell thickness;-			Calculated minimum thickness(in mm)				
Shell inside Dia, mm (Di)		3900		Ts = P * R			9.45
Shell inside rADIUS, mm (R)		1950			((S*E)- (0.6 *P))		
Allowable stress, Kg/Cm^2 (S)		1400.0					
Joint efficiency, (E)		0.85	Required minimum thickness			=	Ts+CA+MT
Corrosion allowance, mm (CA)		2				=	11.700
			Provided minimum thickness			=	12.00
Calculation for Dish Thickness:							
Dish O/D mm DO		3928		Calculated min. thickness(in mm) :-			
Dish I/D , mm D		3900		Td = P * D * M			8.012
				(2 * S * E)-(0.2 * P)			
				Required min.thickness		=	Td+CA+MT+TA
Allowable stress ,Kg/mm^2 (S)		1400.0		Provided min. Thickness		mm	12.312
Joint efficiency, (E)		1					
Corr.Allowance, mm (CA)		2		Provided thickness		mm	14
Factor 'M' (1 for SE 1.54 for tori)		1					
Thinning Allowance mm (TA)		2					
Milling Tolerance mm (MT)		0.30					
Prepared by_____				Approved by_____			

Vessel Design for ACF (A,B)

Client : WANAKBORI 07.05.2016

Project : 0

Equipment : ACF

Size : 3100 mm DIA 3000 mm HOS

Design Calculation as per ASME VIII-D1 :-

Design Data :

Design Pressure Kg/cm^2	5.75
Operating Pressure Kg/cm^2. Max	5
Design Temp. Deg. Cel.	65
Corrosion Allowance, C mm	2
Radiography	
Joint Efficiency (Shell) , J	0.85
Joint Efficiency (Dish) , J	1

Material Data:-

Allowable stress in Kg/mm^2 at -- Room temp.= 14.072

at --Design temp.= 14.072

Material:-

--Shell = IS2062

--Dish = IS 2002

(milltolerance 0.3 mm)

Calculation for Shell thickness;-

Shell inside Dia, mm (Di)	3100
Shell inside rADIUS, mm (R)	1550
Allowable stress, Kg/Cm^2 (S)	1407.2
Joint efficiency, (E)	0.85
Corrosion allowance, mm (CA)	2

Calculated minimum thickness(in mm)

$$Ts = \frac{P * R}{((S*E) - (0.6 * P))} = 7.47$$

Required minimum thickness = Ts+CA+MT = 9.723

Provided minimum thickness = 10.00

Calculation for Dish Thickness:

Dish O/D mm DO	3124
Dish I/D , mm D	3100
Allowable stress ,Kg/mm^2 (S)	1407.2
Joint efficiency, (E)	1
Corr.Allowance, mm (CA)	2
Factor 'M' (1 for SE 1.54 for tori)	1
Thinning Allowance mm (TA)	2
Milling Tolerance mm (MT)	0.30

Calculated min. thickness(in mm) :-

$$Td = \frac{P * D * M}{(2 * S * E) - (0.2 * P)} = 6.336$$

Required min.thickness = Td+CA+MT+TA

Provided min. Thickness mm 10.636

Provided thickness mm 12

Prepared by _____ Aproved by _____

VESSEL DESIGN FOR WAC(A,B)

Client : WANAKBORI 07.05.2016

Project : 0

Equipment : WAC

Size : **1900** mm DIA **2000** mm HOS

Design Calculation as per ASME VIII-D1 :-

Design Data :		**Material Data:-**	
Design Pressure Kg/cm^2	**5.75**	**Allowable stress in Kg/mm^2 at -- Room temp.=**	**14.072**
Operating Pressure Kg/cm^2. Max	**5**	**at --Design temp.=**	**14.072**
Design Temp. Deg. Cel.	**65**	**Material:-**	
Corrosion Allowance, C mm	**0**	**--Shell = IS2062**	
Radiography		**--Dish = IS 2002**	
Joint Efficiency (Shell) , J	**0.7**		
Joint Efficiency (Dish) , J	**1**	**(milltolerance 0.3mm)**	

Calculation for Shell thickness;-

Shell inside Dia, mm (Di)	**1900**	**Calculated minimum thickness(in mm)**		
Shell inside rADIUS, mm (R)	**950**	**Ts = P * R / ((S*E)- (0.6 *P))**		**5.56**
Allowable stress, Kg/Cm^2 (S)	**1407.2**			
Joint efficiency, (E)	**0.7**	**Required minimum thickness**	**=**	**Ts+CA+MT**
Corrosion allowance, mm (CA)	**0**		**=**	**5.815**
		Provided minimum thickness	**=**	**6.00**

Calculation for Dish Thickness:

Dish O/D mm DO	**1916**	**Calculated min. thickness(in mm) :-**		
Dish I/D , mm D	**1900**	**Td = P * D * M / (2 * S * E)-(0.2 * P)**		**3.883**
		Required min.thickness	**=**	**Td+CA+MT+TA**
Allowable stress ,Kg/mm^2 (S)	**1407.2**	**Provided min. Thickness mm**		**6.183**
Joint efficiency, (E)	**1**			
Corr.Allowance, mm (CA)	**0**	**Provided thickness mm**		**8**
Factor 'M' (1 for SE 1.54 for tori)	**1**			
Thinning Allowance mm (TA)	**2**			
Milling Tolerance mm (MT)	**0.30**			

Prepared by_____ Aproved by_____

VESSEL DESIGN FOR SAC (A,B)

Client : WANAKBORI 07.05.2016

Project : 0

Equipment : SAC

Size : 1900 mm DIA 2300 mm HOS

Design Calculation as per ASME VIII-D1 :-

Design Data :		Material Data:-	
Design Pressure Kg/cm^2	5.75	Allowable stress in Kg/mm^2 at -- Room temp.=	14.072
Operating Pressure Kg/cm^2. Max	5	at --Design temp.=	14.072
Design Temp. Deg. Cel.	65	Material:-	
Corrosion Allowance, C mm	0	--Shell = IS2062	
Radiography		--Dish = IS 2002	
Joint Efficiency (Shell) , J	0.7		
Joint Efficiency (Dish) , J	0.7	(milltolerance 0.3mm)	

Calculation for Shell thickness;-

Shell inside Dia, mm (Di)	**1900**	**Calculated minimum thickness(in mm)**
Shell inside rADIUS, mm (R)	**950**	**Ts = P * R / ((S*E)- (0.6 *P))** = **5.56**
Allowable stress, Kg/Cm^2 (S)	**1407.2**	
Joint efficiency, (E)	**0.7**	**Required minimum thickness = Ts+CA+MT**
Corrosion allowance, mm (CA)	**0**	**= 5.815**
		Provided minimum thickness = 6.00

Calculation for Dish Thickness:

Dish O/D mm DO	**1916**	**Calculated min. thickness(in mm) :-**
Dish I/D , mm D	**1900**	**Td = P * D * M / (2 * S * E)-(0.2 * P)** = **5.577**
		Required min.thickness = Td+CA+MT+TA
Allowable stress ,Kg/mm^2 (S)	**1400.0**	**Provided min. Thickness mm** **7.877**
Joint efficiency, (E)	**0.7**	
Corr.Allowance, mm (CA)	**0**	**Provided thickness mm** **8**
Factor 'M' (1 for SE 1.54 for tor	**1**	
Thinning Allowance mm (TA)	**2**	
Milling Tolerance mm (MT)	**0.30**	

Prepared by_____ Aproved by_____

WANAKBORI

DESIGN CALCULATIONS FOR
DEGASSER TOWER

CLIENT	:	**BHEL**
LOCATION	:	**Wanakbori**
PLANT	:	**DM-Plant**
SERVICE	:	**DEMINERALISED WATER**

ISSUED FOR: **Approval**
Rev / Date: **Rev 0 / 09.05.2016**
DESIGN CODE: **IS 803**

DESIGN DATA :		**Unit**	
DESIGN PRESSURE	p,	$KG/CM^2(G)$	= ATMOSPHERIC
DESIGN TEMPERATURE	T,	°C	= 60
OPERATING PRESSURE		$KG/CM^2(G)$	ATMOSPHERIC
OPERATING TEMPERATURE		°C	Ambient
TEST PRESSURE		$KG/CM^2(G)$	= FULL OF WATER
CORROSION ALLOWANCE	CA,	MM	= 0
RADIOGRAPHY			= NIL
JOINT EFFECIENCY	E,		= 0.70
CAPACITY - MAXIMUM ,		M^3	= 6.0
- NOMINAL ,		M^3	= 6.0
DESIGN SPECIFIC GRAVITY			
- FOR WATER	G,		= 1.00
TANK DIMENSIONS :			
INNER DIAMETER	D,	MM	= 1600
HEIGHT	H,	MM	= 3000
ROOF			= Flat roof
MATERIAL OF CONSTRUCTION :			
PLATE			= IS 2062 Gr.B
FLANGE			= IS 2062 Gr.B
PIPE			= **IS 1239 & IS 3589**
SUPPORTS			= IS 2062 Gr.B
GASKETS			= NATURAL RUBBER
STUDS/BOLTS& NUTS			= IS 1367

DESIGN CALCULATION :

A) BOTTOM PLATE THICKNESS :

As per IS 803 Cl.No.6.2.1(a)

Minimum bottom plate thickness required — MM = 6

Provided Bottom Plate Thickness — MM = 6

HENCE SAFE

B) SHELL PLATE THICKNESS

Minimum Shell Thickness , t (As per cl.No.B-4.1)

$$t = \frac{4.9 \times (H-0.3) \times D \times G}{SE} + CA$$

where,

t = Thickness Required in mm

D = Inner Diameter of Tank	M	= 1.6
H = Height of tank	M	= 3
G = Specific Gravity for Water		= 1.00
E = Weld Joint Effeciency		= 0.70
P = Design Pressure		= atmospheric
Se= Allowable Stress at Design Temp. of 50°C	N/MM^2	= 165
		= 165
CA=Corossion Allowanace	MM	= 0

1) For Operating Condition

(a) Minimum reqd thk as per Cl.No:6.3.3.1- Ist Course. — H = 3 M

$$t = \frac{4.9x\ (H - 0.3) \times 8 \times 1.00 + C.A}{165*0.7} \quad C.A = 0.0$$

MM = 0.15

Provided thickness — MM = **6**

HENCE SAFE

(a) Minimum reqd thk as per Cl.No:6.3.3.1- Ist Course.- Hydro test condiition

$$t = \frac{4.9x(\ H - 0.3\ ) \times D}{St} \quad H \text{ in mts} = 8.5$$

MM = 0.37

				Provided thickness		MM	=	6				
				HENCE SAFE								
	Hydrostatic Stress:											
	St = Allowable Stress						=	3/7 of Minimum Ultimate Tensile Strength				
	Ultimate Tensile Strength of IS 2062 Plates					N/MM^2	=	410				
	3/7 of Ultimate Tensile Strength						=	3 / 7 x 410				
						N/MM^2	=	175.71				
						t	=	4.9(H-0.3)xD/St				
								0.12				
	Provided thickness of bottom plate:					MM	=	6				
	HENCE SAFE											
	Design Verification of Stability of Shell Plates (As per Cl.No.6.3.3.6)											
	Maximum height of unstiffened Shell (H1)				in Mts		=	$\frac{1500 \times t}{P} \times \sqrt{\left(\frac{t}{D}\right)^3}$				
	where,						=	39.35		t	5	
	t = Shell thk , mm									p	145.00	
	D = Inner Diameter of Tank, m									D	6	
	P = External Pressure acting on Shell , KG/m²			P wind + P vac								
	Pwind = Wind Pressure , As per IS 875											
	P vac = Internal Vacuum ,(Which is negligible)											
	Maximum size of unstiffened shell is greater than the height of the tank :				H1> H							
	Hence wind Girder is not required.											
	P = External Pressure acting on Shell , KG/m²			P wind + P vac								
	Pwind = Wind Pressure , As per IS 875											
	P vac = Internal Vacuum ,(Which is negligible)						=	0.00				
	Wind Pressure (As per IS 875)											
	Design wind pressure at a height of 10 m						=	**0.06 x Vz²**				
	Design wind Speed (Vz) ,					M/S	=	**Vb x K1 x K2 x K3**				
	Basic Wind Speed (Vb)					M/S	=	39.00	(As per Client)		140.4	Km/hr
	Probabilty factor (Risk Co-efficient)					(K1)	=	1.08	(As per IS 875 -Part-3- clause 5.3.1)			
	Terrain, Height & Structure Size factor					(K2)	=	0.91	(As per IS 875 part-3-Clause 5.3.2.2)			
	(Terrain Category 3,Class A)											
	Topogarphy factor					(K3)	=	1	(As per IS 875 -Part-3, clause 5.3.3)			
	Design Wind Speed					(Vz)	=	39 x 1.08 x 0.91 x 1.				
						m/s	=	**38.33**				
	Design Wind Pressure- = 0.06 *Vz^2					(P wind)	=	88.15				
						KG/M^2	=	145.00				
	SUPPORTED CONICAL ROOF AS per Clause:6.4.1.1											
	Hence,Provided thk of Roof plate -				=	**6 mm**						
	FLAT roof is proposed - Considering Rubber lining and small size.											
	ROOF - CURB ANGLE											
	Minimum size of Roof Curb angle as per Cl.No.6.3.6.3(a)						=	65 x 65 x8 mm				
	Provided Curb angle						=	ISA 65 x 65 x8				
	HENCE SAFE											
	Wind load on the Tank:											
	Weight of shell plate+weight of curb angle+ weight of shell appertunances+weight of staircases+wt of stair case+wf of											
	roof plates+wt of roof structures+wt of crown plate= Weight of shell											
	where,									t	5	
	t = Shell thk , mm						=	285.74		p	145.00	
	D = Inner Diameter of Tank, m									D	1.6	
	P = External Pressure acting on Shell , KG/m²			P wind + P vac						h	3	
	Pwind = Wind Pressure , As per IS 875									L	3	
	P vac = Internal Vacuum ,(Which is negligible)											
										hr	0.33	
	Projected Area of the Cylindrical Surface: m2 : LxD(Tank shell)+ 1/2x Dxroofcone height.											
							=	L*D + 1/2 (D) hr				
							=	**5.064**	m2			
	As per Figure of 5: IS 875 part 3:Clause: 6.2.2.13.			Cf=0.5						Cf	0.5	
	Force Co efficient											
	Wind Force :	F =		Cf. A . Pd. (KG-m)						Cg	1.5	

		Height of Centre of gravity : Cg in Mts				F	=	367.14	KG-m			
		Over Turning Moment at the height of Centre of Gravity : F x Cg										
							=	550.71	KG-m			
		Ws: Weight of shell and roof										
										Ws	1500	
		Restoring Moment of tank : Weight of shell with roof X Dia of tank/2										
							=	1200	KG-m			
		As per IS 875 -Part 5 Clause : 8.1 :										
		Where dead load provides the restoring moment only 0.9 times the dead load shall be considered.										
		In this case :										
				Resultant Restoring moment is			=	0.9x Restoring moment				
							=	1080	KG-m			
		Since the Resultant Restoring moment is greater than the overturning moment. **Tank is Safe.**										
			ie 1080 > 550.71									
	HOWEVER WE ARE PROVIDING NOS OF M20 DIA x 100 MM LONG FOUNDATION BOLTS											
		(To be fixed on the Degassed water storage tank top)										

WANAKBORI

DESIGN CALCULATIONS FOR

Degassed Water Storage tank

Horizontal with dished ends

CLIENT	:	**BHEL**					ISSUED FOR		**Approval**			
LOCATION	:	**Wanakbori**										
PLANT	:	**DM-Plant**					Rev / Date		**Rev 0 / 06.05.2016**			
SERVICE	:	**Degassed water storage tank**					DESIGN CODE		**BS EN 12285-2**			
		DESIGN DATA :			**Unit**							
		DESIGN PRESSURE	p,	$KG/CM^2(G)$	=	ATMOSPHERIC						
		DESIGN TEMPERATURE	T,	°C	=	60						
		OPERATING PRESSURE		$KG/CM^2(G)$		ATMOSPHERIC						
		OPERATING TEMPERATURE		°C		Ambient						
		TEST PRESSURE		$KG/CM^2(G)$	=	FULL OF WATER						
		CORROSION ALLOWANCE	CA,	MM	=	0	Rubber lined					
		RADIOGRAPHY			=	NIL						
		JOINT EFFECIENCY	E,		=	0.70						
		CAPACITY - MAXIMUM ,		M^3	=	181.0						
		- NOMINAL ,		M^3	=	175.0						
		DESIGN SPECIFIC GRAVITY										
		- FOR WATER	G,		=	1.00						
		TANK DIMENSIONS :										
		INNER DIAMETER	D,	MM	=	4800						
		Length on Straight	LOS,	MM	=	8400						
		Type of Dished Ends			=	2:1, Semi ellipsoidal						
		MATERIAL OF CONSTRUCTION :										
		SHELL PLATE			=	IS 2062 Gr.B						
		DISHED ENDS			=	IS 2002						
		FLANGE			=	IS 2062 Gr.B						
		PIPE			=	**IS 1239 & IS 3589**						
		SUPPORTS			=	IS 2062 Gr.B						
		GASKETS			=	NATURAL RUBBER						
		STUDS/BOLTS& NUTS			=	IS 1367						
		DESIGN CALCULATION :										
		A) SHELL PLATE THICKNESS :										
		As per BS EN 12285- Table 3, Cl.No.4.3.6.1										
		Minimum shell plate thickness required		t	=	7	mm					
		Provided Shell Plate Thickness			=	8	mm					
		HENCE SAFE										
		B) DISHED END PLATE THICKNESS										
		Minimum Dished end plate Thickness , t (As per cl.No 4.3.6.1)		t	=	7	mm					
		Provided Dised End Plate Thickness			=	8	mm					
		HENCE SAFE										
		where,										
		t = Thickness Required in mm										
		D = Inner Diameter of Tank		M	=	4.8						
		L = Length on straight of tank		M	=	8.4						
		G = Specific Gravity for Water			=	1.00						
		E = Weld Joint Effeciency			=	0.70						
		P = Design Pressure			=	atmospheric						
		Se= Allowable Stress at Design Temp. of 50°C		N/MM^2	=	165						
					=	165						
		Saddle Supports :										
		Saddles shall be welded to the tank - (in accordance with clause: 4.9.2)										

VESSEL DESIGN FOR WBA (A,B)

Client :	WANAKBORI						07.05.2016
Project :	0						
Equipment :	WBA						
Size :	**1900**	mm DIA		**2200**	mm HOS		
Design Calculation as per ASME VIII-D1 :-							
Design Data :			**Material Data:-**				
Design Pressure Kg/cm^2		**4.5**	**Allowable stress in Kg/mm^2 at -- Room temp.=**				**14.072**
Operating Pressure Kg/cm^2.Max		**3.8**				**at --Design temp.=**	**14.072**
Design Temp. Deg. Cel.		**65**	**Material:-**				
Corrosion Allowance, C mm		**0**	**--Shell =**	**IS2062**			
Radiography			**--Dish =**	**IS2002**			
Joint Efficiency (Shell) , J		**0.7**					
Joint Efficiency (Dish) , J		**1**	**(milltolerance 0.3mm)**				
Calculation for Shell thickness;-			**Calculated minimum thickness(in mm)**				
Shell inside Dia, mm (Di)		**1900**		**Ts = P * R**			**4.35**
Shell inside rADIUS, mm (R)		**950**			**((S*E)- (0.6 *P))**		
Allowable stress, Kg/Cm^2 (S)		**1407.2**					
Joint efficiency, (E)		**0.7**	**Required minimum thickness**			**=**	**Ts+CA+MT**
Corrosion allowance, mm (CA)		**0**				**=**	**4.602**
			Provided minimum thickness			**=**	**6.00**
Calculation for Dish Thickness:							
Dish O/D mm DO		**1912**		**Calculated min. thickness(in mm) :-**			
Dish I/D , mm D		**1900**		**Td = P * D * M**			**3.039**
				(2 * S * E)-(0.2 * P)			
				Required min.thickness		**=**	**Td+CA+MT+TA**
Allowable stress ,Kg/mm^2 (S)		**1407.2**		**Provided min. Thickness**		**mm**	**5.339**
Joint efficiency, (E)		**1**					
Corr.Allowance, mm (CA)		**0**		**Provided thickness**		**mm**	**6.00**
Factor 'M' (1 for SE 1.54 for tori)		**1**					
Thinning Allowance mm (TA)		**2**					
Milling Tolerance mm (MT)		**0.30**					
Prepared by_____				Aproved by_____			

VESSEL DESIGN FOR SBA (A, B)

Client : WANAKBORI 07.05.2016

Project : 0

Equipment : SBA

Size : **1900** mm DIA **2600** mm HOS

Design Calculation as per ASME VIII-D1 :-

Design Data :		**Material Data:-**	
Design Pressure Kg/cm^2	**4.5**	**Allowable stress in Kg/mm^2 at -- Room temp.=**	**14.072**
Operating Pressure Kg/cm^2.Max	**3.8**	**at --Design temp.=**	**14.072**
Design Temp. Deg. Cel.	**65**	**Material:-**	
Corrosion Allowance, C mm	**0**	**--Shell = IS2062**	
Radiography		**--Dish = IS 2002**	
Joint Efficiency (Shell) , J	**0.7**		
Joint Efficiency (Dish) , J	**1**	**(milltolerance 0.3mm)**	

Calculation for Shell thickness;-

Shell inside Dia, mm (Di)	**1900**	**Calculated minimum thickness(in mm)**	
Shell inside rADIUS, mm (R)	**950**	**Ts = P * R / ((S*E)- (0.6 *P))**	**4.35**
Allowable stress, Kg/Cm^2 (S)	**1407.2**		
Joint efficiency, (E)	**0.7**	**Required minimum thickness =**	**Ts+CA+MT**
Corrosion allowance, mm (CA)	**0**	**=**	**4.602**
		Provided minimum thickness =	**6.00**

Calculation for Dish Thickness:

Dish O/D mm DO	**1912**	**Calculated min. thickness(in mm) :-**	
Dish I/D , mm D	**1900**	**Td = P * D * M / (2 * S * E)-(0.2 * P)**	**3.039**
		Required min.thickness =	**Td+CA+MT+TA**
Allowable stress ,Kg/mm^2 (S)	**1407.2**	**Provided min. Thickness mm**	**5.339**
Joint efficiency, (E)	**1**		
Corr.Allowance, mm (CA)	**0**	**Provided thickness mm**	**6**
Factor 'M' (1 for SE 1.54 for tori)	**1**		
Thinning Allowance mm (TA)	**2**		
Milling Tolerance mm (MT)	**0.30**		

Prepared by_____ Aproved by_____

VESSEL DESIGN FOR MB (A,B)

Client : WANAKBORI 07.05.2016

Project : 0

Equipment : MB

Size : 1600 mm DIA 2100 mm HOS

Design Calculation as per ASME VIII-D1 :-

Design Data :		Material Data:-	
Design Pressure Kg/cm^2	4.5	Allowable stress in Kg/mm^2 at -- Room temp.=	14.072
Operating Pressure Kg/cm^2. Max	3.8	at --Design temp.=	14.072
Design Temp. Deg. Cel.	65	Material:-	
Corrosion Allowance, C mm	0	--Shell = IS2062	
Radiography		--Dish = IS 2002	
Joint Efficiency (Shell) , J	0.7		
Joint Efficiency (Dish) , J	0.7	(milltolerance 0.3mm)	

Calculation for Shell thickness;-

Shell inside Dia, mm (Di)	**1600**	**Calculated minimum thickness(in mm)**
Shell inside rADIUS, mm (R)	**800**	**Ts = P * R / ((S*E)- (0.6 *P))** = **3.66**
Allowable stress, Kg/Cm^2 (S)	**1407.2**	
Joint efficiency, (E)	**0.7**	**Required minimum thickness = Ts+CA+MT**
Corrosion allowance, mm (CA)	**0**	**= 3.915**
		Provided minimum thickness = 6.00

Calculation for Dish Thickness:

Dish O/D mm DO	**1612**	**Calculated min. thickness(in mm) :-**
Dish I/D , mm D	**1600**	**Td = P * D * M / (2 * S * E)-(0.2 * P)** = **3.675**
		Required min.thickness = Td+CA+MT+TA
Allowable stress ,Kg/mm^2 (S)	**1400.0**	**Provided min. Thickness mm 5.975**
Joint efficiency, (E)	**0.7**	
Corr.Allowance, mm (CA)	**0**	**Provided thickness mm 6**
Factor 'M' (1 for SE 1.54 for tor	**1**	
Thinning Allowance mm (TA)	**2**	
Milling Tolerance mm (MT)	**0.30**	

Prepared by_____ Aproved by_____

WANAKBORI

DESIGN CALCULATIONS FOR

Bulk Acid Storage tank

Horizontal with dished ends

CLIENT	:	**BHEL**	ISSUED FOR	**Approval**	
LOCATION	:	**Wanakbori**			
PLANT	:	**DM-Plant**	Rev / Date	**Rev 0 / 07.06.2016**	
SERVICE	:	**Bulk Acid Storage tank**	DESIGN CODE	**BS EN 12285-2**	

DESIGN DATA :			**Unit**			
DESIGN PRESSURE	p,	$KG/CM^2(G)$	=	ATMOSPHERIC		
DESIGN TEMPERATURE	T,	°C	=	60		
OPERATING PRESSURE		$KG/CM^2(G)$		ATMOSPHERIC		
OPERATING TEMPERATURE		°C		Ambient		
TEST PRESSURE		$KG/CM^2(G)$	=	FULL OF WATER		
CORROSION ALLOWANCE	CA,	MM	=	0	Rubber lined	
RADIOGRAPHY			=	NIL		
JOINT EFFECIENCY	E,		=	0.70		
CAPACITY - MAXIMUM ,		M^3	=	48.8		
- NOMINAL ,		M^3	=	46.0		
TANK DIMENSIONS :						
INNER DIAMETER	D,	MM	=	3000		
Length on Straight	LOS,	MM	=	5900		
Type of Dished Ends			=	2:1, Semi ellipsoidal		
MATERIAL OF CONSTRUCTION :						
SHELL PLATE			=	IS 2062 Gr.B		
DISHED ENDS			=	IS 2002		
FLANGE			=	IS 2062 Gr.B		
PIPE			=	**IS 1239 & IS 3589**		
SUPPORTS			=	IS 2062 Gr.B		
GASKETS			=	NATURAL RUBBER		
STUDS/BOLTS& NUTS			=	IS 1367		
DESIGN CALCULATION :						
A) SHELL PLATE THICKNESS :						
As per BS EN 12285- Table 3, Cl.No.4.3.6.1						
Minimum shell plate thickness required		t	=	7	mm	
Provided Shell Plate Thickness			=	8	mm	
HENCE SAFE						
B) DISHED END PLATE THICKNESS						
Minimum Dished end plate Thickness , t (As per cl.No 4.3.6.1)		t	=	7	mm	
Provided Dised End Plate Thickness			=	8	mm	
HENCE SAFE						
where,						
t = Thickness Required in mm						
D = Inner Diameter of Tank		M	=	3		
L = Length on straight of tank		M	=	5.9		
E = Weld Joint Effeciency			=	0.70		
P = Design Pressure			=	atmospheric		
Saddle Supports :						
Saddles shall be welded to the tank - (in accordance with clause: 4.9.2)						

WANAKBORI

DESIGN CALCULATIONS FOR

Bulk Caustic Storage tank
Horizontal with dished ends

CLIENT	:	**BHEL**	ISSUED FOR	**Approval**
LOCATION	:	**Wanakbori**		
PLANT	:	**DM-Plant**	Rev / Date	**Rev 0 / 07.06.2016**
SERVICE	:	**Bulk Caustic Storage tank**	DESIGN CODE	**BS EN 12285-2**

DESIGN DATA :			**Unit**		
DESIGN PRESSURE	p,	$KG/CM^2(G)$	=	ATMOSPHERIC	
DESIGN TEMPERATURE	T,	°C	=	60	
OPERATING PRESSURE		$KG/CM^2(G)$		ATMOSPHERIC	
OPERATING TEMPERATURE		°C		Ambient	
TEST PRESSURE		$KG/CM^2(G)$	=	FULL OF WATER	
CORROSION ALLOWANCE	CA,	MM	=	0	Rubber lined
RADIOGRAPHY			=	NIL	
JOINT EFFECIENCY	E,		=	0.70	
CAPACITY - MAXIMUM ,		M^3	=	15.3	
- NOMINAL ,		M^3	=	14.2	
TANK DIMENSIONS :					
INNER DIAMETER	D,	MM	=	2200	
Length on Straight	LOS,	MM	=	3300	
Type of Dished Ends			=	2:1, Semi ellipsoidal	
MATERIAL OF CONSTRUCTION :					
SHELL PLATE			=	IS 2062 Gr.B	
DISHED ENDS			=	IS 2002	
FLANGE			=	IS 2062 Gr.B	
PIPE			=	**IS 1239 & IS 3589**	
SUPPORTS			=	IS 2062 Gr.B	
GASKETS			=	NATURAL RUBBER	
STUDS/BOLTS& NUTS			=	IS 1367	
DESIGN CALCULATION :					
A) SHELL PLATE THICKNESS :					
As per BS EN 12285- Table 3, Cl.No.4.3.6.1					
Minimum shell plate thickness required		t	=	6	mm
Provided Shell Plate Thickness			=	8	mm
HENCE SAFE					
B) DISHED END PLATE THICKNESS					
Minimum Dished end plate Thickness , t (As per cl.No 4.3.6.1)		t	=	6	mm
Provided Dised End Plate Thickness			=	8	mm
HENCE SAFE					
where,					
t = Thickness Required in mm					
D = Inner Diameter of Tank		M	=	2.2	
L = Length on straight of tank		M	=	3.3	
E = Weld Joint Effeciency			=	0.70	
P = Design Pressure			=	atmospheric	
Saddle Supports :					
Saddles shall be welded to the tank - (in accordance with clause: 4.9.2)					

WANAKBORI

DESIGN CALCULATIONS FOR
BRINE MEASURING TANK

CLIENT	:	**BHEL**
LOCATION	:	**Wanakbori**
PLANT	:	**DM-Plant**
SERVICE	:	**BRINE**

ISSUED FOR: **Approval**
Rev / Date: **Rev 0 / 09.05.2016**
DESIGN CODE: **IS 803**

DESIGN DATA :		**Unit**		
DESIGN PRESSURE	p,	$KG/CM^2(G)$	=	ATMOSPHERIC
DESIGN TEMPERATURE	T,	°C	=	60
OPERATING PRESSURE		$KG/CM^2(G)$		ATMOSPHERIC
OPERATING TEMPERATURE		°C		Ambient
TEST PRESSURE		$KG/CM^2(G)$	=	FULL OF WATER
CORROSION ALLOWANCE	CA,	MM	=	0
RADIOGRAPHY			=	NIL
JOINT EFFECIENCY	E,		=	0.70
CAPACITY - MAXIMUM ,		M^3	=	18.0
- NOMINAL ,		M^3	=	18.0
DESIGN SPECIFIC GRAVITY				
- FOR WATER	G,		=	1.00
TANK DIMENSIONS :				
INNER DIAMETER	D,	MM	=	2600
HEIGHT	H,	MM	=	3400 (3.1 m +0.3 m Free board)
ROOF			=	Flat roof
MATERIAL OF CONSTRUCTION :				
PLATE			=	IS 2062 Gr.B
FLANGE			=	IS 2062 Gr.B
PIPE			=	**IS 1239 & IS 3589**
SUPPORTS			=	IS 2062 Gr.B
GASKETS			=	NATURAL RUBBER
STUDS/BOLTS& NUTS			=	IS 1367

DESIGN CALCULATION :

A) BOTTOM PLATE THICKNESS :

As per IS 803 Cl.No.6.2.1(a)

Minimum bottom plate thickness required		MM	=	6
Provided Bottom Plate Thickness		MM	=	6

HENCE SAFE

B) SHELL PLATE THICKNESS

Minimum Shell Thickness , t (As per cl.No.B-4.1) $t = \frac{4.9 \times (H-0.3) \times D \times G}{SE} + CA$

where,

t = Thickness Required in mm				
D = Inner Diameter of Tank		M	=	2.6
H = Height of tank		M	=	3.4
G = Specific Gravity for Water			=	1.00
E = Weld Joint Effeciency			=	0.70
P = Design Pressure			=	atmospheric
Se= Allowable Stress at Design Temp. of 50°C		N/MM^2	=	165
			=	165
CA=Corossion Allowanace		MM	=	0

1) For Operating Condition

(a) Minimum reqd thk as per Cl.No:6.3.3.1- Ist Course.

	H	M	3.4	
	t		=	$\frac{4.9x\ (H - 0.3) \times 8 \times 1.00}{165*0.7} + C.A$ C.A= 0.0
		MM	=	0.28
Provided thickness		MM	=	**6**
HENCE SAFE				

(a) Minimum reqd thk as per Cl.No:6.3.3.1- Ist Course.- Hydro test condiition

	t		=	$\frac{4.9x(H - 0.3) \times D}{St}$ H in mts 3.2
		MM	=	0.21

				Provided thickness		MM	=	6				
				HENCE SAFE								
	Hydrostatic Stress:											
	St = Allowable Stress						=	3/7 of Minimum Ultimate Tensile Strength				
	Ultimate Tensile Strength of IS 2062 Plates					N/MM^2	=	410				
	3/7 of Ultimate Tensile Strength						=	3 / 7 x 410				
						N/MM^2	=	175.71				
						t	=	4.9(H-0.3)xD/St				
								0.22				
	Provided thickness of bottom plate:					MM	=	6				
	HENCE SAFE											
	Design Verification of Stability of Shell Plates (As per Cl.No.6.3.3.6)											
	Maximum height of unstiffened Shell (H1)				in Mts		=	$\frac{1500 \times t}{P} \times \sqrt{\left(\frac{t}{D}\right)^3}$				
	where,						=	39.35		t	5	
	t = Shell thk , mm									p	145.00	
	D = Inner Diameter of Tank, m									D	6	
	P = External Pressure acting on Shell , KG/m²			P wind + P vac								
	Pwind = Wind Pressure , As per IS 875											
	P vac = Internal Vacuum ,(Which is negligible)											
	Maximum size of unstiffened shell is greater than the height of the tank :				H1> H							
	Hence wind Girder is not required.											
	P = External Pressure acting on Shell , KG/m²			P wind + P vac								
	Pwind = Wind Pressure , As per IS 875											
	P vac = Internal Vacuum ,(Which is negligible)						=	0.00				
	Wind Pressure (As per IS 875)											
	Design wind pressure at a height of 10 m						=	**0.06 x Vz²**				
	Design wind Speed (Vz) ,					M/S	=	**Vb x K1 x K2 x K3**				
	Basic Wind Speed (Vb)					M/S	=	39.00	(As per Client)		140.4	Km/hr
	Probabilty factor (Risk Co-efficient)					(K1)	=	1.08	(As per IS 875 -Part-3- clause 5.3.1)			
	Terrain, Height & Structure Size factor					(K2)	=	0.91	(As per IS 875 part-3-Clause 5.3.2.2)			
	(Terrain Category 3,Class A)											
	Topogarphy factor					(K3)	=	1	(As per IS 875 -Part-3, clause 5.3.3)			
	Design Wind Speed					(Vz)	=	39 x 1.08 x 0.91 x 1.				
						m/s	=	**38.33**				
	Design Wind Pressure- = 0.06 *Vz^2					(P wind)	=	88.15				
						KG/M^2	=	145.00				
	SUPPORTED CONICAL ROOF AS per Clause:6.4.1.1											
	Hence,Provided thk of Roof plate				=	**6 mm**						
	ROOF - CURB ANGLE											
	Minimum size of Roof Curb angle as per Cl.No.6.3.6.3(a)						=	65 x 65 x8 mm				
	Provided Curb angle						=	ISA 65 x 65 x8				
	HENCE SAFE											
	Wind load on the Tank:											
	Weight of shell plate+weight of curb angle+ weight of shell appertunances+weight of staircases+wt of stair case+wf of											
	roof plates+wt of roof structures+wt of crown plate= Weight of shell											
	where,									t	5	
	t = Shell thk , mm						=	137.94		p	145.00	
	D = Inner Diameter of Tank, m									D	2.6	
	P = External Pressure acting on Shell , KG/m²			P wind + P vac						h	3.4	
	Pwind = Wind Pressure , As per IS 875									L	3.4	
	P vac = Internal Vacuum ,(Which is negligible)											
										hr	0.33	
	Projected Area of the Cylindrical Surface: m2 : LxD(Tank shell)+ 1/2x Dxroofcone height.											
							=	L*D + 1/2 (D) hr				
							=	**9.269**	m2			
	As per Figure of 5: IS 875 part 3:Clause: 6.2.2.13.			Cf=0.5						Cf	0.5	
	Force Co efficient											
	Wind Force :	F =		Cf. A . Pd. (KG-m)						Cg	1.7	

		Height of Centre of gravity : Cg in Mts				F	=	672.0025	KG-m				
		Over Turning Moment at the height of Centre of Gravity : F x Cg											
							=	1142.40	KG-m				
		Ws: Weight of shell and roof											
										Ws	2200		
		Restoring Moment of tank : Weight of shell with roof X Dia of tank/2											
							=	2860	KG-m				
		As per IS 875 -Part 5 Clause : 8.1 :											
		Where dead load provides the restoring moment only 0.9 times the dead load shall be considered.											
		In this case :											
				Resultant Restoring moment is			=	0.9x Restoring moment					
							=	2574	KG-m				
		Since the Resultant Restoring moment is greater than the overturning moment. **Tank is Safe.**											
			ie 2574 > 1142.40										
	HOWEVER WE ARE PROVIDING 6 NOS OF M20 DIA x 300 MM LONG FOUNDATION BOLTS.												

VESSEL DESIGN - FOR HOT WATER TANK

Client :	WANAKBORI						07.05.2016
Project :	0						
Equipment :	HWT						
Size :	**2000**	mm DIA		**2500**	mm HOS		
Design Calculation as per ASME VIII-D1 :-							
Design Data :			**Material Data:-**				
Design Pressure Kg/cm^2		**4.5**	**Allowable stress in Kg/mm^2 at -- Room temp.=**				**14.072**
Operating Pressure Kg/cm^2. Max		**3.8**				**at --Design temp.=**	**14.072**
Design Temp. Deg. Cel.		**65**	**Material:-**				
Corrosion Allowance, C mm		**0**	**--Shell =**	**SS 316**			
Radiography			**--Dish =**	**SS 316**			
Joint Efficiency (Shell) , J		**0.7**					
Joint Efficiency (Dish) , J		**1**	**(milltolerance 0.3mm)**				
Calculation for Shell thickness;-			**Calculated minimum thickness(in mm)**				
Shell inside Dia, mm (Di)		**2000**		**Ts = P * R**			**4.58**
Shell inside rADIUS, mm (R)		**1000**			**((S*E)- (0.6 *P))**		
Allowable stress, Kg/Cm^2 (S)		**1407.2**					
Joint efficiency, (E)		**0.7**	**Required minimum thickness**			**=**	**Ts+CA+MT**
Corrosion allowance, mm (CA)		**0**				**=**	**4.831**
			Provided minimum thickness			**=**	**5.00**
Calculation for Dish Thickness:							
Dish O/D mm DO		**2012**	**Calculated min. thickness(in mm) :-**				
Dish I/D , mm D		**2000**	**Td = P * D * M**				**3.199**
			(2 * S * E)-(0.2 * P)				
			Required min.thickness			**=**	**Td+CA+MT+TA**
Allowable stress ,Kg/mm^2 (S)		**1407.2**	**Provided min. Thickness**			**mm**	**5.499**
Joint efficiency, (E)		**1**					
Corr.Allowance, mm (CA)		**0**	**Provided thickness**			**mm**	**6.00**
Factor 'M' (1 for SE 1.54 for tor		**1**					
Thinning Allowance mm (TA)		**2**					
Milling Tolerance mm (MT)		**0.30**					
Prepared by_____			Aproved by_____				

Vessel Design for ACF-ALKALI(C)

Client : WANAKBORI — 07.05.2016

Project : 0

Equipment : ACF- ALKALI

Size : 1000 mm DIA — 2700 mm HOS

Design Calculation as per ASME VIII-D1 :-

Design Data :

Design Pressure Kg/cm^2	4.5
Operating Pressure Kg/cm^2. Max	3.8
Design Temp. Deg. Cel.	65
Corrosion Allowance, C mm	2
Radiography	
Joint Efficiency (Shell) , J	0.7
Joint Efficiency (Dish) , J	1

Material Data:-

Allowable stress in Kg/mm^2 at -- Room temp.= 14.072

at --Design temp.= 14.072

Material:-

--Shell = IS2062

--Dish = IS 2002

(milltolerance 0.3 mm)

Calculation for Shell thickness;-

Shell inside Dia, mm (Di)	1000
Shell inside rADIUS, mm (R)	500
Allowable stress, Kg/Cm^2 (S)	1407.2
Joint efficiency, (E)	0.7
Corrosion allowance, mm (CA)	2

Calculated minimum thickness(in mm)

$$Ts = \frac{P * R}{((S*E) - (0.6 * P))} = 2.29$$

Required minimum thickness = Ts+CA+MT = 4.540

Provided minimum thickness = 6.00

Calculation for Dish Thickness:

Dish O/D mm DO	1012
Dish I/D , mm D	1000
Allowable stress ,Kg/mm^2 (S)	1407.2
Joint efficiency, (E)	1
Corr.Allowance, mm (CA)	2
Factor 'M' (1 for SE 1.54 for tori)	1
Thinning Allowance mm (TA)	2
Milling Tolerance mm (MT)	0.30

Calculated min. thickness(in mm) :-

$$Td = \frac{P * D * M}{(2 * S * E) - (0.2 * P)} = 1.599$$

Required min.thickness = Td+CA+MT+TA

Provided min. Thickness mm = 5.899

Provided thickness mm = 6

Prepared by _____ Aproved by _____

Vessel Design for DMF POTABLE WATER (C,D)

Client :	BHEL						07.05.2016
Project	0						
Equipment :	DMF-P						
Size :	1400	mm Dia		2000	mm LOS		
Design Calculation as per ASME VIII-D1 :-							
Design Data :			Material Data:-				
Design Pressure Kg/cm2 (P)		10	Allowable stress in Kg/mm^2 at -- Room temp.=				14.072
Operating Pressure Kg/cm^2. Max		8			at --Design temp.=		14.072
Design Temp. Deg. Cel.		65	Material:-				
Corrosion Allowance, mm (CA)		2	--Shell =	IS2062			
Radiography			--Dish =	IS 2002			
Joint Efficiency (Shell) , J		0.85					
Joint Efficiency (Dish) , J		1	(milltolerance (MT) 0.3 mm)				
Calculation for Shell thickness;-			Calculated minimum thickness(in mm)				
Shell inside Dia, mm (Di)		1400		Ts = P * R			5.91
Shell inside rADIUS, mm (R)		700			((S*E)- (0.6 *P))		
Allowable stress, Kg/Cm^2 (S)		1400.0					
Joint efficiency, (E)		0.85	Required minimum thickness =				Ts+CA+MT
Corrosion allowance, mm (CA)		2				=	8.162
			Provided minimum thickness =				10.00
Calculation for Dish Thickness:							
Dish O/D mm DO		1420		Calculated min. thickness(in mm) :-			
Dish I/D , mm D		1400		Td = P * D * M			5.004
				(2 * S * E)-(0.2 * P)			
				Required min.thickness =			Td+CA+MT+TA
Allowable stress ,Kg/mm^2 (S)		1400.0		Provided min. Thickness mm			9.304
Joint efficiency, (E)		1					
Corr.Allowance, mm (CA)		2		Provided thickness mm			10
Factor 'M' (1 for SE 1.54 for tori)		1					
Thinning Allowance mm (TA)		2					
Milling Tolerance mm (MT)		0.30					
Prepared by_____				Approved by_____			

Chapter 9

PRESSURE DROP CALCUALTIONS

LIST OF PUMPS

1. DM PLANT FEED PUMPS
2. DG WATER TRANSFER PUMPS
3. REGENERATION WATER TRANSFER PUMPS
4. BACKWASH WASTE WATER DISPOSAL PUMPS
5. NEUTRALISED EFFULENT DISPOSAL PUMPS
6. AIR BLOWER FOR DMF
7. AIR BLOWER FOR DEGASSER
8. AIR BLOWER FOR MB AND NPIT
9. AIR BLOWER FOR DMF POTABLE

END USER:	GSECL, 1 X 800 MW WANAKBORI STPP	CONTRACTOR:	AQUADESIGNS INDIA PVT.LTD
CLIENT :	M/S. BHEL	CLIENT :	M/S. BHEL - WANAKBORI
Doc. No	PE-V0-408-163-A003	Doc. Name	Pressure drop calculation

PROJECT : DM PLANT PACKAGE

TITLE : HYDRAULIC CALCULATION FOR

DM FEED PUMP - Capacity - 120 m3/hr @ 50 mWC head

FORMULA'S * $V = 0.849\ C\ R^{0.63}\ S^{0.54}$, Entry Loss = $0.5\ V^2/2g$, Exit Loss = $V^2/2g$ & Fitting Losses = $K \times V^2/2g$ x No. of fittings.

PIPE			Flow Q		Pipe Size	Hydraulic	Area	Velocity	Length	MOC	Pipe Coeff.	Slope S		Pipe	Entry &	Head loss
FROM	TO	NB mm	m^3/hr	m^3/sec	ID mm	mean dep. R	m^2	m/sec V	mts L		C	*	1 in	Loss SxL	Exit loss	m
DM feed pump suction header - Common	DM feed pump suction header - Individual	200	120.0	0.0333	200	0.0500	0.031	1.061	3.00	CS	100	0.010	102	0.0296	0.0000	**0.0296**
DM feed pump suction header - Individual	Pump suction	200	120.0	0.0333	200	0.0500	0.031	1.061	1.50	CS	100	0.010	102	0.0148	0.0000	**0.0148**
Pump Discharge	Pump Discharge Header	150	120.0	0.0333	150	0.0375	0.018	1.886	1.50	CS	100	0.040	25	0.0600	0.0000	**0.0600**
Pump Discharge Header	To DMF	150	120.0	0.0333	150	0.0375	0.018	1.886	200.00	CS	100	0.040	25	7.9982	0.0000	**7.9982**

FITTING LOSSES

Fittings K - values are taken from Chemical Engineers Hand Book - By Robert H. Perry /Cecil H Chilton

PIPE			ID	Bell mouth	Bend						Tee		Valve									Exp / Reducer	Y/ strainer	Miscellaneous	welding loss				
FROM	TO	NB mm	K val		11¼°	22½°	45°	90°	180°	Square	Miter	Branch	Main	Gate	Globe	Diaph.	Butter	Plug	Ball	Angle	Check	Foot								
				0.10	0.10	0.20	0.35	0.45	1.50	0.40	0.17	1.00	0.40	0.17	6.00	2.60	0.24	9.00	0.30	2.00	2.00	15.0	0.60	3.00	0.90	0.05				
DM feed pump suction header - Common	DM feed pump suction header - Individual	200	200.00									1																	**0.0574**
DM feed pump suction header - Individual	Pump suction	200	200.00														1												**0.0138**
Pump Discharge	Pump Discharge Header	150	150.00					1									1				1									**0.4878**
Pump Discharge Header	To DMF	150	150.00					2																	2	41.2				**0.8632**

Hydraulic Levels of the Sump		NPSH - Available				Notes

Frictional loss (Calculated)			**9.525**
Suction Head	0.000	1.00	**-1.000**
MAXIMUM HEAD LOSS IN THE DMF, ACF is 5 mWC in DMF and 7 mWC in ACF			**12.0**
MAXIMUM HEAD LOSS IN THE WAC (pl refer DM plant design software projection)			**7.0**
MAXIMUM HEAD LOSS IN THE SAC (pl refer DM plant design software projection)			**5.5**
Maximum Pipe Ht (static Head)			**12.0**
Total Head in M (Required)			**45.025**
TOTAL HEAD PROVIDED in M			**50**
Margin Available in %			**10%**

END USER:	GSECL, 1 X 800 MW WANAKBORI STPP
CLIENT :	M/S. BHEL
Doc. No	PE-V0-408-163-A003

CONTRACTOR:	AQUADESIGNS INDIA PVT.LTD
CLIENT :	M/S. BHEL - WANAKBORI
Doc. Name	Pressure drop calculation

PROJECT : DM PLANT PACKAGE

TITLE : HYDRAULIC CALCULATION FOR

DG WATER TRANSFER PUMPS - Capacity - 110 m3/hr @ 38 mWC head

FORMULA'S * $V = 0.849\ C\ R^{0.63}\ S^{0.54}$, Entry Loss = $0.5\ V^2/2g$, Exit Loss = $V^2/2g$ & Fitting Losses = $K \times V^2/2g$ x No. of fittings.

PIPE			Flow Q		Pipe Size	Hydraulic	Area	Velocity	Length	MOC	Pipe Coeff.	Slope S		Pipe	Entry &	Head loss
FROM	TO	NB mm	m^3/hr	m^3/sec	ID mm	mean dep. R	m^2	m/sec V	mts L		C	*	1 in	Loss SxL	Exit loss	m
DG water transfer pump suction header - Common	DG water transfer pump suction header - Individual	200	110.0	0.0306	200	0.0500	0.031	0.973	3.00	CSRL	100	0.008	119	0.0252	0.0000	**0.0252**
DG water transfer pump suction header - Individual	Pump suction	200	110.0	0.0306	200	0.0500	0.031	0.973	1.50	CSRL	100	0.008	119	0.0126	0.0000	**0.0126**
Pump Discharge	Pump Discharge Header	150	110.0	0.0306	150	0.0375	0.018	1.729	1.50	CSRL	100	0.034	29	0.0511	0.0000	**0.0511**
MB	To DMWST	150	110.0	0.0306	150	0.0375	0.018	1.729	100.00	CSRL	100	0.034	29	3.4039	0.0000	**3.4039**

FITTING LOSSES

Fittings K - values are taken from Chemical Engineers Hand Book - By Robert H. Perry /Cecil H Chilton

PIPE			ID / K val	Bell mouth	Bend							Tee		Valve									Exp / Reducer	Y/ strainer	Miscellaneous	welding loss				
FROM	TO	NB mm			11¼°	22½°	45°	90°	180°	Square	Miter	Branch	Main	Gate	Globe	Diaph.	Butter	Plug	Ball	Angle	Check	Foot								
				0.10	0.10	0.20	0.35	0.45	1.50	0.40	0.17	1.00	0.40	0.17	6.00	2.60	0.24	9.00	0.30	2.00	2.00	15.0	0.60	3.00	0.90	0.05				
DG water transfer pump suctio	DG water transfer pump suction header - I	200	200.00									1																		**0.0482**
DG water transfer pump suctio	Pump suction	200	200.00														1													**0.0116**
Pump Discharge	Pump Discharge Header	150	150.00					1									1				1									**0.4099**
MB	To DMWST	150	150.00					2				2													2	21.2				**0.8777**

Hydraulic Levels of the Sump		NPSH - Available				Notes

Frictional loss (Calculated)			4.840
Suction Head	0.000	1.00	-1.000
MAXIMUM HEAD LOSS IN THE WBA (pl refer DM plant design software projection)			6.0
MAXIMUM HEAD LOSS IN THE SBA (pl refer DM plant design software projection)			6.0
MAXIMUM HEAD LOSS IN THE MB (pl refer DM plant design software projection)			7.0
Maximum Pipe Ht (static Head)			12.0
Total Head in M (Required)			34.840
TOTAL HEAD PROVIDED in M			38
Margin Available in %			10%

END USER:	GSECL, 1 X 800 MW WANAKBORI STPP
CLIENT :	M/S. BHEL
Doc. No	PE-V0-408-163-A003

CONTRACTOR:	AQUADESIGNS INDIA PVT.LTD
CLIENT :	M/S. BHEL - WANAKBORI
Doc. Name	Pressure drop calculation

PROJECT : DM PLANT PACKAGE

TITLE : HYDRAULIC CALCULATION FOR

REGENERATION WATER TRANSFER PUMPS - Capacity - 18 m3/hr @ 35 mWC head

FORMULA'S * $V = 0.849\ C\ R^{0.63}\ S^{0.54}$, Entry Loss = $0.5\ V^2/2g$, Exit Loss = $V^2/2g$ & Fitting Losses = $K \times V^2/2g$ x No. of fittings.

PIPE			Flow Q		Pipe Size	Hydraulic	Area	Velocity	Length	MOC	Pipe Coeff.	Slope S		Pipe	Entry &	Head loss
FROM	TO	NB mm	m^3/hr	m^3/sec	ID mm	mean dep. R	m^2	m/sec V	mts L		C	*	1 in	Loss SxL	Exit loss	m
REGENERATION WATER TRANSFER pump suction header - Common	REGENERATION WATER TRANSFER pump suction header - Individual	80	18.0	0.0050	80	0.0200	0.005	0.995	3.00	CSRL	100	0.025	39	0.0764	0.0000	**0.0764**
REGENERATION WATER TRANSFER pump suction header - Individual	Pump suction	80	18.0	0.0050	80	0.0200	0.005	0.995	1.50	CSRL	100	0.025	39	0.0382	0.0000	**0.0382**
Pump Discharge	Pump Discharge Header	65	18.0	0.0050	65	0.0163	0.003	1.507	1.50	CSRL	100	0.070	14	0.1050	0.0000	**0.1050**
MB	To DMWST	65	18.0	0.0050	65	0.0163	0.003	1.507	100.00	CSRL	100	0.070	14	6.9987	0.0000	**6.9987**

FITTING LOSSES

Fittings K - values are taken from Chemical Engineers Hand Book - By Robert H. Perry /Cecil H Chilton

PIPE			ID /	Bell mouth	Bend							Tee		Valve									Exp / Reducer	Y/ strainer	Miscellaneous	welding loss				
FROM	TO	NB mm	K val		11¼°	22½°	45°	90°	180°	Square	Miter	Branch	Main	Gate	Globe	Diaph.	Butter	Plug	Ball	Angle	Check	Foot								
				0.10	0.10	0.20	0.35	0.45	1.50	0.40	0.17	1.00	0.40	0.17	6.00	2.60	0.24	9.00	0.30	2.00	2.00	15.0	0.60	3.00	0.90	0.05				
REGENERATION WATER TRANSFER pump suction header - Common	REGENERATION WATER TRANSFER pump suction header - Individual	80	80.00									1																		**0.0504**
REGENERATION WATER TRANSFER pump suction header - Individual	Pump suction	80	80.00														1													**0.0121**
Pump Discharge	Pump Discharge Header	65	65.00					1									1				1									**0.3113**
MB	To DMWST	65	65.00					2				2													2	21.2				**0.6665**

Hydraulic Levels of the Sump		NPSH - Available				Notes

Frictional loss (Calculated)			8.259
Suction Head	0.000	1.00	-1.000
MAXIMUM HEAD LOSS IN THE EJECTOR			5.0
MAXIMUM HEAD LOSS IN THE VESSEL (MB vessel has maximum, pls refer design software projection)			7.0
Maximum Pipe Ht (static Head)			12.0
Total Head in M (Required)			31.259
TOTAL HEAD PROVIDED in M			34
Margin Available in %			10%

END USER:	GSECL, 1 X 800 MW WANAKBORI STPP	CONTRACTOR:	AQUADESIGNS INDIA PVT.LTD
CLIENT :	M/S. BHEL	CLIENT :	M/S. BHEL - WANAKBORI
Doc. No	PE-V0-408-163-A003	Doc. Name	Pressure drop calculation

PROJECT : DM PLANT PACKAGE

TITLE : HYDRAULIC CALCULATION FOR

BACKWASH WASTE WATER DISPOSAL PUMPS - Capacity - 50 m3/hr @ 41 mWC head

FORMULA'S * $V = 0.849\ C\ R^{0.63}\ S^{0.54}$, Entry Loss = $0.5\ V^2/2g$, Exit Loss = $V^2/2g$ & Fitting Losses = K x $V^2/2g$ x No. of fittings.

PIPE			Flow Q		Pipe Size	Hydraulic	Area	Velocity	Length	MOC	Pipe Coeff.	Slope S		Pipe	Entry &	Head loss
FROM	TO	NB mm	m^3/hr	m^3/sec	ID mm	mean dep. R	m^2	m/sec V	mts L		C	*	1 in	Loss SxL	Exit loss	m
Backwash waste water disposal pump suction header - Common	Backwash waste water disposal pump suction header - Individual	125	50.0	0.0139	125	0.0313	0.012	1.132	3.00	CS	100	0.019	52	0.0576	0.0000	0.0576
Backwash waste water disposal pump suction header - Individual	Pump suction	125	50.0	0.0139	125	0.0313	0.012	1.132	1.50	CS	100	0.019	52	0.0288	0.0000	0.0288
Pump Discharge	Pump Discharge Header	100	50.0	0.0139	100	0.0250	0.008	1.768	1.50	CS	100	0.057	18	0.0854	0.0000	0.0854
MB	To DMWST	100	50.0	0.0139	100	0.0250	0.008	1.768	350.00	CS	100	0.057	18	19.9326	0.0000	19.9326

FITTING LOSSES

Fittings K - values are taken from Chemical Engineers Hand Book - By Robert H. Perry /Cecil H Chilton

PIPE			ID	Bend							Tee		Valve															
FROM	TO	NB mm	K val	Bell mouth	11¼°	22½°	45°	90°	180°	Square	Miter	Branch	Main	Gate	Globe	Diaph.	Butter	Plug	Ball	Angle	Check	Foot	Exp / Reducer	Y/ strainer	Miscellaneous	welding loss				
				0.10	0.10	0.20	0.35	0.45	1.50	0.40	0.17	1.00	0.40	0.17	6.00	2.60	0.24	9.00	0.30	2.00	2.00	15.0	0.60	3.00	0.90	0.05				
Backwash waste water disposal pump suction	Backwash waste water disposal pump su	125	125.00									1																	0.0653
Backwash waste water disposal pump suction header - Individual	Pump suction	125	125.00														1												0.0157
Pump Discharge	Pump Discharge Header	100	100.00					1									1				1								0.4288
MB	To DMWST	100	100.00					2				2													2	71.2			1.3165

Hydraulic Levels of the Sump		NPSH - Available				Notes		

Frictional loss (Calculated)			21.931
Sump Depth	0.000	3.00	3.000
Maximum Pipe Ht (static Head)			12.0
Total Head in M (Required)			36.931
TOTAL HEAD PROVIDED in M			41
Margin Available in %			10%

END USER:	GSECL, 1 X 800 MW WANAKBORI STPP	CONTRACTOR:	AQUADESIGNS INDIA PVT.LTD
CLIENT :	M/S. BHEL	CLIENT :	M/S. BHEL - WANAKBORI
Doc. No	PE-V0-408-163-A003	Doc. Name	Pressure drop calculation

PROJECT : DM PLANT PACKAGE

TITLE : HYDRAULIC CALCULATION FOR

Neutrailised effulent DISPOSAL PUMPS - Capacity - 40 m3/hr @ 48 mWC head

FORMULA'S * $V = 0.849\ C\ R^{0.63}\ S^{0.54}$, Entry Loss = $0.5\ V^2/2g$, Exit Loss = $V^2/2g$ & Fitting Losses = $K \times V^2/2g$ x No. of fittings.

PIPE			Flow Q		Pipe Size	Hydraulic	Area	Velocity	Length	MOC	Pipe Coeff.	Slope S		Pipe	Entry &	Head loss
FROM	TO	NB mm	m^3/hr	m^3/sec	ID mm	mean dep. R	m^2	m/sec V	mts L		C	*	1 in	Loss SxL	Exit loss	m
Neutrailised effulent disposal pump suction header - Common	Neutrailised effulent disposal pump suction header - Individual	100	40.0	0.0111	100	0.0250	0.008	1.415	3.00	SS304	100	0.038	27	0.1130	0.0000	0.1130
Neutrailised effulent disposal pump suction header - Individual	Pump suction	100	40.0	0.0111	100	0.0250	0.008	1.415	1.50	SS304	100	0.038	27	0.0565	0.0000	0.0565
Pump Discharge	Pump Discharge Header	100	40.0	0.0111	100	0.0250	0.008	1.415	1.50	SS304	100	0.038	27	0.0565	0.0000	0.0565
MB	To DMWST	100	40.0	0.0111	100	0.0250	0.008	1.415	800.00	SS304	100	0.038	27	30.1386	0.0000	30.1386

FITTING LOSSES

Fittings K - values are taken from Chemical Engineers Hand Book - By Robert H. Perry /Cecil H Chilton

PIPE			ID		Bend							Tee		Valve															
FROM	TO	NB mm	K val	Bell mouth	11¼°	22½°	45°	90°	180°	Square	Miter	Branch	Main	Gate	Globe	Diaph.	Butter	Plug	Ball	Angle	Check	Foot	Exp / Reducer	Y/ strainer	Miscellaneous	welding loss				
				0.10	0.10	0.20	0.35	0.45	1.50	0.40	0.17	1.00	0.40	0.17	6.00	2.60	0.24	9.00	0.30	2.00	2.00	15.0	0.60	3.00	0.90	0.05				
Neutrailised effulent disposal pump suction header -	Neutrailised effulent disposal pump suctio	100	100.00									1																	0.1020
Neutrailised effulent disposal pump suction header - Individual	Pump suction	100	100.00														1												0.0245
Pump Discharge	Pump Discharge Header	100	100.00					1									1				1								0.2744
MB	To DMWST	100	100.00					2				2													2	161			1.3016

Hydraulic Levels of the Sump		NPSH - Available				Notes

Frictional loss (Calculated)	32.067
Maximum Pipe Ht (static Head)	12.0
Total Head in M (Required)	44.067
TOTAL HEAD PROVIDED in M	48
Margin Available in %	10%

END USER:	GSECL, 1 X 800 MW WANAKBORI STPP	CONTRACTOR:	AQUADESIGNS INDIA PVT.LTD
CLIENT :	M/S. BHEL	CLIENT :	M/S. BHEL - WANAKBORI
Doc. No	PE-V0-408-163-A003	Doc. Name	Pressure drop calculation

PROJECT : DM PLANT PACKAGE

TITLE : HYDRAULIC CALCULATION FOR

Air blower for DMF - Capacity - 480 m3/hr @ 4000 mWC head

FORMULA'S Head loss (P/L) = pv^2u/2d, **& Fitting Losses = K x $\rho V^2/2g$ x No. of fittings.**

PIPE			Flow Q		Pipe Size	Hydraulic	Area	Velocity	Length	MOC	friction loss coefficient	P/L		Pipe Loss	Head loss
FROM	TO	NB mm	m^3/hr	m^3/sec	ID mm	mean dep. R	m^2	m/sec V	mts L		u	N/m2	m	P/L*L	mm
Air blower for DMF suction header - Common	Air blower for DMF suction header - Individual	80	480.0	0.1333	80	0.0800	0.005	26.526	3.00	GI	0.015	79.157	0.008	0.0237	23.7472
Air blower for DMF suction header - Individual	Pump suction	80	480.0	0.1333	80	0.0800	0.005	26.526	1.50	GI	0.015	79.157	0.008	0.0119	11.8736
Pump Discharge	Pump Discharge Header	80	480.0	0.1333	80	0.0800	0.005	26.526	1.50	GI	0.02	105.543	0.011	0.0158	15.8314
Pump Discharge Header	To DMF	80	480.0	0.1333	80	0.0800	0.005	26.526	30.00	GI	0.02	105.543	0.011	0.3166	316.6287

FITTING LOSSES

Fittings K - values are taken from Chemical Engineers Hand Book - By Robert H. Perry /Cecil H Chilton

PIPE			ID	Bell mouth	Bend						Tee		Valve								Exp / Reducer	Y/ strainer	Miscellaneous	welding loss				
FROM	TO	NB mm	K val		11¼°	22½°	45°	90°	180°	Square	Miter	Branch	Main	Gate	Globe	Diaph.	Butter	Plug	Ball	Angle	Check	Foot								
				0.10	0.10	0.20	0.35	0.45	1.50	0.40	0.17	1.00	0.40	0.17	6.00	2.60	0.24	9.00	0.30	2.00	2.00	15.0	0.60	3.00	0.90	0.05				
Air blower for DMF suction header - Common	Air blower for DMF suction header - Indiv	80	80.00									1																		42.2172
Air blower for DMF suction header - Individual	Pump suction	80	80.00														1													10.1321
Pump Discharge	Pump Discharge Header	80	80.00					1									1				1									113.5642
Pump Discharge Header	To DMF	80	80.00					2				2													2	7.2				213.6188

Hydraulic Levels of the Sump		NPSH - Available				Notes

Frictional loss (Calculated)	747.613
Static head = 12 m above ground level = 12*density of air*1000/1000 mm	14.4
Maximum head loss in DMF	2500.0
Total Head in M (Required)	3262.013
TOTAL HEAD PROVIDED in M	4000
Margin Available in %	23%

END USER:	GSECL, 1 X 800 MW WANAKBORI STPP
CLIENT :	M/S. BHEL
Doc. No	PE-V0-408-163-A003

CONTRACTOR:	AQUADESIGNS INDIA PVT.LTD
CLIENT :	M/S. BHEL - WANAKBORI
Doc. Name	Pressure drop calculation

PROJECT : DM PLANT PACKAGE

TITLE : HYDRAULIC CALCULATION FOR

Air blower for Degasser - Capacity - 2412 m3/hr @ 100 mWC head

FORMULA'S Head loss (P/L) = pv^2u/2d, **& Fitting Losses = K x $\rho V^2/2g$ x No. of fittings.**

PIPE			Flow Q		Pipe Size	Hydraulic	Area	Velocity	Length	MOC	friction loss coefficient	P/L		Pipe Loss	Head loss
FROM	TO	NB mm	m^3/hr	m^3/sec	ID mm	mean dep. R	m^2	m/sec V	mts L		u	N/m2	m	P/L*L	mm
Air blower for Degasser suction header - Common	Air blower for Degasser suction header - Individual	200	2412.0	0.6700	200	0.2000	0.031	21.327	3.00	GI	0.01	13.645	0.001	0.0041	**4.0935**
Air blower for Degasser suction header - Individual	Pump suction	200	2413.0	0.6703	200	0.2000	0.031	21.336	1.50	GI	0.01	13.656	0.001	0.0020	**2.0484**
Pump Discharge	Pump Discharge Header	200	2414.0	0.6706	200	0.2000	0.031	21.344	1.50	GI	0.01	13.668	0.001	0.0021	**2.0501**
Pump Discharge Header	To Degasser	200	2415.0	0.6708	200	0.2000	0.031	21.353	10.00	GI	0.01	13.679	0.001	0.0137	**13.6789**

FITTING LOSSES

Fittings K - values are taken from Chemical Engineers Hand Book - By Robert H. Perry /Cecil H Chilton

PIPE			ID	Bell mouth	Bend							Tee		Valve									Exp / Reducer	Y/ strainer	Miscellaneous	welding loss				
FROM	TO	NB mm	K val		11¼°	22½°	45°	90°	180°	Square	Miter	Branch	Main	Gate	Globe	Diaph.	Butter	Plug	Ball	Angle	Check	Foot								
				0.10	0.10	0.20	0.35	0.25	1.50	0.40	0.17	0.30	0.40	0.17	6.00	2.60	0.24	9.00	0.30	1.00	0.50	15.0	0.60	3.00	0.90	0.05				
Air blower for Degasser suction header - Common	Air blower for Degasser suction header -	200	200.00									1																		**8.1870**
Air blower for Degasser suction header - Individual	Pump suction	200	200.00														1													**6.5550**
Pump Discharge	Pump Discharge Header	200	200.00					1									1				1									**27.0618**
Pump Discharge Header	To Degasser	200	200.00					1																		3.2				**11.2167**

Hydraulic Levels of the Sump		NPSH - Available				Notes

Frictional loss (Calculated)	74.891
Static head = 6 m above ground level = 6*density of air*1000/1000 mm	7.2
Total Head in M (Required)	82.091
TOTAL HEAD PROVIDED in M	100
Margin Available in %	22%

END USER:	GSECL, 1 X 800 MW WANAKBORI STPP	CONTRACTOR:	AQUADESIGNS INDIA PVT.LTD
CLIENT :	M/S. BHEL	CLIENT :	M/S. BHEL - WANAKBORI
Doc. No	PE-V0-408-163-A003	Doc. Name	Pressure drop calculation

PROJECT : DM PLANT PACKAGE

TITLE : HYDRAULIC CALCULATION FOR

Air blower for MB & NPIT - Capacity - 390 m3/hr @ 4000 mWC head

FORMULA'S Head loss (P/L) = pv^2u/2d, **& Fitting Losses = K x $\rho V^2/2g$ x No. of fittings.**

PIPE			Flow Q		Pipe Size	Hydraulic	Area	Velocity	Length	MOC	friction loss coefficient	P/L		Pipe Loss	Head loss
FROM	TO	NB mm	m^3/hr	m^3/sec	ID mm	mean dep. R	m^2	m/sec V	mts L		u	N/m2	m	P/L*L	mm
Air blower for MB suction header - Common	Air blower for MB suction header - Individual	100	390.0	0.1083	100	0.1000	0.008	13.793	3.00	GI	0.015	17.123	0.002	0.0051	5.1370
Air blower for MB suction header - Individual	Pump suction	100	390.0	0.1083	100	0.1000	0.008	13.793	1.50	GI	0.015	17.123	0.002	0.0026	2.5685
Pump Discharge	Pump Discharge Header	65	250.0	0.0694	65	0.0650	0.003	20.928	1.50	GI	0.02	80.856	0.008	0.0121	12.1283
Pump Discharge Header	To MB	65	250.0	0.0694	65	0.0650	0.003	20.928	15.00	GI	0.02	80.856	0.008	0.1213	121.2833

FITTING LOSSES

Fittings K - values are taken from Chemical Engineers Hand Book - By Robert H. Perry /Cecil H Chilton

PIPE			ID	Bell mouth	Bend							Tee		Valve								Exp / Reducer	Y/ strainer	Miscellaneous	welding loss				Head loss
FROM	TO	NB mm	K val		11¼°	22½°	45°	90°	180°	Square	Miter	Branch	Main	Gate	Globe	Diaph.	Butter	Plug	Ball	Angle	Check	Foot								mm
				0.10	0.10	0.20	0.35	0.45	1.50	0.40	0.17	1.00	0.40	0.17	6.00	2.60	0.24	9.00	0.30	2.00	2.00	15.0	0.60	3.00	0.90	0.05				
Air blower for MB suction header - Common	Air blower for MB suction header - Individ	100	100.00									1																	1.1637
Air blower for MB suction header - Individual	Pump suction	100	100.00														1												0.2793
Pump Discharge	Pump Discharge Header	65	65.00					1									1				1								7.2057
Pump Discharge Header	To MB	65	65.00					2				2													2	4.2			13.1524

Hydraulic Levels of the Sump		NPSH - Available				Notes

Frictional loss (Calculated)	162.918
Static head = 12 m above ground level = 12*density of air*1000/1000 mm	14.4
Maximum head loss in MB	3000.0
Total Head in M (Required)	3177.318
TOTAL HEAD PROVIDED in M	4000
Margin Available in %	26%

END USER:	GSECL, 1 X 800 MW WANAKBORI STPP	CONTRACTOR:	AQUADESIGNS INDIA PVT.LTD
CLIENT :	M/S. BHEL	CLIENT :	M/S. BHEL - WANAKBORI
Doc. No	PE-V0-408-163-A003	Doc. Name	Pressure drop calculation

PROJECT : DM PLANT PACKAGE

TITLE : HYDRAULIC CALCULATION FOR

Air blower for DMF- potable - Capacity - 62 m3/hr @ 3000 mWC head

FORMULA'S Head loss (P/L) = pv^2u/2d, **& Fitting Losses = K x $\rho V^2/2g$ x No. of fittings.**

PIPE			Flow Q		Pipe Size	Hydraulic	Area	Velocity	Length	MOC	friction loss coefficient	P/L		Pipe Loss	Head loss
FROM	TO	NB mm	m^3/hr	m^3/sec	ID mm	mean dep. R	m^2	m/sec V	mts L		u	N/m2	m	P/L*L	mm
Air blower for DMF- potable suction header - Common	Air blower for DMF- potable suction header - Individual	40	62.0	0.0172	40	0.0400	0.001	13.705	3.00	GI	0.015	42.261	0.004	0.0127	**12.6783**
Air blower for DMF- potable suction header - Individual	Pump suction	40	62.0	0.0172	40	0.0400	0.001	13.705	1.50	GI	0.015	42.261	0.004	0.0063	**6.3392**
Pump Discharge	Pump Discharge Header	40	62.0	0.0172	40	0.0400	0.001	13.705	1.50	GI	0.02	56.348	0.006	0.0085	**8.4522**
MB	To DMWST	40	62.0	0.0172	40	0.0400	0.001	13.705	10.00	GI	0.02	56.348	0.006	0.0563	**56.3482**

FITTING LOSSES

Fittings **K - values are taken from Chemical Engineers Hand Book - By Robert H. Perry /Cecil H Chilton**

PIPE			ID	Bell mouth	Bend							Tee		Valve								Exp / Reducer	Y/ strainer	Miscellaneous	welding loss				
FROM	TO	NB mm	K val		11¼°	22½°	45°	90°	180°	Square	Miter	Branch	Main	Gate	Globe	Diaph.	Butter	Plug	Ball	Angle	Check	Foot								
				0.10	0.10	0.20	0.35	0.45	1.50	0.40	0.17	1.00	0.40	0.17	6.00	2.60	0.24	9.00	0.30	2.00	2.00	15.0	0.60	3.00	0.90	0.05				
Air blower for DMF- potable suction header - Common	Air blower for DMF- potable suction head	40	40.00									1																		**1.1488**
Air blower for DMF- potable suction header - Individual	Pump suction	40	40.00														1													**0.2757**
Pump Discharge	Pump Discharge Header	40	40.00					1									1				1									**3.0902**
MB	To DMWST	40	40.00					2				2													2	3.2				**5.5831**

Hydraulic Levels of the Sump		NPSH - Available				Notes

Frictional loss (Calculated)	93.916
Static head = 12 m above ground level = 12*density of air*1000/1000 mm	14.4
Maximum head loss in DMF- potable	2500.0
Total Head in M (Required)	2608.316
TOTAL HEAD PROVIDED in M	**3000**
Margin Available in %	15%

Chapter 10 BATTERY LIMITS

BATTERY LIMITS FOR DEMINERALISATION PLANT:

S.NO	DESCRIPTION	TERMINATION POINT BY ADIPL
1.	DM Feed Water	From Clarified Water Pump House to DM plant (Max 200 meter distance from DM plant Area)
2.	Treated Water	Upto 5 m from the DM plant building.
3.	Backwash Waste Water	To Stilling Chamber of Pre Treatment Plant (Max 350 Meter distance from DM plant area)
4.	Neutralized Effluent	To Central Monitoring Basin (Max 800 meter distance from DM plant area)
S.NO	**DESCRIPTION**	**TERMINATION POINT BY CLIENT**
1.	Instrument air	25 NB Instrument Air Supply at 5-7 Kg/Cm2-At 5 meter distance from DM plant area
2.	Service Area	25 NB Instrument Air Supply at 5-7 Kg/Cm2-At 5 meter distance from DM plant area
3.	Power supply	415V , 50 Hz, 3 Phase Supply at Motor Terminals
4.	Service Water	50 NB connection to be provided at 5 meter distance from DM plant area
5.	Drinking Water	25 NB connection to be provided at 5 meter distance from DM plant area
6.	Chemicals	20 m hose from unloading pumps.

BATTERY LIMITS FOR POTABLE WATER PLANT:

S.NO	DESCRIPTION	TERMINATION POINT BY ADIPL
1.	Filter Feed Water	50 NB Pipe Connection to be provided At 5 meter distance from DMF inlet
2.	Treated Water	50 NB connection to be provided at 5 meter distance from Potable plant area
3.	Backwash Waste Water	To Filter Backwash Sump
S.NO	**DESCRIPTION**	**TERMINATION POINT BY CLIENT**
1.	Instrument air	25 NB Instrument Air Supply at 5-7 Kg/Cm2-At 5 meter distance from Potable plant area
2.	Service Air	25 NB Instrument Air Supply at 5-7 Kg/Cm2-At 5 meter distance from Potable plant area
3.	Power supply	415V , 50 Hz, 3 Phase Supply at Motor Terminals
4.	Service Water	50 NB connection to be provided at 5 meter distance from Potable plant area
5.	Chemicals	At the inlet of dosing tanks

Chapter
11

ANNEXURE-1

1. DM PLANT DESIGN SOFTWARE PROJECTION
2. MB PLANT DESIGN SOFTWARE PROJECTION

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CALCULATION OF ION EXCHANGE PLANT WITH PUROLITE ION EXCHANGE RESINS

Customer	BHEL-wankbori	**Operator**	Operator
Sales Person	Praveen	**Agent**	Agent
OEM Company	ADIPL	**Date**	19-04-2016
Calcn. No	No	**Code**	NONAME

1. INFLUENT WATER SPECIFICATIONS

1.1. Origin: River
1.2. Pretreatment: filtration

1.3. Water analysis:

Ca, ppm CaCO3	85.00	**HCO3**, ppm CaCO3	160.00	**CO2**, meq/l	0.0000
Mg, ppm CaCO3	94.00	**CO3**, meq/l		**SiO2**, ppm	22.0000
Na, ppm CaCO3	75.00	**Cl**, ppm CaCO3	52.00	**Temperature**, °C	10
K, meq/l		**SO4**, ppm CaCO3	20.00	**Org.**, mg/l KMnO4	
Fe, ppm	0.0500	**NO3**, ppm CaCO3	22.00		
T.C., meq/l	5.0827	**T.A.**, meq/l	5.0800		

2. DESIGN INPUT DATA

2.1. Flow rate per line, m3/h: 105.2
2.2. Running time, h: 18.0
2.3. Net run, m3: 1893.6

3. TREATED WATER QUALITY

	achieved
Conductivity, µS/cm:	<5 at 25 °C at the outlet of SBA
Silica leakage, ppm SiO2:	<0.1 at the outlet of SBA
Sodium leakage, ppm Na:	<1 at outlet of SAC
Hardness leakage	Not detectable at the outlet of SAC

Residual CO2:	after SAC filter, meq/l	3.2000
	after degasser, ppm	< 5 at the outlet of degasser tower

4. PUROLITE IX PROCESS OPTIONS

4.1. Ion exchange process: Demineralisation
4.2. Plant layout: WAC -> SAC -> DEG -> WBA -> SBA
No of Lines: _____
4.3. Resins chosen: PUROLITE C-104 Purofine C-100 A-100 Purofine A-400

5. COMMENTS

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6. FULL PLANT DESIGN DETAILS

Project: NONAME

6.1. Filter	WAC	SAC	WBA	SBA
6.2. IX Load				
Gross run load, m3		1982.6		1982.6
Ionic load, eq	5393	4685	2982	1870
Overrun, %		15		20
6.3. Resin Data				
Resin type	C-104	C-100	A-100	A-400
Resin grade	Std	Pfn	Std	Pfn
Theor. capacity, eq/l	1.94	1.62	1.11	0.65
Oper. capacity, eq/l	1.75	1.46	1.00	0.59
Resin volume, l	3100	3225	3000	3200
Flow rate, BV/h	35.6	34.1	36.8	34.4
Organic load, g/l			0.000	0.000
6.4. Regeneration Data				
Regeneration Mode	Co current	CTF:Pfn	Co current	CTF:Pfn
Regenerant	HCl	HCl	NaOH	NaOH
Concentration, %		5.0		4.0
% of Theory	143	265	179	386
for W-S Pair	123		148	
Level, g/l		140.0		90.0
Total, kg		452		288
Excess, eq		2303		2347
Temperature, °C			25	25
Backwash water, m3	4.25		2.36	
Dilution water, m3		7.6		6.6
Slow rinse, m3	3.1	8.1	1.5	9.6
Fast rinse, m3	12.4	12.9	12.0	12.8
6.5. Plant Size Data				
Bed depth, mm (changing from supplied form as shown)				
Supplied form	1094	1138	1058	1129
Exhausted form	1284	1115	1297	
Regenerated form		1255		1360
Vessel diameter, mm	1900	1900	1900	1900
Cross-section, m2	2.83	2.83	2.83	2.83
Cylindrical height, mm	Per design	Per design	Per design	Per design
6.6. Hydraulic Data				
Linear velocity, m/h	38.9	38.9	38.9	38.9
Pressure Drop, kPa	70.0	52.8	57.9	58.2
6.7. Design Factor	0.90	0.90	0.90	0.90
Limitations caused by: *Flow rate Silica*				

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CALCULATION OF ION EXCHANGE PLANT WITH PUROLITE ION EXCHANGE RESINS

Customer	BHEL – wankbori – MB	**Operator**	Operator
Sales Person	Praveen	**Agent**	Agent
OEM Company	Aquadesign	**Date**	19-04-2016
Calcn. No	No	**Code**	NONAME

1. INFLUENT WATER SPECIFICATIONS

1.1. Origin: River
1.2. Pretreatment: Filter

1.3. Water analysis:

Ca, meq/l		**HCO3**, meq/l		**CO2**, meq/l	0.0000
Mg, meq/l		**CO3**, meq/l		**SiO2**, ppm	0.5000
Na, ppm CaCO3	1.00	**Cl**, ppm CaCO3	1.00	**Temperature**, °C	10
T.C., meq/l	0.0200	**T.A.**, meq/l	0.0200		

2. DESIGN INPUT DATA

2.1. Net Flow rate per line, m3/h: 105.0
2.2. Running time, h: 126.0
2.3. Net run, m3: 13230.0

3. TREATED WATER QUALITY

	achieved
Conductivity, µS/cm:	<0.10 at 25 °C
Silica leakage, ppb SiO2:	<10
Iron as Fe	Nil
Free CO2 ppm as CO2	Nil
Total Hardness	Nil
Total Electrolyte ppm	0.1 Max
pH value	6.8 -7.2 at 25 °C

4. PUROLITE IX PROCESS OPTIONS

4.1. Ion exchange process: Working Mixed Bed
4.2. Plant layout: SAC+SBA (Working MB)
No of Lines: _____
4.3. Resins chosen: PUROLITE Purofine C-100 Purofine A-400
4.4. Volume ratio: Free selection

5. COMMENTS

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6. FULL PLANT DESIGN DETAILS

Project: NONAME

6.1. Filter	SAC		SBA
		(common)	
6.2. IX Load			
Gross run load, m3		13255.0	
Ionic load, eq	265		376
6.3. Resin Data			
Resin type	C-100		A-400
Resin grade	Pfn		Pfn
Theor. capacity, eq/l	1.32		0.50
Oper. capacity, eq/l	0.27		0.38
Resin volume, l	1000		1000
Flow rate, BV/h		52.6	
SAC %	50.00		
6.4. Regeneration Data			
Regeneration Mode		Internal	
Regenerant	HCl		NaOH
Concentration, %	5.0		5.0
% of Theory	1034		665
Level, g/l	100.0		100.0
Total, kg	100		100
Excess, eq	2477		2124
Temperature, °C			25
Backwash, m3	3		
Dilution water, m3	1.7		2.3
Bed warming			1
Slow rinse, m3	3.0		3.0
Fast rinse, m3	4.0		4.0
6.5. Plant Size Data			
Bed depth, mm (changing from supplied form as shown)			
Supplied form	510		510
Exhausted form	490		
Regenerated form	551		602
Vessel diameter, mm		1600	
Cross-section, m2		2.01	
Cylindrical height, mm		Per design	
6.6. Hydraulic Data			
Linear velocity, m/h		52.35	
Pressure Drop, kPa		69.5	
6.7. Design Factor	0.20		0.75
Limitations caused by*: Flow rate Silica*			

Chapter 12

ANNEXURE-2

Table No.-A-2.1

N-Pit sizing Calculations												
Wastes Generated	**WAC**		**SAC**		**WBA**		**SBA**		**MB-Cation**		**MB-Anion**	
	Vol in m3	**Source of water**	**Vol in m3**	**Source of water**	**Vol in m3**	**Source of water**	**Vol in m3**	**Source of water**	**Vol in m3**	**Source of water**	**Vol in m3**	**Source of water**
Backwash Waste	4.25	ACF	-	-	2.36	DG	-	-	3	SBA	-	-
Dilution Water	-	-	7.6	DG	-	-	6.6	SBA	1.7	MB	2.3	MB
Bed warming	-	-	-	-	-	-	3.2	SBA	-	-	1	MB
Slow Rinse	3.1	DG	8.1	DG	1.5	SBA	6.4	SBA	3	MB	2	MB
Fast Rinse	12.4	ACF	12.9	WAC	12	DG	12.8	WBA	4	SBA	4	SBA
Total Regeneration Waste Generated	**19.75**		**28.6**		**15.86**		**29**		**11.7**		**9.3**	
Total N-Pit capacity Required with 20% margin (in m3)	**=(19.75+28.6+15.86+29+11.7+9.3)*1.2 = 137 m3**											
Total N-Pit capacity constructed with 20% margin (in m3)	**140 m3**											

Table No.-A-2.2

DG Tank Capacity Calculations (Please refer annexure – 1 for the below data and also Table No.- A-2.1)	
Wastes Generated	**m3**
WAC Slow Rinse Waste	3.1
SAC Dilution Water	7.6
SAC Slow Rinse Waste	8.1
WBA Backwash Water	2.36
WBA Fast Rinse Waste	12
Total Degassed Water Required for Regeneration of WAC, WBA and SAC	=(3.1+7.6+8.1+2.36 +12) =33.16
One hour retention for the DM chain	=110 m3
Capacity required for DG water tank	143.16 m3
DG Tank capacity provided with 20% margin	**175 m3**

RESIN REPORT DM Plant S-15 to S-16 BHEL- Wanakbori

ION EXCHANGE
Refreshing the Planet

SERVICE SAMPLE REPORT

Client's Name: M/s BHEL- PSWR , Wanakbori	Date Received: 07.02.2020
Sender's Ref:: Mr. Anushant Mishra	Date Reported: 11.02.2020

1	**Lab. Re. No.**	**Standard**	**S-15/2020**	**S-16/2020**
2	**Source**	**Standard Specs**	**DM**	**DM**
3	**Type of Resin As a Label**	**SBA**	**SBA-A**	**SBA-B**
Sr.**No**.	**PARAMETER**	**RESULT**		
1	Condition of Resin	Moist (MP)	Moist (MP)	Moist (MP)
2	Appearance in Water	Clear	Slight turbid	Slight turbid
3	Appearance of Resin	Off white to brown opaque beads	Off white to brown	Off white to brown
4	Contamination	Nil	---	----
5	Color Throw	Nil	---	---
6	Organic Fouling	Nil	**Slight**	**Slight**
7	%Moisture Holding Capacity	56 - 63	60.3	58.3
8	Total Exchange Capacity, meq/ml	1.0 Min	0.97	1.00
9	% Strong Base Capacity(% of TEC)	95 Min	90.90	98.40
10	% Cracks	NA	--	--
11	%Pieces / %Non Sphericity	5 Max	0.2	0.2
12	% Fines (-52 BSS)	1 Max	0.2	0.2

Remarks:

SBA- A: Resin is slightly organically fouled and turbid.
TEC is dropped by 3 % and SBC is dropped by 5 % approx.

SBA – B: Resin is slightly organically fouled and turbid.

Comments: Alkaline Brine Treatment should be done for organic fouling. Pre-treatment for removal of organics should be improved. Resin can be used further with improved pre-treatment.

TECHNICAL SERVICES

Approved PG test procedure

COMMENTS RESOLUTION SHEET [CRS]			
PROJECT NAME	1 x 800 MW Wanakbori Thermal Power Station EXT. UNIT-8		
DOCUMENT/ DRAWING NUMBER.	PE-V0-408-163-A012	**DATE**	04/01/2021
DOCUMENT TITLE	PG TEST PROCEDURE FOR DM PLANT	**REVISION**	0

No.	GSECL/DCPL COMMENTS	BHEL REPLY	DCPL Reply _06Jan21
1	Samples of water will be drawn every hour from the outlet of Dual Media Pressure Filters, Activated Carbon Filters, Weakly Acidic Cation Exchangers, Strongly Acidic Cation Exchangers, Degasified Water Storage Tanks, Weakly Basic Anion Exchangers, Strongly Basic Anion Exchangers and Mixed Bed Exchangers and then tested in the laboratory. The results shall be compared against the required parameters as per tender specification.	Noted and incorporated.	Noted
2	Exhaustion of each Unit shall be indicated by the features described under Cl. No. 6.00.04 - Operation and Control Philosophy for Demineralization Plant. Units shall then be backwashed / regenerated at the specified regeneration level. Total amount of chemicals required for regeneration and the duration of chemical injection /regeneration of each Ion Exchange Unit shall be noted against the guaranteed figures.	These parameters are for normal operation of DM Plant and the same were already taken care. There was no guarantee for chemical consumption, hence, this clause not envisaged in PG test procedure. However, as per General Note-3 in PG test procedure the chemical consumption shall be noted for record purpose. Please accept.	Noted
3	The regenerated stream shall be again put into service and tests in item will be continued. At the end of run (as determined in above, total amount of water treated will be noted from the flow integrators.	The same is there in General Note-4 in PG test Procedure and also refer newly added General Note-6. Please accept.	Noted
4	The regenerated stream shall be again put into service and tests in item will be continued. At the end of run (as determined in above, total amount of water treated will be noted from the flow integrators.	The same is there in General Note-4 in PG test Procedure and also refer newly added General Note-6. Please accept.	Noted
5	Inlet water analysis is determined by making arithmetic average of all hourly readings of clarified water taken during the test.	Noted and incorporated.	Noted
6	Based on this inlet water analysis, regeneration level employed, resin volume provided and characteristic curves of the resins employed, the capacity of each stream in terms of total volume of treated water (m3) between two (2) successive regenerations shall be calculated. Resin volume shall not include the buffer and inert layers provided.	Refer newly added General Note-7. This is applicable if the present inlet water quality w.r.t tender water quality varies significantly. Please accept.	Noted
7	All the rotating/moving components shall be run at the rated speed with water/chemicals up to the normal water level for a period of twenty-four (24) hours. During this period all the components shall function smoothly without any unbalance, vibration, overheating at bearing parts, etc.	Refer newly added General Note-8. However, this shall be decided based on their duty of application. Please accept.	Noted

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

REV	DATE	ALTERED:	REV	DATE	ALTERED
		CHECKED: APPROVED			CHECKED

STATUS : CONTRACT

JOB NO.: 408

DEVELOPMENT CONSULTANTS PRIVATE LIMITED

Reviewed only for general conformance with contract drawings and specifications.
Contractor to be responsible for any errors and for fulfillment of detailed requirements of contract documents.

ACTION : 2 DATE : 06.01.21

DISTRIBUTED BY : BR

1	Distributed	4	Approved except as noted. Resubmission required.
2	Approved	5	Disapproved. See accompanying letter.
3	Approved except as noted. Forward final drawing.	6	For information and record only.

SEE COVERING LETTER

Letter Ref. No. M/9928 Date :

FALGUNI SAHA 2021.01.05 09:17:15 +05'30'

1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

DEVELOPMENT CONSULTANTS PVT LTD.

BHARAT HEAVY ELECTRICALS LIMITED
PROJECTS ENGINEERING MANAGEMENT,NEW DELHI

DEPT.	CODE		SCALE	WEIGHT(KG)	REF DRG.	ITEM
--	A		-	-	-	-

TITLE:

PG TEST PROCEDURE FOR DM PLANT.

	NAME	SIGN	DATE
PREP	FS		05/01/21
CHKD	JP		05/01/21
APPD	SB		05/01/21

DEPT.							CARD CODE	DRAWING NO.	REV
SIGN			N.A.				-	PE-V0-408-163-A012	1
DATE									

NO. OF SHEETS [ ] EXCLUDING COVER PAGE

PROJECT	:	1X800 MW WANAKBORI TPS.
PACAKGE	:	DEMINERALIZATION PLANT
OWNER	:	GUJARAT STATE ELECTRICITY CORPORATION LTD, GUJARAT.
CONSULTANT	:	DEVELOPMENT CONSULTATNS PVT LTD, KOLKATA.
SUPPLIER	:	BHARAT HEAVY ELECTRICALS LIMITED..

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OBJECTIVE

The objective of the PG Test is to ensure that the system is performing well, with respect to meeting/delivering the required parameters at the outlet of Filters and DM plants as prescribed in the contract specification and as indicated in this document elsewhere.

The system is closely monitored to ensure trouble free and optimum/efficient performance of all the electrical & mechanical equipments, accuracy of all instruments and functioning of all process interlocks for system reliability and integrity. Further, the PG test will also establish that the consumption of chemical and power is as per commitment with in tolerance limits.

DM PLANT FEED WATER ANALYSIS ANNEXURE-I

CONSTITUENTS	As	CONTENT
Calcium	CaCO3	85.0 ppm
Magnesium	CaCO3	94.0 ppm
Sodium & Potassium	CaCO3	75.0 ppm
Iron in Soln.	Fe	0.05 ppm
Hydrogen (FMA)	CaCO3	NIL
TOTAL CATIONS (except iron)	**CaCO3**	**254.0 ppm**
Bicarbonate	CaCO3	160.0 ppm
Carbonate	CaCO3	NIL
Hydroxide	CaCO3	NIL
Sulphate	CaCO3	20.0 ppm
Chloride	CaCO3	52.0 ppm
Nitrate	CaCO3	22.0 ppm
Phosphate	CaCO3	NIL
Fluoride	CaCO3	NIL
TOTAL ANIONS	**CaCO3**	**254.0 ppm**
Reactive Silica	SiO2	22.0 oppm
Colloidal Silica	SiO2	NIL
Conductivity at 25 deg C		440 Microsiemens/cm (max)
pH value at 250 C	-	7.5 – 8.0
Turbidity/TSS		Not to exceed 15 NTU/PPM (max)

Note: Parameters not indicated in above list shall be consider as Nil.

DM PLANT OUTLET WATER QUALITY ANNEXURE-II

Water Quality at the outlet of MB Exchanger:	
Total Electrolyte	0.1 ppm, max.
Reactive SiO_2	Less than 0.01 ppm as SiO_2
Iron as Fe	Nil
Free CO2 ppm as CO_2	Nil
Total Hardness	Nil
pH value at 25^0C	6.8 - 7.2
Conductivity, micro mho/cm	< 0.1 at 25 ^0C
Operating Hour	126
Water Quality at the outlet of SBA Exchanger:	
SiO_2	<0.1 ppm as SiO_2
Conductivity, micro mho/cm	< 5.0 at 25 ^0C
Operating Hour	18
Water Quality at the outlet of Degasser Tower:	
CO_2 content	< 5 ppm as CO_2.
Water Quality at the outlet of SAC Exchanger:	
Sodium	<1.0 ppm as $CaCO_3$
Hardness	Not Detectable
Operating Hour	18
Water Quality at the outlet of Dual Media Filter	
TSS	<1 ppm
Operating Hour	18
Water Quality at the outlet of Dual Media Filter	
TSS	<1 ppm
Operating Hour	18
Water Quality at the outlet of Dual Media Filter	
TSS	<1 ppm
Operating Hour	18
Water Quality at the outlet of ACF	
Free chlorine	Nil
Operating Hour	18

ANNEXURE – III

STANDARD OPERATING PROCEDURE (SOP) FOR CONDUCTING THE P.G.TEST

STEP 1: COMPLETION OF ERECTION OF MECHANICAL AND ELECTRICAL EQUIPMENTS.

Certify that all equipments (Mechanical / Electrical / Instrumentation as indicated in P&ID for DM Plant: PE-V0-408-155-A001) have been erected and commissioned and reliability ensured the plant is ready for PG test.

STEP 2: CALIBRATION OF INSTRUMENTS AND INTERLOCKS.

Certify that all instruments (as indicated in P&ID for DM Plant: PE-V0-408-155-A001) are functioning and all interlocks are provided and tested.

STEP 3: COLLECTION OF SAMPLES.

DM Plant feed water Samples shall be collected as per Annexure-I at the starting of PG Test. Testing of water samples at respective Dual Media Pressure Filters, Activated Carbon Filters, Weakly Acidic Cation Exchangers, Strongly Acidic Cation Exchangers, Degasified Water Storage Tanks, Weakly Basic Anion Exchangers, Strongly Basic Anion Exchangers and Mixed Bed Exchangers shall be collected in hourly basis and then shall be tested in the laboratory. The results shall be compared against the required parameters as stipulated in Annexure-II. Testing of these samples shall be carried out by BHEL and to be witnessed by M/s GSECL, however, facility as available in M/s GSECL lab can be used with prior permission from M/s GSECL.

1

Inlet water analysis is determined by making arithmetic average of all hourly readings of clarified water taken during the test.

1

STEP 4: LOG SHEET CERTIFICATION

All readings noted will be jointly signed by representatives of BHEL & GSECL.

STEP 5: AUTHORIZATION OF TEAM FOR PG TEST

BHEL:

GSECL:

General Notes for PG Test.

1) Necessary pumps shall be started and flow shall be established. Valves be adjusted so as to have required flow.

2) One (1) stream shall be running at a time.

3) Total amount of chemicals required for regeneration and the duration of chemical injection /regeneration of each Ion Exchange Unit shall be noted against the figures stipulated in process sizing calculation (Refer Doc No. PE-V0-408-163-A003).

4) Quantity of treated water as determined by tests as in above shall be checked against calculated quantity of treated water during regeneration as in above and must be equal to or more than the calculated amount.

5) All the tests shall be separately done for each of the two (2) Streams of the complete DM Plant.

1

6) After regeneration of one stream the same shall be taken into service again for testing.

1

7) Based on the inlet water analysis (**if the present inlet water quality w.r.t tender water quality varies significantly**), regeneration level employed, resin volume provided and characteristic curves of the resins employed, the capacity of each stream in terms of total volume of treated water (m3) between two (2) successive regenerations shall be calculated. Resin volume shall not include the buffer and inert layers provided.

1

8) All the rotating/moving components shall be run at the rated speed with water/chemicals up to the normal water level for a period of twenty-four (24) hours **as applicable based on respective item's duty of application**. During this period all the components shall function smoothly without any unbalance, vibration, overheating at bearing parts, etc.

9) At the end of the PG test the DM Plant shall be taken over for operation by M/s GSECL. Punch points, if any, may be mentioned in separate MOM to BHEL to subsequently address the same. These punch points will not have any effect on the success of the PG test.

LOG SHEET FOR DM PLANT PARAMETERS:

DATE								
TIME	DMF FEED PUMP		DMF					REMARKS
	FLOW (CUM/HR)	DISCH PRESSURE (KG/CM2)	FLOW (IN) (CUM/HR)	INLET PRESSURE (KG/CM2)	FLOW (OUT) (CUM/HR)	OUTLET PRESSURE (KG/CM2)	OUTLET TURBIDITY (NTU)	

DATE						
TIME	**ACF**					**REMARKS**
	FLOW (IN) (CUM/HR)	INLET PRESSURE (KG/CM2)	FLOW (OUT) (CUM/HR)	OUTLET PRESSURE (KG/CM2)	FRC (PPM)	

DATE					
TIME	**WAC**				**REMARKS**
	FLOW (IN) (CUM/HR)	INLET PRESSURE (KG/CM2)	FLOW (OUT) (CUM/HR)	OUTLET PRESSURE (KG/CM2)	

DATE						
TIME	**SAC**					**REMARKS**
	FLOW (IN) (CUM/HR)	INLET PRESSURE (KG/CM2)	FLOW (OUT) (CUM/HR)	OUTLET PRESSURE (KG/CM2)	SODIUM (PPM)	

DATE						
TIME	DGT			DG WATER TRANSFER PUMP		REMARKS
	FLOW (IN) (CUM/HR)	INLET PRESSURE (KG/CM2)	OUTLET CO2 (PPM)	OUTLET FLOW (CUM/HR)	DISCH PRESSURE (KG/CM2)	

DATE					
TIME	**WBA**				**REMARKS**
	FLOW (IN) (CUM/HR)	INLET PRESSURE (KG/CM2)	FLOW (OUT) (CUM/HR)	OUTLET PRESSURE (KG/CM2)	

DATE							
TIME	**SBA**						**REMARKS**
	FLOW (IN) (CUM/HR)	INLET PRESSURE (KG/CM2)	FLOW (OUT) (CUM/HR)	OUTLET PRESSURE (KG/CM2)	CONDUCTIVITY (micro mho/cm at 25 DEG C)	SILICA (PPM AS SIO2)	

DATE								
TIME	**MB**							**REMARKS**
	FLOW (IN) (CUM/HR)	INLET PRESSURE (KG/CM2)	FLOW (OUT) (CUM/HR)	OUTLET PRESSURE (KG/CM2)	CONDUCTIVITY (micro mho/cm at 25 DEG C)	SILICA (PPM AS SIO2)	pH VALUE	