Addendum 02

To

MRPL Tender No. 3200000481 dated 16.01.2021

TENDER FOR LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU

With reference to the above tender, bidders are requested to note the following:

The items, conditions, specification and stipulations of the Bidding Documents and modified to the extent indicated in

i) **Annexure – 1: Commercial Addendum**
ii) **Annexure – 2: Technical Addendum**
iii) **Annexure – 3: Reply to Pre-Bid Queries**

The implications of the same, elsewhere in the tender shall be taken care of appropriately by the bidders. All other terms and conditions, stipulations and specifications of tender shall remain unaltered.

Note:

Bidders shall submit copy of these documents along with the technical–commercial bid, **duly signed and stamped**, as a token of having read and understood the same.

_____
Bidder's Seal & Signature

Addendum 02 – Annexure -1: Commercial Addendum

Sr. No.	Volume	Section No. / Clause No.	Page No.	Existing Tender Clause	Addition / Deletion / Modification
1	1	**SECTION 4** **SPECIAL CONDITIONS OF CONTRACT** **Clause 6.3** **AND** **SECTION 5** **PREAMBLE TO SCHEDULE OF LUMPSUM PRICE** **Clause 1.15**	7 of 673 4 of 5	The quoted prices shall also be inclusive of cost towards insurance taken by the Bidder/Contractor, except for the Comprehensive Marine Cum Erection Insurance Policy taken by Owner as stipulated in this tender document, till contractual / extended Contractual completion period. Quoted Lump sum price shall be exclusive of Comprehensive Insurance (Marine cum transit cum storage and erection) till handing over of the package, as per provision of the Bidding Document. However, the insurances to be taken by the Contractor as per provision of the bidding document shall be included in the lumpsum quoted price.	Bidder to note that the Comprehensive all risk insurance is in LSTK Bidder's scope. Owner will not provide any insurance. Bidder to also note that "LSTK Bidder has to provide Insurance Policies, duly mentioning that MRPL is Owner & LSTK Bidder is a Contractor."

Addendum 02 – Annexure -2: Technical Addendum

Sr. No.	Volume	Section No. / Clause No.	Page No.	Existing Tender Clause	Addition / Deletion / Modification / Clarification
1	2	Tie-In Dosier Document ID: 6723-PIP-331-MB-0003 Piping and Instrumentation Diagram PFCCU Utility Section (331/332/339) Cooling Water Distribution	Sheet 7 of 17		Since Effluent Cooler is deleted, there is no process requirement of cooling water. However, the tie ins TP-331-05 and TP-331-06 are retained in the Tie in Dossier. CONTRACTOR to resize or delete these tie ins during detail engineering based on cooling water requirement for pump seal etc.
2	2	Tie-In Dosier Document ID: 6723-PIP-331-MB-0003 Oily Waste Transfer System (Near DCU Unit)	Sheet 6 of 17	**8" Hot tapping for 4" conn**	**8" Hot tapping for 6" conn** Bidder to consider 6" instead of 4"

Sr. No.	Volume	Section No. / Clause No.	Page No.	Existing Tender Clause	Addition / Deletion / Modification / Clarification
3	2	Tie-In Dosier Document ID: 6723-PIP-331-MB-0003 Piping and Instrumentation Diagram PFCCU Utility Section (331/332/339) Cooling Water Distribution	Sheet 7 of 17	TP-331-05 TP-331-06	Existing header size is extended to make new tap-off.
4	2	Tie-In Dosier Document ID: 6723-PIP-331-MB-0003 Piping and Instrumentation Diagram FCC Utility Distribution - (Unit - 331/332/339) Plant Air / Instrument Air Distribution	Sheet 9 of 17	TP-331-14 TP-331-08	Existing header size is extended to make new tap-off.
5	2	Tie-In Dosier Document ID: 6723-PIP-331-MB-0003 Piping and Instrumentation Diagram PFCCU Utility Section (331/332/339) Nitrogen Distribution	Sheet 13 of 17	TP-331-19	Existing header size is extended to make new tap-off.

Sr. No.	Volume	Section No. / Clause No.	Page No.	Existing Tender Clause	Addition / Deletion / Modification / Clarification
6	2	Tie-In Dosier Document ID: 6723-PIP-331-MB-0003 Layout of Underground Services ISBL PFCC / PR Unit. Drawing No. 6993-331-16-47-0-404 AREA - 04	Sheet 16 of 17	**Comment: This was shown in field. However this is OWS man hole**	Bidder to ignore this comment.
7	4	Piping List Document ID: 6723-PIP-331-MB-0001 PWHT for Sr. No. 46 to 65	2 of 4		Bidder to note that Site PWHT for stainless steel materials should be avoided in order to avoid IGC problem.
8	4	Equipment Layout PFCC Unit Flue Gas Wet Scrubber System Plan View. Document ID: 6723-LAY-331-LD-0001 (Sheet 1 of 2)			Nozzle Orientation shown in plot is indicative only. LSTK contractor to finalize the nozzle orientation during detail engineering

Sr. No.	Volume	Section No. / Clause No.	Page No.	Existing Tender Clause	Addition / Deletion / Modification / Clarification
9	2	Contractor's Scope of Supplies and Scope of Work – Piping. Document ID: 6723-PIP-331-CA-0002 Clause No. 5.1.8	7 of 9		Erection spares, Commissioning spares & All piping related Mandatory spares will be in the scope of LSTK contractor. Mandatory spares to free issued to MRPL.
10	2	Contractor's Scope of Supplies and Scope of Work – Piping Document ID: 6723-PIP-331-CA-0002 Clause No. 5.1.9	7 of 9		Contractor to Check feasibility & adequacy of hot taps for tie-in's. Contractor to prepare tie in schedule.
11	2	Contractor's Scope of Supplies and Scope of Work – Piping Document ID: 6723-PIP-331-CA-0002 Clause No. 7 Revised Underground Piping Concept	8 of 9		Shifting of any existing Firewater lines or any other UG lines in current plot is scope of LSTK contractor

Sr. No.	Volume	Section No. / Clause No.	Page No.	Existing Tender Clause	Addition / Deletion / Modification / Clarification
12	2	Contractor's Scope of Supplies and Scope of Work – Piping Document ID: 6723-PIP-331-CA-0002 Preamble	4 of 9		Miscellaneous scope of LSTK contractor during constructions like liquidation of Owner / Licensor Punch list, third party safety audits, OISD safety audits if required, obtaining clearances from Statutory authorities etc., shall be in Bidder's scope of work.
13					The Adequacy Check Report, Document ID 6723-PRC-331-DD-0001 for the WSS Project at MRPL is attached as Attachment-1. The same to be validated and implemented by the LSTK Contractor without any additional Price and Schedule implication.

Sr. No.	Volume	Section No. / Clause No.	Page No.	Existing Tender Clause	Addition / Deletion / Modification / Clarification
14	4	Engineering Design Basis for Electrical doc. no. EDB-0003, clause 4.2 – Area classification and Equipment selection	7 of 59		There are no hazardous chemicals in WSS plot. However, WSS plot is a part of PFCC Unit. The effect of hazards in PFCC Unit on WSS area is to be checked by LSTK contractor and to be considered for selection of electrical equipment of WSS unit as per Clause 4.2 and Annex-I to Design Basis for Electrical attached herewith as Attachment-2. The area classification layout of PFCC Unit (Doc No. 6993-331-16-50-0601 Rev C) is attached herewith as Attachment-5. Further all Electrical Equipment (HV and LV Induction Motors, Light Fixtures, power and convenience sockets, Distribution boards, Local Control Stations, Cable glands, Fire Alarm devices and Communication system equipment etc) within WSS plot as a

					minimum shall be suitable for Zone-2, Gas Group IIA/IIB, as per Note-3 of area classification layout of PFCC Unit. Necessary certification from statutory authorities shall be provided as per Clause 4.2 of Design Basis for Electrical (EDB-0003)
15	4	Technical Specifications-High Voltage Induction Motors (Doc No. 6723-ELT-331-EC-0008, Rev 00) Part 7.14		6723-ELT-331-EC-0008, Rev 00	The document is replaced with 6723-ELT-331-EC-0008, Rev 01 Refer Attachment - 3
16					Technical Specifications for Flameproof LED Luminaires (Doc No. 6723-ELT-331-EC-0015,Rev 00) is added as Attachment-4

Addendum 02 – Annexure -3: Reply to Pre-Bid Queries

SL. NO.	BIDDING DOCUMENT		SUBJECT	BIDDER'S QUERY	OWNER'S REPLY
	PAGE NO.	CLAUSE NO.			
1	25 of 27	VOLUME_2_2 6723-ELT-331-CA-0001_000_00_Electrical LOCAL CONTROL STATION PART-II DESIGN DATA SHEET	Hazardous Area Classification	As per tender Doc- Local Control Station Data sheet mentions "Hazardous area classification: NOT APPLICABLE" whereas, - LOW VOLTAGE INDUCTION MOTORS Data Sheet (6723-ELT-331-EC-0007) mentions "Hazardous Area Enclosure Protection: To be selected as per hazardous area classification drawing" - Electrical Design Basis doc. no. EDB003, clause 4.2.1 mentions "area shall be classified as applicable". Bidder requests client to confirm the hazardous area applicability; and provide Hazardous Area Classification Drawing, if applicable.	There are no hazardous chemicals in WSS plot. However, WSS plot is a part of PFCC Unit. The effect of hazards in PFCC Unit on WSS area is to be checked by LSTK contractor and to be considered for selection of equipment of WSS unit accordingly. The area classification layout of PFCC Unit (Doc No. 6993-331-16-50-0601 Rev C) is attached herewith as Attachment-5.
2	ELECTRICAL DESIGN BASIS	VOLUME_4_1 DESIGN BASIS 7.4.7	Aircraft Warning Lights (ACWL) on Stack	As per tender Doc - Aircraft Warning Lights shall be medium intensity flashing red light per ICAO, as mentioned in the Design Basis.	Bidder to follow tender document for Aircraft Warning Lights (ACWL). The

				Bidder proposes to install ACWL control panel in Sub Station-37. Presently, ACWL control panel is not shown in Sub Station-37 layout Drawing no. 6723-ELT-G00-LH-0001_000_00. Client to confirm if our proposal of locating ACWL panel in substation-37 is acceptable.	location of control panel for ACWL shall be finalised during detailed engineering.
3		VOLUME_4_7_ELECTRICAL_6 Drawing no. 6723-ELT-G00-FA-0001_000_00	Usability of existing 6.6kV SWGR-37211 Spare Feeders	As Per Drawing no. 6723-ELT-G00-FA-0001_000_00, Single Line Diagram Sub Station-37, 6.6kV Switchgear SWGR-37211, existing feeders (PANEL NO. 4 and 54) shall be used for the two 6.6kV WSS 150kW Motors. Bidder request Client to confirm/ furnish the following: - These two feeders, PANEL NO. 4 and 54 are SPARE. - Physical condition of these two feeders are OK - Model number and Make of the Switchgear - Circuit Breaker Model number - Nameplate details (photo, if permitted)	Bidder to refer Technical Specification (Doc No. 6723-ELT-331-EC-0001) for existing panel documents. Bidder to visit the site for verification of physical conditions of existing panels and to understand extent of scope of work for existing feeder modification.

4		VOLUME_4_7_ELECTRICAL_6 Drawing no. 6723-ELT-G00-FA-0001_000_00	Usability of existing 415 V SWGR-37302 Spare Feeders	As Per Drawing no. 6723-ELT-G00-FA-0001_000_00, Single Line Diagram Sub Station-37, 415 V Switchgear SWGR-37302, existing feeders (PANEL NO. 4F2 and 15F1) shall be used as feeder to new WSS 415V MCC. Bidder request Client to confirm/ furnish the following: - These two feeders, PANEL NO. 4F2 and 15F1, are SPARE. - Physical condition of these two feeders are OK - Note the Model number and Make of the Switchgear - Confirm Air Circuit Breaker is 800 Amps and note the Model number. - Nameplate details (photo, if permitted) - Check cables are bottom entry	Bidder to refer Technical Specification (Doc No. 6723-ELT-331-EC-0001) for existing panel documents. Bidder to visit the site for verification of physical conditions of existing panels and to understand extent of scope of work for existing feeder modification.
5		VOLUME_4_7_ELECTRICAL_7 Drawing no. 6723-ELT-G00-FA-0001_010_00	UPS ACDB extension	Please note that 37-US-703 UPS 110VAC: UPS ACDB will be extended to feed WSS UPS loads - Please confirm extension of ACDB on LEFT-HAND side is possible as proposed.	Bidder to refer Technical Specification (Doc No. 6723-ELT-331-EC-0013) for existing ACDB documents and SRR-31 equipment layout indicating location of

				- Confirm space availability of Left-hand side of ACDB. - Check feasibility of ACDB extension without UPS shutdown or if shutdown required. - Note the UPS make, ACDB Model number and nameplate details	31-ACDB-703. Bidder can further visit the site to collect information on space availability.
6		VOLUME_4_7_ELECTRICAL_7 Drawing no. 6723-ELT-G00-FA-0001_010_00	DC UPS spare availability	Please note that 37-DB-701 UPS 110V DC: Existing Spare shall be used. - Client to Furnish number of Spares and its Amp rating. (Requirement for WSS is one feeder)	The details of spare feeder in existing 37-DB-701 shall be provided to successful bidder during detailed engineering
7		VOLUME_4_7_ELECTRICAL_7 Drawing no. 6723-ELT-G00-FA-0001_010_00	63A, 415V Aux. DB spare availability	Please note that SWGR-37411, Aux Service Board: Existing Spare will be used for WSS aux. power. - Check number of 63 Amps Spares available - Check other rating spares available	Bidder to refer documents already available in tender. Bidder can visit the site to collect additional information required if any.
8		VOLUME_4_7_ELECTRICAL_7 Drawing no. 6723-ELT-G00-FA-0001_010_00	Lighting feeder spare availability	Please note that SWGR-37331, Lighting DB: Existing Spare circuit will be used for WSS Lighting. - Check number of 63 Amps Spares available - Check other rating spares available	Bidder to refer documents already available in tender. Bidder can visit the site to collect additional information required if any.

9		VOLUME_4_7_ELECTRICAL_7 Drawing no. 6723-ELT-G00-FA-0001_010_00	Emergency Lighting feeder spare availability	Please note that SWGR-37333, Emergency Lighting DB: Existing Spare circuit will be used for WSS Lighting. - Check number of 63 Amps Spares available - Check other rating spares available	Bidder to refer documents already available in tender. Bidder can visit the site to collect additional information required if any.
10		VOLUME_4_7_ELECTRICAL_8 Drawing no. 6723-ELT-G00-LH-0001_000_00	Substation Floor cut-out and space for VSD	Please note that in Sub Station-37: - in VSD Room, please confirm that space is available for 2 VSD of dimension 900mm Wide x 800mm Depth - Please check floor cut-out is available at the location of new MCC for WSS. - Type of floor cut-out, whether it is chequered plate/ removable slabs. - Indicate if floor cutting is required and approximate area of cutting.	Bidder can visit the site and collect required information.
11		VOLUME_4_7_ELECTRICAL_10 Drawing no. 6723-ELT-G00-LH-0001_000_00	Space for new cable ducts and trench	Please note that as marked in this Overall Cable routing: - Kindly Confirm feasibility of making new cable culvert of 1200mm wide on south-side of Substation-37, east of existing cable culvert.	Overall Cable route indicated in document 6723-ELT-G00-LD-0001 is preliminary. LSTK contractor to develop cable routing layout based on site condition and as

				- Kindly Check space between SRR-31 existing cable trench and Hard-stand to make new cable trench of 600 mm wide. - Kindly Check space available on north side of Hard-stand for new cable trench of 750 mm wide	per requirement of layout and tender documents. Bidder to visit the site to understand site condition and collect all requisite details.
12		General	Civil & Structural	Whether the existing plot is levelled? Any earthwork need to be considered?	The plot is generally levelled. Bidder is supposed to visit the site to understand site condition & local conditions.
13		General	Civil & Structural	Site cleaning - any tree cuttings are required?	Not required. Bidder to visit the site to understand site condition & local conditions.
14		General	Civil & Structural	Relocation of existing services/structures needed, if any?	Bidder to carry out underground scanning work for locating underground services. For above ground relocation work, bidder to visit site to get clear idea of the work.
15		General	Civil & Structural	Requirement of temporary barricading envisaged (Lg x Wd x Ht ?), if any?	Temporary Barricading is required. Refer Tender specifications. Bidder to visit site for length X Width X height

					requirement. The unit plot plan is attached with Tender.
16		General	Civil & Structural	Foundation type (Open FDN. Or Deep FDN.) for existing structures surrounding WSS	The decision of type of foundation depends upon loading & available strata. Available soil investigation report of surrounding area is enclosed with the Tender document, for general idea. Nearby Foundations are generally open foundations but bidder to decide based upon envisaged loads.
17		General	Civil & Structural	Hard stand requirements?	Hardstand required for crane movement during erection - Bidder to decide the expected crane load based upon his erection scheme & available strata.
18		General	Civil & Structural	Any hurdles for Transportation from MRPL gate to Site	Bidder to visit site & get acquainted with site & other local conditions.
19		General	Civil & Structural	Availability of Fabrication Area inside refinery (for Piping, Structure & Equipment fabrication- if required)	There is no space available inside refinery. Bidder to visit site to get more insight of site conditions.

20		General	Civil & Structural	Clearance available below Existing Pipe racks (Width & height)	Bidder to visit site to get more insight of site conditions.
21		General	Civil & Structural	Any Culverts / Sharp Turns, Bridges between the gate & Site	Bidder to visit site to get more insight of site conditions.
22		General	Civil & Structural	Soil bearing capacity of the Scrubber Area	Soil investigation WSS area is not carried out. It is in bidder's scope. The available soil investigation report of nearby area is attached with Tender.
23	10 of 33	Volume 2 2.6.3	Contractor's Scope of Work - Process Doc. No. 6723-PRC-331-CA-0003	New Service Water Pump is to be installed in parallel to existing pump and integrated with existing system. Bidder request Client to furnish P&ID for existing Service Water Pumps.	New Service Water pump not to be installed. However, P&ID of existing service water network indicating the tie in point is a part of Tie In Dossier in FEED.
24	31 of 33	Volume 2 2.12.4	Contractor's Scope of Work - Process Doc. No. 6723-PRC-331-CA-0003	As per Tender Bidder shall design / develop solid waste management, handling and disposal system for Units and associated O &U facilities. Bidder request Client to give detailing for the above scope. Is there any basis document for solid waste management?	The quantity and composition of solid waste generated is provided in "Emission List". The details of solid waste management on WSS plot are described in "Process Description" Both the documents are part of FEED.

25	1	P&ID C194302-00-WGS-AA00-PID-0002	Specifications	Please note that the Datasheet and Specification of following items are not available: 1. Damper marked as BD-331900, BD-331901, BD-331902 & BD-331903 to be installed in the inlet line of High Expansion Venturi. 2. Expansion bellows marked as SP-SXB-33101A, SP-SXB-33101B, SP-SXB-33101C & SP-SXB-33101D to be provided just at inlet of each High Expansion Venturi. Bidder requests client to provide the same.	Expansion Bellows SXB-33101A & SXB-33102 Technical Specifications are attached as Attachment-6 Dampers (BD-331900, BD-331901, BD-331902 & BD-331903) Specifications are attached as Attachment-7
		General	Site Photographs	Bidder requests client to share site photographs of area under consideration and adjacent area	Site Photographs shall be provided only to successful bidder.
26	DATA SHEET Page 10 of 10	VOLUME_4_7_ELECTRICAL_1 6723-ELT-331-EC-0002_000_001 TECHNICAL SPECIFICATION - LOW VOLTAGE SWITCHGEAR Notes no. s) & t)	Spares for Motor Starter Feeders	As per Notes s) and t), "Spare outgoing feeders of each rating and type shall be provided equal to 20% of number of feeders but not less than one on each bus section." Bidder's understanding is as follows: 1) Spares will be 20% of each identical type of feeders. e.g. if 0.37kW, 0.75kW and 1.1kW motors are identical in components rating and wiring type,	Bidder's understanding is not correct. Bidder shall comply with Technical Specification (Doc No. 6731-ELT-331-EC-0002) / Part IIA_Design Data sheet / Sheet 10 of 10/Clause t) for spare feeder requirement. Spare outgoing feeders of each rating and type shall be provided equal to 20%

				then number of spares will be 20% of the total of 0.37kW, 0.75kW and 1.1kW starters and not 20% of each kW of motor. Else it would result in 100% spare number of feeders and increase in MCC length and issue of available space between the two existing switchboards in Substation-37. 2) If there are two spares to be provided of same type, one spare feeder will be provided on each Bus. 3) If it is one Spare required based on 20%, then the Spare will be provided on one of the Bus. This single spare motor starter module can be used on any Bus since all starter modules are draw out type. Please confirm if our understanding on SPARE feeders as mentioned above is correct.	of number of feeders but not less than one on each bus section.
27	DATA SHEET Page 10 of 10	VOLUME_4_7_ELECTRICAL_1 - 6723-ELT-331-EC-0002_000_001 TECHNICAL SPECIFICATION - LOW VOLTAGE SWITCHGEAR	Spare Feeders for Owner's use	As per Note.t) of Datasheet, in addition to spares, following feeders for Owner's use shall also be provided: 2 No. ACB fed motor feeder (rating shall be informed during detailed engineering) 2 No. 55 kW motor feeder (DOL)	Bidder's proposal is not acceptable. Bidder to comply with tender documents.

		Notes no. t)		2 No. 11 kW motor feeder (DOL) 2 No. 7.5 kW motor feeder (DOL) 2 No. 2.2 kW motor feeder (DOL) 2 No. 125A MCCB power feeder 2 No. 63A MCCB power feeder Since MCC is rated only 800A and upstream feeder is also only 800A, Bidder suggestion is that having 2 No. ACB fed motor feeder serves no purpose for future also due to loading limitation of the 800A MCC. Hence all above listed feeders for Owner's use will be provided except 2 Nos. ACB feeders. This should be more than adequate for Owner's future use. Please confirm if Bidder's suggestion is acceptable.	
28	Sheet 1 of 1	VOLUME_4_2_PROCESS_7 P&I DIAGRAM C1943402-00-WGS-AA00-PID-0002-03	Technical Specification for Bellows	Please note that the Technical Specification for Bellows (SP-SXB-3310A/B/C/D & SP-SXB-33102) are not available. Request to furnish the Technical Specification for Bellows.	Expansion bellows SXB-33101A, SXB-33102 technical specification are attached as Attachment-6

29	Sheet 1 of 1	VOLUME_4_2_PROCESS_7 P&I DIAGRAM C1943402-00-WGS-AA00-PID-0002-03	Technical Specification for Dampers	Please note that the Technical Specification for Dampers (BD-331900, BD-331901, BD-331902 & BD-331903). Request to furnish the Technical Specification for Dampers.	Dampers (BD-331900, BD-331901, BD-331902 & BD-331903) Specifications are attached as Attachment-7
30		VOL 2-1 1. Proj Mgmt, Planning. 6.6 para 2 8 of 26 of 6723-PMG-331-BD-0001_000_01.pdf	Dismantling of existing steel stack	- This is limited to structural steel in superstructure (including lining, ladders, F15 platform etc.) and pedestals/bolts above ground level. Bidder request client to confirm the same. - Foundation/Pile cap / Piles (as applicable), PCC and so forth below ground level need not to dismantle/dispose. Bidder request client to confirm the same.	Bidder to refer cl. No.4 c (iv) of Doc. No. 6723-CVC-331-CA-0005. Clause is self-explanatory. In case, for accommodating some nearby foundations based upon bidder design is required, then only demolition below ground in stack area is expected.
31		MDS pg 2 of 5, 6723-EQS-331-EC-0001	Hydrotest of DISENGAGING DRUM	The difference in hydrotest & Operating loads for disengaging drum is ~ 1200.0 t, the field hydrotest or accidental fill of water is NOT considered for civil/structural design. Bidder request client to confirm the same.	Bidder to consider static head of 0.57 kg/sq cm(g) for design of disengaging drum, civil/structural design and the same is to be used as test water fill up level [Refer to note 11 of PDS, Doc ID : C1943402-00-WGS-AA00-DSH-0001-R3]

32		Vol 4.9 REPORTS EIL Geotechnical Investigation Report for PFCC Unit.pdf	Pile Foundation	Whether proper access & adequate space is available for rigs & other accessories?	Bidder is supposed to visit the site to understand site condition & local conditions.
33	Page 8 of 14 (PIP)	VOLUME_4_4_PIPING AND LAYOUT 6723-HES-331-EC-0001, Rev 00 Clause No. 5.2	"Dwg. No.6993-331-16-47-0024- Rev 2	Requirement of "Dwg. No.6993-331-16-47-0024- Rev 2" Fire Hydrant Network Drawing is not available in Bid documents. Bidder request client/PMC to furnish the "Dwg. No.6993-331-16-47-0024- Rev 2" Fire Hydrant Network Drawing.	This drawing shall be shared with successful bidder during Detailed Engineering.
34		C1943402-00-WGS-AA00-LST-0004	Chemical Requirement	Bidder requests client/PMC to furnish duration for which chemical need to be supplied for Dosing system.	Refer Clause 2.11 of document 6723-PRC-331-CA-0003 (CONTRACTOR'S SCOPE OF WORK PROCESS) Filling of lubricants, Oils, consumables, chemicals etc. for first filling and replacement during cleaning/ flushing/ pre-commissioning/ commissioning and upto successful PGTR is in CONTRACTOR's scope.
35			Vendor name	The approved vendor list for "Agitator" is not available. Bidder requests client/PMC to furnish the	Wherever there is no Vendor list available in the Tender, Bidder to submit

				same. We are considering M/s GMM faudler for the same.	their proposed Vendor list for approval of PMC / Owner.
36	53 of 271	GENERAL CONDITIONS OF LUMPSUM TURNKEY (LSTK) / PACKAGE CONTRACT Clause No 3.5.0.0	Power Supply	Bidder understands that power will be provided by Client on chargeable basis. Request Client to provide unit rate for Power	Unit Rate shall be shared with successful Bidder.
37				Bidder request Client to provide the drawing for existing stack (which needs to be dismantled).	Please find attached stack drawing for reference. (drg. no. G27-1WH-68248 Rev 01) as Attachment-8. This drawing an indicative drawing of existing stack. Any deviation found at site shall be in Bidder's scope with no extra time and cost to Owner's / PMC's account.
38		C1943402-00-WGS-AA00-DSH-0001-R3_archive	Disengaging Drum	Please note that as per said document no Process Datasheet of Disengaging Drum is available. Instead of that only Disengaging Drum Drg detail is attached. Bidder request client to furnish process Datasheet of the same including Drum internals (Chimney Tray and De-Entrainment Grid)	The document "C1943402-00-WGS-AA00-DSH-0001-R3_archive" is furnished by the licensor and contains all the data required for design of the equipment along with the GA drawing. The details of Chimney Tray and De-Entrainment Grid are also included in

					Sheet 2 of the same document. In case any specific dimension or parameter is required, bidder may raise specific query.
39			Size Limitations	Bidder requests to provide details of the maximum limit of size for Transportation (i.e. L* w *h) along with weight limitation (to be transported within the refinery premises upto Wet Gas Scrubber Area. There are two nos of oversized equipment in the subject tender Disengaging Drum: 7 m (I.D) * 30 (I) Clarifier Tank: 11.5 m (I.D) * 4 m (Height)	Bidder to visit site & get acquainted with site & other local conditions. Accordingly, he has to make his transportation planning. The soil investigation report of nearby area is attached with Tender for getting the idea of available strata. Furthermore, bidder to refer point no.12 , of cl.no. 3 of 6723-CVC-331-CA-0006.
40	SITE VISIT ON 27/01/2021; VOLUME 4.4 PIPING & LAYOUT	OVERALL PLOT PLAN-REF. DWG :- 6993-331-16-43-0001-R1	LEVEL & GRADED SPACE FOR FABRICATION YARD	BIDDER'S OBSERVATION AFTER SITE VISIT & REF. PLOT PLAN IS THAT THERE IS NO SUFFICIENT SPACE FOR FABRICATION YARD & CONTAINER / CABINS AT PROJECT SITE. PLEASE LET US KNOW OF ALTERNATIVE ARRANGEMENT FOR THE SAME BY CLIENT	Refer relevant points of cl.no. 4, of 6723-331-CA-0005 which are self-explanatory.

41	PRE-BID MEETING & SITE VISIT DATED 27/01/2021; PAGE 174 OF 271 OF GCC & PAGE 19 OF PAGE 673 OF SCC	10.17.0.0 – WORK PERMIT- PAGE 174 OF 271 OF GCC. & 20.3 OF PAGE 19 OF PAGE 673 OF SCC	REQUIREMENT OF WORK PERMIT WITHIN BARRICADED AREA	BIDDER REQUESTS CONFIRMATION ON REQUIREMENT OF WORK PERMIT FOR CARRYING OUT WORK WITHIN BARICADED AREA	As per MRPL Safety Policy Bidder shall require Work Permit for carrying out any work within Barricaded Area inside Refinery Premises.
42	SITE VISIT ON 27/01/2021; VOLUME 4.4 PIPING & LAYOUT	P&IDS, DOCUMENT ID : 6723-PIP-331-MB-0002 & TIE IN LIST	SPACE AVAILABILITY FOR LAYING ADDITIONAL PIPE-LINE FROM TIE-INS ON EXISTING TIERS / RACKS	BIDDER'S OBSERVATION THAT EXISTING PIPING IS CLOSELY PACKED / ROBUST, IT IS A CHALLENGE TO LAY/ERECT PIPING IN EXISTING TIERS. REQUEST WHETHER TIER/RACK WIDTH CAN BE EXTENDED OR ADDITIONAL TIER PROVIDED IN ORDER TO INCORPORATE ADDITIONAL LINES WHERE EVER REQUIRED. ALSO, PLEASE CONFIRM WHETHER WORK PERMITS ARE REQUIRED FOR LAYING OF SUCH PIPING	No additional Tier is envisaged. However, Bidder to make a site visit and take appropriate decision to suit the site conditions. For any work to be carried out within existing facility, Permit to Work system will be applicable.

43	SITE VISIT ON 27/01/2021; VOLUME 4.4 PIPING & LAYOUT	P&IDS	CHALLENGES INVOLVED IN ROUTING INST. CABLE UP TO SRR	BIDDER'S OBSERVATION ON CHALLENGES IN ROUTING CABLE. WHETHER ADDITIONAL CABLING CAN BE ROUTED IN SUCH A MANNER / OPTION WORKED OUT TO AVOID HINDRANCES.	Bidder to follow Tender Conditions.
44	ANNEXURE-III FORMAT FOR SUB-CONTRACTORS APPROVAL IN SCC	ANNEXURE-III IN SPECIAL CONDITIONS OF CONTRACT - SCC	SUB-CONTRACTING OF POST ORDER DETAIL ENGINEERING FROM THIRD PARTY / CONSULTANT	BIDDER REQUIRES CONFIRMATION WHETHER POST ORDER DETAIL ENGINEERING CAN BE OUTSOURCED AND IF SO, THEN REQUIREMENTS/ELIGIBILITY CRITERIA OF ANNEXURE – III OF SCC SHOULD BE FOLLOWED OR NOT.	Bidder to follow the Tender Conditions.
45	PAGE NO. 3 OF 18- NIT	NOTICE INVITING TENDER – BRIEF SCOPE OF WORK	IMPLEMENTATION OF RECOMMENDATION FROM SAFETY STUDIES	PLEASE CONFIRM WHETHER HAZOP, SIL, HAZEN IS IN THE SCOPE OF LSTK CONTRACTOR OR NOT. – ONLY IF RECOMMENDATIONS HAVE TO BE FOLLOWED	HAZOP, SIL, HAZAN are in the scope of LSTK Contractor. Refer Section 2.2 (HAZOP and SIL study) in Document 6723-PRC-331-CA-0003 (Contractor's Scope of Work-Process) for details of appointing Third Party Chairman.
46	PAGE NO. 26 OF PAGE 673 OF SCC	30.0 OF PAGE NO.26 OF PAGE 673 OF SCC	GUARANTEES	BIDDER UNDERSTANDS THAT BIDDER DOES NOT HAVE TO PROVIDE THE PROCESS GUARANTEE.	Bidder to refer the document "Contractor's Scope of Work – Process", Page 32 of 33, Clause No. 2.13

47	VOLUME 4.4 PIPING & LAYOUT	PIPING COMPONENTS	DATA SHEETS FOR VALVES – BALL, GLOBE, CHECK, TSVs, PCVs, ETC.	BIDDER WAS UNABLE TO LOCATE DATA SHEETS PERTAINING TO VALVES - BALL, GLOBE, CHECK, TSVs, PCVs, ETC. REQUEST TO FURNISH THE SAME.	There are no separate valve specifications. EIL pipe class information shall be used as it is which is provided along with bid documents
48	VOLUME 2_1	VENDOR LIST	APPROVED VENDORS FOR SCANNING - GPR	BIDDER WAS UNABLE TO LOCATE APPROVED VENDORS FOR GPR. REQUEST TO FURNISH THE SAME.	As this is not a Critical item, it is not appearing in approved Vendor List of MRPL. Hence Bidder to select appropriate agency for GPR. Bidder will be responsible for correctness and completeness of GPR Survey.
49	PAGE NO. 3 OF 18- NIT	NOTICE INVITING TENDER – BRIEF SCOPE OF WORK	DISMANTLING OF EXISTING STACK & KEEPING SCRAP MATERIAL AT THE DESIGNATED AREA SUGGESTED BY VENDOR	BIDDER REQUIRES CONFIRMATION THAT ANY SORT OF CLEARANCES – GOVT OR FROM LOCAL AUTHORITIES – VIZ ENVIRONMENTAL, ETC. NOR ANY OTHER FORM OF ENCUMBERNCES FOR KEEPING SCRAP AT DESIGNATED AREA WILL NOT BE IN BIDDER'S SCOPE	The designated Area to keep the dismantled Stack is within MRPL Premises. Hence no external permissions are required, but Bidder to follow MRPL guidelines for the same. Other than this any other Statutory requirements / Permissions required for the project are in Bidder's scope as per Tender Conditions.

50		VOLUME 4-4 (PIPING AND LAYOUT)		BIDDER REQUEST TP PROVIDE VALVE MATERIAL SPECIFICATION FOR MANUAL VALVES	There are no separate valve specifications. EIL pipe class information shall be used as it is which is provided along with tender documents
51	PAGE 5 OF 9	VOLUME 2-2 /VOLUME 4-4 (SCOPE OF WORK PIPING) CLAUSE NO.4.1.8 & SPECIFICATION FOR 3D MODELLING		AS PER CAUSE BIDDER REQUEST TO KINDLY CONFIRM THE 3D SOFTWARE (PDMS OR E3D) TO ADOPTED FOR THIS PROJECT.	Refer Doc. No. 6723-PIP-331-EB-0004 in vol 4. PDMS software shall be used for 3D modelling.
52		VOLUME 2-2 TIE IN DOSSIER		BIDDER REQUEST TO PROVIDE TENTATIVE LOCATIONS OF TIE IN POINT AS PER TIE IN LIST. AND BIDDER UNDERSTANDS THAT ONLY 5 NOS. TIE IN ARE BY HOT TAPPING. BIDDER REQUEST TO KINDLY CONFIRM THE SAME	Refer Tie-in dossier Doc. No. 6723-PIP-331-MB-0003_000_00 in vol 2
53	PAGE 7 OF 9	VOLUME 2-2 PIPING SCOPE OF WORK 5.1.10		BIDDER REQUEST TO PROVIDE EXISTING PIPE RACK DETAILS i.e. PIPE RACK DETAILS, STADD FILES TO ACERTAIN THE ADEQACY CHECK.	Shall be shared with successful bidder if required during detail engineering. Refer cl.no. 4.b.xxii of 6723-CVC-331-CA-0005 pertaining to existing structures.

54		VOLUME 4-4 (PIPING AND LAYOUT) 6723-HES-331-EC-0001_000_00 SOW FIRE PROTECTION		BIDDER REQUEST TO PROVIDED THE DATSHEETS FOR DELUGE VALVE FOR SPRAY SYSTEM AND SOFTWARE TO USE FOR HYDRAULIC CALCULATIONS.	Licensor confirms that there is no hydrocarbon hence no spray system is envisaged. For Hydranant system calculation pipenet software shall be used.
55	14 of 33	Clause 2.7.8 - Process scope of work - Doc No. 6723-PRC-331-CA-0003		This clause states that the Effluent Cooler (EA-33110) and its all associated instrumentation, sample point, special parts, cooling water tie ins etc. shall be deleted. Client may please confirm this point.	Bidder's understanding is correct. However, it is to be noted that the 6" size effluent line from pump GA-33145B to TP-331-04 exists. Also, Bidder to note that, since Effluent Cooler is deleted, there is no process requirement of cooling water. However, the tie ins TP-331-05 and TP-331-06 are retained in the Tie in Dossier. Bidder to resize or delete these tie ins during detail engineering based on cooling water requirement for pump seal etc.
56	VOLUME_4_2_PROCESS_2	Tie-in P&IDs		Client may please confirm that generation of any utilities shown in all tie-in P&IDs shall not be the part of this project scope of work.	Generation of any utility required for plant operation shall not be in Bidder's scope.

57	VOLUME_4_ 2_PROCESS_2	Tie-in P&IDs		Tie-in arrangement (Tap-off with Blind flange) is shown on all utility tie-in P&IDs. Bidder understand that only this tie-in arrangement to be provided by bidder. Client may please confirm	Tap-off with Blind flange, valves, drains as shown in PIDs and also the piping upto WSS plot is in Bidder's scope.
58	General	General		Client may please confirm that only first fill of lubricant / chemicals and consumables to be provided by contractor	Refer Section 2.11 SCOPE OF SUPPLY in the same document. First fill of all lubricants, chemicals, consumables and hydraulic oils and subsequent filling up to and including PGTR is in CONTRACTOR's scope.
59	General	General		Client may please confirm that whether the special equipment like Scrubber, Clarifier etc. should be procured from licensor only or not	Free Issue Items from Licensor are already specified in the Tender document. For remaining items, Bidder to follow the approved Vendor List.
60	25 of 67 & 73 of 673	Annexure 1 (Major Project Milestone) of Project Planning, Scheduling & Monitoring System Requirements & Time Schedule of SCC		Client may please confirm which Project Milestone Schedule should we follow in order to prepare the Overall Project Schedule (Level 2) for Technical Bid as there is some discrepancy between the two documents.	Bidder to consider the Time Schedule as mentioned on page 73 of 673 under SCC. The Major Project Milestone for WSS Unit in Annexure 1 of the doc 6723-PSC-331-BD-0001 (Page 25 of 67) to be considered as mentioned in

					the Time Schedule on Page 73 of 673 of SCC.
61		Volume-2, Mech Services Vendor list 23 10 2020, S.No.2	Vendor List	Bidder understand that vendor list for Vessels Columns Overhauling is applicable for WSS-Disengaging Drum (DA-33101) & Stack (CB-33105). Please confirm the Bidder understanding is correct.	Bidder to consider Sr. No. 82 from Mechanical Supplies Vendor List available in Tender. Also Bidder to follow Owner's reply at Sr. No. 35 above.
62	Page 02 of 4	Agitator Data Sheet, C1943402-00-WGS-PS00-DSH-0012	Agitator Data Sheet	Bidder request Client to provide the type of Agitator & MOC for Shaft and impeller.	Agitator MOC can be same as Tank MOC. Clarifier vendor shall provide suitable type of impeller to ensure homogeneity of the mixture considering the selected flocculent. Duty of the agitator is for mixing.
63		General	System Architecture	Bidder request Client to provide System Architecture	Bidder to refer documents already available in tender and follow tender
64		General	System Specification	Bidder request Client to provide System Specification	Bidder to refer documents already available in tender and follow tender
65		General	Battery Limit	We understand that bidder has to supply all the instrumentation from or till the WSS system supplier battery limit only. No other instrument/ cabling is to	Bidders understanding is not correct. Bidder to refer documents already available in tender and follow tender

				be supplied outside the bidder's battery limit. Please confirm.	
66		6723-INS-331-EC-0001_000_00_Instrumentation Scope of Work	Cable Tray Layout	Bidder request Client to provide Cable Tray Drawings indicating tentative route	Bidder to refer documents already available in tender and follow tender
67		General	Existing MCC	Bidder request Client to provide Existing MCC details for checking availability of spare feeders / feasibility of extending existing board	Bidder to refer documents already available in tender for existing switchgear panels / distribution boards requiring modification of existing feeders / extension of existing distribution boards. Bidder to follow tender documents for modification of existing feeders / extension of existing boards.
68		General	Battery Limit	We understand that bidder has to supply all the Electrical items from or till the WSS system supplier battery limit only. No other electrical item / cabling is to be supplied outside the bidder's battery limit. Please confirm.	Bidders understanding is not correct. Bidder to refer documents already available in tender and comply with tender documents.
69		General	Piping Layout	Bidder request Client to provide Piping Layouts for WSS System	For Layout refer Doc. No. 6723-LAY-331-LD-0001 in Vol. 4 Bidder shall not

					consider the pipe rack shown in WSS layout as Pipe rack from existing PFCC pipe rack to WSS unit shall be consider as per discussed & shown at site during pre-bid meeting held at MRPL on 27.01.2021.
70		General	Battery Limit	We understand that bidder has to supply all the Piping items from or till the WSS system supplier battery limit only. No other piping is to be supplied outside the bidder's battery limit. Please confirm.	Bidder to supply all the piping material. Scope shall include to all necessary material required for safe and efficiently operating WSS for PFCC Flue Gas Unit
71		General	Civil and Structural Design Basis	Bidder request Client to provide Civil and Structural Design Basis	The Civil design basis is attached with Tender. Refer 6723-CVC-331-EC-0005
72		General	Typical foundation drawing for ladder and staircase	Bidder request Client to provide typical foundation drawings for ladder and staircase	LSTK contractor to design as per site condition & as required as per his layout.
73		General	Typical drawings for Roads, Trenches and Duct banks	Bidder request Client to provide typical drawings for roads, trenches and duct banks	LSTK contractor to design as per site condition & as required as per his layout.

ATTACHMENT – 1

ADEQUACY CHECK REPORT

tkIS India / Vendor

Category Codes (Submission Purpose)

- ☐ 1 For Approval
- ☐ 2 For Review / Comments
- ☐ 3 For Information
- ☐ 4 For Engineering
- ☐ 5 For Enquiry
- ☐ 6 For Order Placement
- ☐ 7 Final & Approved
- ☐ 8 Released for Construction

Acceptance Codes (Approval Codes)

- ☐ 1 Approved
- ☐ 2 Approved for Manufacturing / Fabrication with Comments as marked
- ☐ 3 Not Approved / Resubmit
- ☐ 4 Retained for Information / Records
- ☐ 5 Reviewed
- ☐ 6 Reviewed as Noted / Resubmit

Remarks for AC2 : This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-sbumitted after revision. This drawing should be revised only to the extent of tkIS India / Owner / Client comments. Any other changes made by you will not be considered unless clearly highlighted in covering letter asking for approval.

This approval / review does not absolve the supplier from the full responsibility for design and fabrication.

Date : ___/___/_____ Name : _____

tkIS India / Owner / Client

Category Codes (Submission Purpose)

- ☐ 1 For Approval
- ☐ 2 For Review / Comments
- ■ 3 For Information
- ☐ 4 For Engineering
- ☐ 5 For Enquiry
- ☐ 6 For Order Placement
- ☐ 7 Final & Approved
- ☐ 8 Released for Construction

Acceptance Codes (Approval Codes)

- ☐ 1 Approved
- ☐ 2 Approved for Manufacturing / Fabrication with Comments as marked
- ☐ 3 Not Approved / Resubmit
- ☐ 4 Retained for Information / Records
- ☐ 5 Reviewed
- ☐ 6 Reviewed as Noted / Resubmit

Date : ___/___/_____ Name : _____

Rev.	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC
00	3	Issued for Addendum	04.02.2021	RKD	04.02.2021	KPT	04.02.2021	DMJ	

Barcode

Category Code: 3

Contents

1 Introduction

Mangalore Refinery & Petrochemicals Limited (MRPL) a government of India schedule 'A' CPSE and a subsidiary of ONGC is a State of Art Grassroots Petroleum Refinery located in a beautiful hilly terrain, north of Mangalore city, in Dakshina Kannada region, Karnataka State. The Refinery has got a versatile design with high flexibility to process Crudes of various API and with high degree of Automation. MRPL has high standards in refining and environment protection matched by its commitments to society. MRPL has also developed a Green Belt around the entire Refinery with plant species specially selected to blend with the local flora.

MRPL intends to set up Wet Gas Scrubber system for PFCC Flue gas of PFCC Unit in MRPL Mangalore. tkIS India have been appointed as PMC for this project.

Purpose of this report is to assess adequacy of some of the existing utilities at MRPL site available due to incremental load of WSS for PFCC Flue Gas project and provide recommendations, if any.

2 Basis of Adequacy Check

Adequacy check is carried out based on following documents and information provided by MRPL. The documents are attached in Annexures for reference.

S.No	Document Tag	Description
1	3820-ISO-16, 17 & 18	1000255930 Service water pump discharge isometrics 1 to 4
2	PLA-03	Service Water P&ID
3	6782-02-387-0-1116	387-1116 Service Water ICPR
4	6782-3820-PA-DS-0001	Service Water Pump Vendor Datasheet
5	6782-387-16-43-0101 6782-387-16-43-0093 6782-387-16-43-0083 6782-387-16-43-0073 6782-387-16-43-0063 6782-387-16-43-0052 6782-387-16-43-0042 6782-387-16-43-0032 6782-387-16-43-0022 6782-387-16-43-0012	Service Water Header GA Drawings
	AFPL/67882-3820/J114-RW-MPA-11	Vendor Layout for Raw Water Treatment Package
	6993-331-16-43-0001	Equipment Layout-PFCC/PR Unit
6	NA	Email from MRPL "WSS-Inputs from MRPL as listed in MOM" dated 18.11.2020
7	6782-387-16-43-0013 6782-387-16-43-0021 6782-387-16-43-0032 6782-387-16-43-0042 6782-387-16-43-0231 6782-387-16-43-0232	Effluent Water Line GA Drawings

S.No	Document Tag	Description
	6782-387-16-43-0241 6782-387-16-43-0251 6782-387-16-43-0261 6782-387-16-43-0271 6782-387-16-43-0291 6782-387-16-43-0311 6782-387-16-43-0321 6782-387-16-43-0331 6782-387-16-43-0341 6782-387-16-43-0351	
8	6782-47-373-0-1111	P&ID for Oily Water Transfer System (Near DCU Unit)
9	6782-373-PA-DS-0060	OWS Transfer Pumps Datasheet
10	C1943402-00-WGS-AA00-LST-0003	Utility Consumption List
11	NA	Email from MRPL "Draft Adequacy Check Report -WSS service water and effluent" dated 02.02.2021

2.1 Adequacy Check of Service Water Pump

Service Water pumps (GA-38203A/B) of 200 m^3/hr each capacity and 100.7 MLC differential head are in operation at site. Current peak consumption of Service Water is 125 m^3/hr. Adequacy check of existing pumps is carried out to cater to additional peak demand of ~130 m^3/hr of new WSS unit (i.e. total flow of 255 m^3/hr) and also for additional normal demand of ~70 m^3/hr of new WSS unit (i.e. total flow of 195 m^3/hr).

Also, the adequacy of 18" Service water header is checked for 400 m^3/hr flow as required by MRPL.

Basis

1. The peak flow of Service Water to WSS unit is considered 130 m^3/hr based on licensor's data of 125.7 m3/hr in Utility Consumption List plus valve seat purge flow.
2. The normal flow of Service Water to WSS unit is considered 70 m^3/hr based on licensor's data of 65.4 m3/hr (Design Case-1 Normal) in Utility Consumption List plus valve seat purge flow.
3. The length of suction and discharge line of the pump and the fittings therein are estimated from the documents and drawings provided by MRPL (attached in Annexure-4). 10% margin is taken over the estimated lengths to account for any deviation in pipe routing at site.
4. As a conservative case, the Service Water tie-in point 331-TP-02 on 16" part of line is considered immediately before the line bifurcates into two 12" routes. This will ensure that the entire length of 18" part and 16" part of the header is accounted for in the calculations.
5. In absence of documents, the minimum level of water above the pump centreline is considered as 1 m, as communicated by MRPL during site visit.
6. The elevation of centreline of Service Water pumps (GA-38203A/B) is at 11.01 m from Mean Sea Level (MSL). The grade level of WSS plot is 12.5 m above MSL. Elevation of FV331902 is considered at 2.5 m above grade level of WSS (worst case scenario).
7. The roughness factor of the Carbon Steel pipes is considered 0.4 mm. Since, the existing pipes have been in service for about 10 years, LSTK Contractor shall establish the roughness factor of the existing Carbon Steel pipes by pressure survey and accordingly validate/update the adequacy recommendations including values of control valve inlet pressures mentioned in this report. The same shall be submitted to PMC for approval.
8. The calculations are based on the preliminary routing of lines from tie in point to the WSS battery limit. LSTK Contractor shall validate/update the adequacy recommendations including values of control valve inlet pressures mentioned in this report. The same shall be submitted to PMC for approval.

9. The LSTK Contractor shall carry out servicing and testing of existing pumps to confirm the operation as per the performance curves. Any deviation in pump performance may have impact on the values of control valve inlet pressures mentioned in this report. LSTK Contractor shall validate/update the adequacy recommendations including values of control valve inlet pressures mentioned in this report. The same shall be submitted to PMC for approval.

   For calculation outputs, refer Annexure-1

Case-1: Observation and Action Points for Peak WSS Consumption (255 m3/hr flow) : Single Pump Operation

The peak flow of Service Water after WSS Unit is operational will be 255 m^3/hr. From the vendor datasheet and performance curves, it is observed that each Service Water Pump can deliver 255 m^3/hr flow with a differential head of 91 mLc. The NPSH available is 6.88 mLC against a required NPSH of 5.8 mLC as per the vendor performance curves. The revised flow condition of 255 m^3/hr with 91 mLC head, the pump is expected to consume 78 kW of power; the installed motor of 90 kW is adequate for this operation.

Existing Service water pump with differential head of 91 mLC will be adequate upon confirming the following user wise actions and checks:

1. Existing Users:

   As informed by MRPL, the differential head of 91 mLc of the Service Water Pumps (GA-38203A/B) is adequate for the existing users.

2. Service Water to WSS Scrubber:

   The licensor datasheet of Service Water control valve FV331902 mentions the upstream pressure of 6.92 kg/cm^2g and a pressure drop of 5.74 kg/cm^2. With available differential head of 91 mLc, the upstream pressure of FV331902 will be reduced to 5 kg/cm^2g. Accordingly, the pressure drop across the control valve will be reduced to 3.82 kg/cm^2. This operating point to be specified in the control valve datasheet.

   The operating pressures of other instruments i.e. PI331901, PT331909,TT331901, FT331908, FT331902 and UV331500 to be specified to include 5 kg/cm^2g as an operating point.

3. Service Water to Effluent Tank (Dilution):

   The licensor datasheet of Service Water control valve FV331916 mentions the upstream pressure of 6.85 kg/cm^{2}g and a pressure drop of 5.8 kg/cm^2. With available differential head of 91 mLc, the upstream pressure of FV331916 will be reduced to 5 kg/cm^{2}g. Accordingly, the pressure drop across the control valve will be reduced to 3.95 kg/cm^2 . This operating point to be specified in the control valve datasheet.

   The operating pressure of FT331916 to be specified to include 5 kg/cm^{2}g as an operating point.

4. Service Water to Flocculant Preparation Tank:

   The operating pressures of FT331922 to be specified to include 5 kg/cm2g as an operating point.

5. No effect envisaged on Service Water to Clarifier sample Lines, Clarifier drain and pump seal flush lines.

Case-2: Observation and Action Points for Normal WSS Consumption (195 m3/hr flow) : Single Pump Operation

The normal flow of Service Water after WSS Unit is operational will be 195 m^3/hr. From the vendor datasheet and performance curves, it is observed that each Service Water Pump can deliver 200 m^3/hr flow with a differential head of 100.7 mLc, which is the rated flow of the pump. Existing Service water pump with differential head of 100.7 mLC will be adequate for 195 m3/hr flow. No impact is envisaged on the instruments. Details listed below.

1. Existing Users:

   As the Service Water Pump will operate at the rated flow and differential head, no action/ checks envisaged.

2. Service Water to WSS Scrubber:

   The licensor datasheet of Service Water control valve FV331902 mentions the upstream pressure of 6.92 kg/cm^{2}g and a pressure drop of 5.74 kg/cm^2. With available differential head of 100.7 mLc, the upstream pressure of FV331902 will be 7.15 kg/cm2g. Accordingly, the pressure drop across the control valve will increase to 5.94 kg/cm^2 which is in operable range of a control valve.

   The operating pressures of other instruments i.e. PI331901, PT331909,TT331901, FT331908, FT331902 and UV331500 will be 7 kg/cm^{2}g.

3. Service Water to Effluent Tank (Dilution):

   The licensor datasheet of Service Water control valve FV331916 mentions the upstream pressure of 6.85 kg/cm^{2}g and a pressure drop of 5.8 kg/cm^2. With available differential head of 100.7 mLc, the upstream pressure of FV331916 will be 7.15 kg/cm^{2}g. Accordingly, the pressure drop across the control valve will be reduced to 6.1 kg/cm^2 which is in operable range of a control valve.

   The operating pressures of FT331916 will be 7 kg/cm^{2}g.

4. Service Water to Flocculant Preparation Tank:

   The operating pressures of FT331922 will be 7 kg/cm2g.

5. No effect envisaged on Service Water to Clarifier sample Lines, Clarifier drain and pump seal flush lines.

Case-3: Observation and Action Points for 400 m3/hr flow: Two pump operation

As a check case, adequacy of the Service Water header upto 331-TP-02 is checked for a total flow of 400 m^3/hr considering two Service Water pumps in operation and one standby (proposed scheme). Each pump is designed for 200 m3/hr flow with a differential head of 100.7 mLc.

In this case, it is observed that the pressure available at upstream of control valve FV331902 in WSS Unit is 5.64 kg/cm^{2}g.

2.2 Adequacy Check of OWS line to ETP

The effluent from WSS will join the existing OWS to ETP line 12-OD-3736014-A96A at tie in point 331-TP-04. The adequacy of line 12-OD-3736014-A96A is checked for a total flow of 290 m^3/hr (180 m^3/hr existing OWS +110 m^3/hr from WSS).

Basis

1. The effluent flow from WSS unit is considered 110 m^3/hr based on licensor's data of 99.9 m^3/hr (max) plus valve seat purge flow.
2. The length of suction and discharge line of the pump and the fittings therein are estimated from the documents and drawings provided by MRPL (attached in Annexure-4). 10% margin is taken over the estimated lengths to account for vertical loops and any deviation in pipe routing at site.
3. As a conservative case, the Effluent Water tie-in point 331-TP-04 on existing OWS to ETP line 12-OD-3736014-A96A is considered at immediate discharge of OWS Transfer Pump GA-37360A/B. This will ensure that the total length of 12" line is accounted for in the calculations.
4. The grade elevation of WSS plot and the OWS pit is 12.5 m above Mean Sea Level. Centreline of Effluent Water pumps (GA-33145A/B) is considered 500 mm above grade i.e. 13 m from Mean Sea Level (MSL). The elevation of nozzle of the inlet nozzle at destination tank is 22m from Mean Sea Level. Hence elevation rise for Effluent Water pumps (GA-33145A/B) is 9 m.
5. The roughness factor of the Carbon Steel pipes is considered 0.4 mm. Since, the existing pipes have been in service for about 10 years, LSTK Contractor shall establish the roughness factor of the existing Carbon Steel pipes by pressure survey and accordingly validate/update the adequacy recommendations mentioned in this report. The same shall be submitted to PMC for approval.
6. The calculations are based on the preliminary routing of lines from tie in point to the WSS battery limit. LSTK Contractor shall validate/update the adequacy recommendations mentioned in this report. The same shall be submitted to PMC for approval.

Observation and Action Points for WSS Effluent Water Pump (GA-33145 A/B)

The peak flow of Effluent Water from WSS Unit is is expected to be 110 m^3/hr. The licensor's datasheet of pump GA-33145 A/B, mentions the rated capacity of 100 m3/hr and differential head of 70 mLc. With 110 m^3/hr flow from WSS is routed through OWS to ETP line 12-OD-3736014-A96A, the differential head requirement of Effluent Pump (GA-33145 A/B) is 130 mlc, which is much higher than

the differential head of 70 mlL in the licensor's datasheet. The reason for higher diff. head requirement is the 4" line size from WSS to 331-TP-04. 1

12" size of the common line 12-OD-3736014-A96A is found to be adequate for 290 m3/hr flow and a backpressure of 1.7 kg/cm^{2}g at the destination.

For Effluent Pump (GA-33145 A/B) , the differential head of 70 mLC will be adequate after the following actions:

1. Increase the size of WSS Effluent Pump (GA-33145 A/B) discharge line upto 331-TP-04 from 4"to 6"(Line nos. 331004, 331005, 331006, 331007, 331008). This will result in differential head requirement of 62 mLc which is in line with licensor's datasheet.

   For calculation outputs, refer Annexure-2

2.3 Adequacy Check of Instrument Air

Basis

Design Instrument Air Consumption of PFCC Unit : 3399 kg/hr

Actual average Instrument Air Consumption of PFCC unit (as per email from MRPL dated 18.11.2020) : 1950Kg/hr.

Available Capacity of Instrument Air : 3399-1950 = 1449 kg/hr

Normal pressure of instrument air : 6.5 kg/cm2g

Normal temperature of instrument air : 38 Deg C

Density of instrument air at normal conditions : 1.29 kg/Nm3

Observation

As per the Utility Consumption List by the licensor, the peak demand of instrument air for WSS unit is 54 Nm3/hr which is equivalent to 70 kg/hr. Since the residual capacity of the instrument air is 1449 kg/hr, the instrument air demand of WSS Unit is fulfilled. Considering the unit will consume IA even at design flow rate, the additional requirement of WSS is about 2% of design flow rate and hence the available instrument air capacity can be considered to be adequate.

2.4 Pressure Drop Calculation of Stripped Sour Water Line

The pressure drop from of Stripped Sour Water line from tie in point 331-TP-03 upto control valves FV331904 and FV331916 is calculated to check adequacy of Stripped Sour Water pressure available at tie in point 331-TP-03 and the line sizes of Stripper Sour water to both the users.

Basis

Stripped Sour water pressure at tie in point 331-TP-03

after the flow of 85.2 m3/hr to WSS is drawn : 6.2 kg/cm2g

(as per email from MRPL dated 18.11.2020)

Elevation of tie in point 331-TP-03 from grade : 18 m

Elevation of FT331904/ FV331916 from grade : 1 m

Max. Stripped Sour Water flow (As per FE331909 data) : 85.2 m^3/hr

Max. Stripped Sour Water flow to Scrubber : 14.7 m^3/hr

Max. Stripped Sour Water flow to Effluent Tank : 70.5 m^3/hr

The length of the Stripped Sour Water line from 331-TP-003 and the fittings therein are estimated during site visit. 10% margin is taken over the estimated lengths to account for the routing changes during detail engineering.

The calculations are based on the preliminary routing of lines from tie in point to the WSS battery limit. LSTK Contractor shall validate/update the adequacy recommendations including values of control valve inlet pressures mentioned in this report. The same shall be submitted to PMC for approval.

Observation and Action Points

1. As per the pressure drop calculations, the Stripped Sour Water pressure available at upstream of control valve FV331904 for maximum flow is 5.39 kg/cm^2g. As per the licensor's datasheet, inlet pressure of FV331904 varies from 3 to 5.98 kg/cm2 g. Hence, no action envisaged..
2. As per the pressure drop calculations, the Stripped Sour Water pressure available at upstream of control valve FV331916 for maximum flow is 5.91 kg/cm2g. As per the licensor's datasheet, inlet pressure of FV331916 for max. flow is 6.45 kg/cm2g. Vendor to size the valve for inlet pressure of 5.91 kg/cm2g at maximum flow condition, as an alternate case.

The Stripped Sour Water pressure of 6.2 kg/cm2g available at tie in point 331-TP-03 as informed by MRPL when flow to WSS is drawn. Based on this pressure for the given flow, the line sizes of Stripper Sour water to both the users are adequate.

For calculation outputs, refer Annexure-3

ATTACHMENT – 2

Annex-I to EDB 0003

EQUIPMENT SELECTION FOR HAZARDOUS AREA

The electrical equipment for hazardous areas shall be selected as per IS-5571 and petroleum rules. The minimum requirement is summarised as below.

	Equipment	Zone 1		Zone 2	
		Gas Group IIA, IIB	Gas Group IIC	Gas Group IIA,IIB	Gas Group IIC
	LV Motors	Ex-d	Ex-d	Ex-d/ Ex-de/ Ex-e	Ex-d/ Ex-de/ Ex-e
	HV Motors	Ex-d/ Ex-p	Ex-d/ Ex-p	Ex-d/ Ex-p/ Ex-e*	Ex-d/ Ex-p/ Ex-e*
	Push Button Station	Ex-d	Ex-d	Ex-d	Ex-d
	Motor Starters	Ex-d	Ex-d	Ex-d	Ex-d
	Plug & Socket	Ex-d	Ex-d	Ex-d	Ex-d
	Welding Receptacle	Ex-d	Ex-d	Ex-d	Ex-d
	Lighting Fixtures				
	a) Integral	Ex-d	Ex-d	Ex-d	Ex-d
	b) Non Integral				
	Control gear	Ex-d	Ex-d	Ex-d	Ex-d
	Luminaire	Ex-d	Ex-d	Ex-d	Ex-d
	Junction Boxes	Ex-d	Ex-d	Ex-e	Ex-e
	Hand Lamps				
	i. Light fitting	Ex-d	Ex-d	Ex-d/ Ex-e	Ex-d/ Ex-e
	ii. Transformer Unit	Ex-d	Ex-d	Ex-d	Ex-d
	iii. Plug & Socket	Ex-d	Ex-d	Ex-d	Ex-d
	Break Glass Unit (Fire Alarm System)	Ex-d	Ex-d	Ex-d	Ex-d
	Lighting Panel/ Power Panel	Ex-d	Ex-d	Ex-d	Ex-d

NOTES:

1. For increased safety motors (Ex-e) fed by VFD, Motor shall be type tested (combine testing) for the duty as a unit in association with the VFD.

   For increased safety motors fed by soft starter, the motor shall be type tested (combine testing) as a unit in association with the soft starter **OR** Motor shall be provided with embedded temperature detectors and effectiveness of the temperature control or proper run up is verified and documented.

2. For explosion proof (Ex d) Motor fed by VFD, the motor shall be type tested for the duty as a unit in association with the VFD **OR** Motor shall be provided with embedded temperature detectors and effectiveness of the temperature control taking into account power, speed range, torque and frequency for the duty required is verified and documented.

   Combine testing shall be conducted at Independent test house and shall be certified by authorities.

3. * Ex-e motor can also be provided if the motors are tested as per latest IS/ IEC. Pre-start purging arrangement shall be made based on risk analysis. Auto start requirement shall be checked in case of pre-start purge requirement.

4. Electrical equipment in fired heater area shall be Ex-d irrespective of zone classification. Gas group shall be appropriately selected.

5. All Electrical LightFixtures, JBs, Sockets, Fans etc. shall be Flame proof type for Battery room where Hydrogen gas is expected to be released.

ATTACHMENT – 3

Technical Specifications-High Voltage Induction Motors

tkIS India / Vendor

Category Codes (Submission Purpose)

- ☐ 1 For Approval
- ☐ 2 For Review / Comments
- ☐ 3 For Information
- ☐ 4 For Engineering
- ☐ 5 For Enquiry
- ☐ 6 For Order Placement
- ☐ 7 Final & Approved
- ☐ 8 Released for Construction

Acceptance Codes (Approval Codes)

- ☐ 1 Approved
- ☐ 2 Approved for Manufacturing / Fabrication with Comments as marked
- ☐ 3 Not Approved / Resubmit
- ☐ 4 Retained for Information / Records
- ☐ 5 Reviewed
- ☐ 6 Reviewed as Noted / Resubmit

Remarks for AC2 : This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-sbumitted after revision. This drawing should be revised only to the extent of tkIS India / Owner / Client comments. Any other changes made by you will not be considered unless clearly highlighted in covering letter asking for approval.

This approval / review does not absolve the supplier from the full responsibility for design and fabrication.

Date : ___/___/_____ Name : _____

tkIS India / Owner / Client

Category Codes (Submission Purpose)

- ☐ 1 For Approval
- ☐ 2 For Review / Comments
- ☐ 3 For Information
- ☐ 4 For Engineering
- ☐ 5 For Enquiry
- ☐ 6 For Order Placement
- ☐ 7 Final & Approved
- ☐ 8 Released for Construction

Acceptance Codes (Approval Codes)

- ☐ 1 Approved
- ☐ 2 Approved for Manufacturing / Fabrication with Comments as marked
- ☐ 3 Not Approved / Resubmit
- ☐ 4 Retained for Information / Records
- ☐ 5 Reviewed
- ☐ 6 Reviewed as Noted / Resubmit

Date : ___/___/_____ Name : _____

Rev.	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC
01	-	Revised as Marked	08.02.21	Jkp	08.02.21	Alg	08.02.21	Jkp	
00	-	Issued for Tender	03.11.20	Jkp	03.11.20	Alg	03.11.20	Jkp	

Barcode

Category Code: -

INDEX SHEET

The document Cover Sheet indicates revisions made in this document along with the purpose of issue of the revised document. The details of revisions made in the enclosures of this document are listed in the table of *Contents* below and the enclosures listed therein are an integral part of this document.

CONTENTS

1.0 INTRODUCTION

This specification covers requirements for design, manufacturing, assembly testing at manufacturer's works, final inspection, site testing and commissioning of **High Voltage Squirrel Cage Induction Motor** for use in industrial plants.

Equipment to be supplied shall comply with latest revision of applicable Indian/ International Standards and specific codes and standards mentioned in clause 'Codes' of Part-II of this specification.

Standard and descriptive requirement is covered in Part-I while specific requirement is covered in Part-IIA & IIB. Inspection and testing requirement is covered in Part-III.

2.0 CONSTRUCTIONAL REQUIREMENTS

2.1 General

High voltage induction motors shall be suitable for High voltage range above 650V & upto 11 kV as specified in Part-IIA.

Motors shall be designed for operation under power supply conditions indicated in Part-II as well as design ambient conditions indicated in "Site Conditions" sheet.

Motor enclosure shall be industrial weatherproof type, with additional requirements for hazardous areas as specified in Part-IIB.

The motor terminal marking shall be so arranged that the desired direction of rotation of driven equipment (as mentioned in data sheet) is obtained with R-Y-B or U-V-W phase sequence.

Direction of rotation shall be indicated on fan cover as well as on nameplate with corresponding phase sequence i.e. R-Y-B or U-V-W.

Arrangement for speed measurement of motors from NDE of motor shall be provided.

All motors shall be provided with suitable lifting arrangement. All motors shall be provided with suitable drain plug to remove the condensed moisture in the motor. For motors designed for hazardous area application, the fans shall be made from non-sparking material.

2.2 Performance

Motors for pumps subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non – energized shaft at 25 % of rated speed in reverse direction.

Thermal withstand time (hot) in locked rotor condition at rated voltage shall be more than the acceleration time of the motor with full load connected, at minimum starting voltage, by 5 seconds for drives having acceleration time more than 20 seconds and by 2.5 seconds for the motors having acceleration time less than 20 seconds. However, in all the cases it shall be ensured that minimum cold thermal withstand time under locked rotor conditions shall be 15 seconds and same under Hot conditions shall be minimum 5 seconds. Thermal withstand time shall be based on permissible temperature of stator and rotor. Time 't_E' for increased safety motors shall be more than or equal to the thermal withstand time (Hot) in locked rotor condition

at maximum permissible voltage. However, in all cases the time 't_E' shall be minimum 5 seconds.

2.3 Application Check

Vendor shall carry out application check to ascertain suitability of offered motor with respect to the load details and specifications as mentioned in this specification.

For all the motors, torque–speed characteristics superimposed on load characteristics shall be furnished.

The torque developed by the motor shall be more than the torque requirement of the driven equipment at all speeds. While accelerating the motor to full speed the torque developed by motor shall be more than that required by driven equipment by at least 10% at all the speeds in pull up region.

2.4 *Tropical Protection*

The winding shall be tropicalized and shall be suitably varnished, baked and treated with epoxy gel for operating satisfactorily in humid and corrosive atmosphere. Adequate insulation shall be provided between coils of different phases which are laid together.

2.5 *Windings*

All six leads of the stator winding shall be brought out to the terminal box. Three leads shall be brought out in phase terminal box and three in neutral terminal box. Windings shall be adequately braced and overhang portion shall be suitably strengthened to withstand stress developed during direct-on-line starting and auto changeover. Winding insulation shall be adequately designed to withstand stresses developed in inter-turn and slot insulation due to switching surge overvoltage generated during switching off through vacuum switching devices.

Overhang portion of winding shall be treated with epoxy gel coat.

VFD Driven Motors:

Winding insulation shall be designed to withstand high level of dv/dt for inverter operation. The vendor shall clearly indicate the level of inter-turn insulation provided. Also, VFD driven motor shall run at very slow speed without overheating.
Motor for VFD application shall be suitable for operating continuously under following conditions:

a. Solid state power supply consisting of an adjustable frequency inverter for speed control.

b. Current waveform produced by power supply including the current harmonics generated by the waveform.

c. Withstand the torque pulsation resulting from current harmonics generated by the variable frequency drive power supply.

2.6 *Rotor*

The rotor shall be dynamically balanced and shall rotate perfectly with no preferential stop points. In some specific cases, driven equipment manufacturer will supply half coupling to

motor manufacturer in advance. In such cases drilling of bore of half coupling, fitting the same on motor shaft and balancing of rotor along with coupling shall be included in motor manufacturer's scope.

Rotor shall be provided with a single/ Double shaft extension (if specified separately) with Key-way and full Key. Shaft end shall be provided with tapped center hole.

Permanent reference marks to indicate magnetic centre shall be scribed (3 grooved lines on the shaft) on the sleeved bearing rotor shaft. A pointer fitted on the sleeve bearing cover shall be provided to indicate the operating point of the shaft. The rotor float (as specified elsewhere) shall be adjustable towards both sides and the float shall be suitable for the selected couplings.

2.7 *Terminal Boxes*

All internal leads shall be brought in the terminal box through seal off bushings only. Terminals shall be stud type and shall be complete with checknuts and washers. In case of increased safety motors, terminals shall be anti-loosening type such as to prevent risk of overheating or sparking.

Terminal boxes for stator leads and neutral star formation shall be inter-changeable. Neutral terminal box for motors shall be suitable to accommodate supplied differential protection current transformers.

Necessary adaptor box shall be provided, if required, to ensure adequate clear space for easy cable termination.

Terminal Box shall be suitable for accommodating HV cable termination kits for the installed cable sizes. All motors Terminal Box shall be provided with metric threaded pre-drilled gland plate, cable entry shall be blocked with the help of metallic plug. In case extra entry is provided for flame-proof motor then same shall be blocked with the help of flame-proof metallic plug.

Motor terminal box shall be suitable for bottom entry of the cables and shall be capable of being turned through 360° in the steps of 90° with sufficient lengths of internal leads for proper connections in any position.

Terminal box for space heater shall be provided with caution nameplate on the terminal box cover inscribed with "LIVE TERMINALS, WHEN MOTOR IS OFF". Phase terminal box for flameproof motors shall be provided with caution nameplate on the cover inscribing "ISOLATE ELSEWHERE BEFORE OPENING".

2.8 *Name Plate*

Each motor shall be provided with following nameplates of stainless steel:

1. Name plate displaying all the particulars specified in relevant standards. In addition, the nameplate shall indicate the identification number of bearings used for motor and the details of recommended lubricant including required quantity of lubricant and interval at which the bearings are to be re-lubricated. In the case of Increased-Safety motors, 't_E' time shall be indicated on the name plate. In addition to the above information, motor nameplate shall also contain the information about permissible number of successive cold and hot restarts.

2. Name plate indicating direction of rotation with corresponding phase sequence i.e. R-Y-B or U-V-W.

3. Name plate of motors for hazardous area shall also include:
   a. Name of approving authority
   b. Certificate number
   c. Temperature class
   d. Gas group.

4. Name plate indicating Owner's motor tag number and description (e.g cooling water pump) .

2.9 *Bearing, Bearing Housing and Lubricant*

Motor bearing shall be suitable (Type and size) to accommodate the axial thrust from the driven equipment and its own axial and radial thrust. In all cases the bearing shall be chosen to provide minimum L10 rating life of 40,000 hrs. at rated operating condition.

Motors shall have grease-lubricated ball or roller bearings.

The grease lubricated bearing and its housing shall be so designed that lubrication is possible while the motor is running. Bearing housings for grease lubricated bearings shall be provided with exterior fill and relief plugs in tapped holes. Grease release arrangement shall be provided so that old grease is simultaneously expelled when regreasing is being done. Grease nipple shall be located at the top of the end shield so that on-line greasing can be carried out without risk of any accident. Radial Internal clearances of all anti-friction bearings shall be C3 class. Other Classs i.e. internal class greater than C3 (i.e. C4) is permitted only with the prior written approval.

All 2 pole motors with rating 1000 kW and above shall be **preferred with** with split type sleeve bearings **however type of bearing shall be also be considered based on the the driven equipment bearing type**. For all other motors, sleeve bearing shall be provided when the product of rated kW and driven equipment speed in RPM exceeds 4,023,000.

The split in the sleeve bearing shall be at the horizontal centreline of the bearing. Maximum motor bearing temperatures at full load shall not exceed 80°C, total temperature based on 40°C oil inlet ambient. The difference between the drive and non-drive end bearing temperatures shall not be greater than 8°C except self-contained lubrication where 10°C will be allowed.

Sleeve bearings when used shall be with limited end float coupling supplied by the driven equipment Supplier and the driven equipment thrust bearings will-be utilized to resist motor thrust in either direction. The magnetic center of the motor shall place the geometric center of the shaft journal within 1.6 mm. of the geometric center of the bearing, with the minimum end play of 4.8 mm. on either side of magnetic center and a total nominal end play (float) of 13 mm.

The lubrication system shall preferably be such that no external forced oil or water is necessary to maintain the required oil supply to keep bearing temperature within design limits.

Self-lubricated sleeve bearings shall be fitted with oil Slinger rings for continuous lubrication during run-in or coast down.

All oil-lubricated bearings shall be provided with oil level sight gauges which shall be mounted to show precise oil level required for standstill and running conditions. A drain plug shall be provided for draining residual oil in the bearings. Bearing shall not permit oil creepage along the shaft into the motor housing.

In case of forced oil lubrication system, the motor shall be supplied complete with dual oil filter, change-over valves and oil differential pressure gauges across the filters. Oil filter shall be inter-changeable during operation. A pressure switch shall be provided at the inlet to the bearings.

Vertical motors shall be equipped with suitable bearings to withstand the axial thrust of rotor.

The NDE bearing shall be insulated from the motor frame by providing suitable insulation embedded during casting of the end shield.

2.10 *Shaft Displacement Measurement*

When proximity vibration probes are specified, they shall be located outside the motor enclosure in the top half of the bearing housing and within the oil mist chamber, (inboard of the labyrinth seals). In the event that the probes cannot be located within the oil mist chamber, the manufacturer shall apply a protective coating to the probe target surface as a corrosion preventive measure. This coating shall be an epoxy enamel material such as Moto -Finish Epoxy Enamel, MF-12GE, manufactured by Electrical insulation Suppliers Inc. or equivalent. The bearing housing shall be provided with two threaded holes for X-Y probes located in the same plane, 45° radially from the horizontal split line of the bearing and 90° apart.

Bently Nevada Series probes along with a Bently Nevada Series mounting head, the latest version of transmitter and cable as specified in the data sheet shall be installed. All equipment supplied shall be mounted in enclosures for outdoor installation. The transmitters shall be mounted in a separate enclosure attached to the outside of the non-removable portion of the motor frame and 1/2 inch (13 mm) sealed flexible conduit shall be used to connect the probe mounting heads to tbe transmitter enclosures. The probes, mounting heads and flexible conduit shall be installed so that they do not negate the bearing insulation system and provide a path for shaft current. All leads shall be clearly numbered, their location indicated and identified by terminal numbers on Seller's drawings.

If a single probe per bearing is specified on the data sheets, then one probe, mounting head, cable, and transmitter shall be installed per bearing, with provision for the future addition of a second probe, short piece of flexible conduit between the future probe.

2.11 *Vibration*

Motor shall be designed to meet the Vibration Grade as specified in the Data sheet. Vibration measurements (velocity measurements) shall be taken on all Motors.
Bearing housing velocity measurements shall be taken in the Horizontal, Vertical and Axial planes and shall include overall (unfiltered) readings. Preferably, the axial readings shall not exceed the Horizontal or Vertical readings or 80% of maximum allowable readings whichever is greater.

Shaft housing displacements shall be measured when displacement probes are included. All readings shall be taken and recorded prior to installation of the coupling with half-key which fills the entire shaft keyway.

2.12 *Mounting & Dowelling*

If required, motors shall be designed to permit convenient access for drilling vertically through motor feet or mounting flange for installation of dowel pins after motor is aligned with the driven equipment.

3.0 INSPECTION AND TESTING

Inspection and testing shall be carried out based on latest revision of this specification and approved drawings certified for manufacturing. Method/ Procedure for load test shall be as specified in Part-II. In case of ambiguity between vendor drawings and technical specifications, the requirement indicated in technical specifications shall govern.

Owner shall have the right to carry out stage inspection and shop visit to review the manufacturing progress. However manufacturer need not hold any of the manufacturing activity for stage inspection.

All tests as specified in Part-III shall be carried out during final inspection. Minimum fifteen days advance notice shall be given for carrying out final inspection.

Motor manufacturer shall ensure that all meters and instruments associated with testing of the equipment are calibrated by a competent testing authority and the calibration certificates are valid at the time of carrying out the testing of equipment.

After completion of inspection and testing, c shall furnish all as-built documents in required number of sets. Final documents shall be submitted before dispatch of documents.

4. PERFORMANCE GUARANTEE

All performance figures shall be guaranteed within the tolerance permitted in relevant standard.

Penalty shall be levied if indicated in Part-IIA under the clause 'Price Loading', if the measured losses exceed the guaranteed losses.

If actual performance figures of the motors, as per test reports witnessed by Owner / TPI, works out to be inferior to the guaranteed values, including tolerance limits indicated in relevant standards, then the motor shall be liable for rejection, however Owner reserves the right to use the rejected motor till a new motor is supplied.

If any motor supplied by the vendor fails at site due to manufacturing defects during erection, commissioning or service (within guarantee period), the vendor shall repair and put back into successful operation, the failed equipment within the time frame and procedure of repair agreed with the Owner, depending on nature of failure, at no extra cost to Owner and the Guarantee period shall be suitably extended.

ONGC MRPL

ThyssenKrupp Industrial Solutions (India)

HIGH VOLTAGE INDUCTION MOTORS

PART - II B

DESIGN DATA SHEET

Code	WSS for PFCC Flue Gas		
Contract no.	66-6723		
Doc.	6723-ELT-331-EC-0008		
Rev.	01	Page	1 OF 5

POWER SUPPLY	001		Number of Phases	:	3 Phase
	002		Rated Voltage (Vr)	:	6600Volts, ± 10 %
	003		Rated Frequency	:	50 Hz ± 3 %
	004		Combined voltage & frequency variation	:	± 10 %
	005		System earthing	:	NGR
	006		Earth Fault Current	:	600A
GENERAL	007		Make	:	As per Approved Vendor List *
	008		Ton No./ Tag No.	:	As per Electrical Load List *
	009		Quantity	:	As required
	010		Service Description	:	As per Electrical Load List
	011		Rating	:	kW (kW≥150) 1 *
	012				
	013		No. of poles/ Synchronous speed	:	rpm *
	014		Rated speed	:	rpm *
	015		Type	:	Hazardous / Non-Hazardous 1 *
	016		Frame Size	:	*
	017		Location	:	Indoor / Outdoor *
	018		Duty cycle	:	*
	019		Motor is auto-start	:	Yes/ No (as per requirement) *
ENCLOSURE / CONSTRUCTION	020		Cooling designation as per IS / IEC	:	*
	021		Type of enclosure	:	TEFC / TETV / CACA *
	022		Degree of Protection	:	IP55
	023		Type of Construction and Mounting	:	*
	024		**Hazardous area classification**	:	
			a) Zone / Div	1	To be assessed & selected by LSTK contractor as required (Min Zone 2)
			b) Gas group	1	To be assessed & selected by LSTK contractor as required (Min. IIA/IIB)
			b) Temperature Class	1 :	To be assessed & selected by LSTK contractor as required
	025		Hazardous area enclosure type	1	To be selected by LSTK contractor as required *
	026		Grounding requirement	:	2 nos. diagonally opposite grounding pads with tapped holes & hardware to be provided.

			Details	Starting	No Load	1/2 Full Load	3/4 Full Load	Full Load
ELECTRICAL DATA	027		Current *	% FLC	A	A	A	A
	028		Power Factor *					
	029		Efficiency *	-	-	%	%	%
	030		Slip *	-	%	%	%	%
	031		Iron Loss at 95°C *	-	kW	kW	kW	kW
	032		Copper Loss at 95°C *	-	kW	kW	kW	kW
	033		Friction, Windage *	-	kW	kW	kW	kW
			& Stray Losses at 95°C					

	034		Overvoltage withstand capacity for fast auto change over of power supply	:	150 % Vr.
	035		Motor subject to reverse rotation (25% of rated speed) prior to energization	:	Wherever required *
	036		Reacceleration Required	:	Yes/ No Wherever required *
	037		Transient reactance	:	% *
	038		Sub-Transient reactance	:	% *
	039		Permissible unbalance in supply voltage	:	% *
	040		**Minimum permissible voltage for**	:	
	041		a. Starting at F.L.	:	80 % Vr
	042		b. 5 Minute running without overheating	:	75 % Vr
	043		Motor shall be suitable for switching by	:	Vacuum CB

ONGC MRPL

ThyssenKrupp Industrial Solutions (India)

HIGH VOLTAGE INDUCTION MOTORS

PART - II B

DESIGN DATA SHEET

Code	WSS for PFCC Flue Gas		
Contract no.	66-6723		
Doc.	6723-ELT-331-EC-0008		
Rev.	01	Page	2 OF 5

STATOR	044		**Stator winding**				
			a. Connection	:	Star, Strip wound		
			b. Insulation	:	Class F		
			c. Temperature rise limited to	:	Class B		
			c. Resistance per phase	:	ohms at 95°C		*
			d. Resistance between terminals	:	ohms at 95°C		*
	045		Winding protection	:	2 nos. RTDs per phase (Duplex) or 4 nos. RTDs per phase (Simplex)		
			Note: RTD shall be provided between the coil sides to correctly measure the winding temperature.				
	046		Bearing protection	:	2 nos. RTDs (1 per DE & NDE bearing) (Simplex)		
	047		Core temperature protection required	:	No		
	048		If Yes, RTD Type	:	3 nos. RTDs Duplex (one per phase) located at the base of the slots, each placed 120° apart.		
	049		RTD Type	:	3 wire, PT-100		
	050		RTD DC resistance	:	ohms at ° C		*
	051		Rated Insulation level:				
	052		a) Rated voltage in kV (rms value)	:	6.6		
	053		b) Rated short duration power-frequency withstand voltage in kV (Ud) (rms value)	:	14.2		
	054		c) Rated lightning impulse withstand voltage in kV (Up) (Peak)	:	31		
	055			:			
ROTOR	056		Type of Rotor	:	Squirrel Cage		
	057		a. Vibration level on motors at no load - Velocity	:	Grade-A as per IEC 60034-14		
			b. Vibration level on motors at no load - Displacement	:	Grade-A as per IEC 60034-14		
	058		Provision for mounting vibration probes:		Yes, wherever required		
	059		Balancing of rotor				
			1) Electric Motors (of at least 80mm shaft height) of	:	GR. 2.5 as per ISO 1940		
			maximum rated speed above 950 rpm				
	060		Shaft extension	:	Single/ Double (As required)		*
OPERATING CHARACTERISTICS	061		Method of starting	:	DOL		
	062		In case of VFD application:		**Not Applicable**		
			Make of VFD	:			
			Operating speed range	:			
			Type of Application	:	~~Constant Torque/ Variable Torque/ Constant Power~~		
			Stress category	:	~~minimum Category C as per IEC 60034-18-41~~		
			~~Peak value of voltages, dv/dt, rise time, pulse duration and other parameters at Motor terminal shall be calculated~~				
			~~and verified with the motor insulation category.~~				
	063		**Starting duty cycle**	:			
			a. Equally spaced starts per hour	:	3 Nos.		
			b. Successive starts from cold condition	:	2 Nos.		
			c. Successive starts from hot condition	:	1 Nos.		
	064		Max. noise level at N.L. (at 1M distance)	:	85 dBA		
	065		Max.Starting Current when started DOL	:	6 times FLC (inclusive of tol.)		
	066		**Accelerating time when**	:			
			a. Uncoupled at rated voltage	:	s		*
			b. Coupled at rated voltage	:	s		*
			c. Coupled at min. permissible voltage	:	s		*

ONGC MRPL

ThyssenKrupp Industrial Solutions (India)

HIGH VOLTAGE INDUCTION MOTORS

PART - II B

DESIGN DATA SHEET

Code	WSS for PFCC Flue Gas		
Contract no.	66-6723		
Doc.	6723-ELT-331-EC-0008		
Rev.	01	Page	3 OF 5

OPERATING CHARACTERISTICS	067		Bi-directional rotation required	:	Yes/ No	*
	068		If yes	:		*
			a. Change of fan orientation is required	:	Yes/ No	*
			b. Direction of rotation of motor	:	Clockwise/ Anti-clockwise when viewed from non driving end of motor	*
	069		Time `tE' (For increased Safety Motor)	:	s	*
MECHANICAL DATA	070		GD² of motor	:	kg-m^2	*
	071		GD² of load	:	kg-m^2	*
	072		Method of coupling	:		*
	073		Torque speed characteristics of Load	:		*
	074		Full load torque	:	kgfm	*
	075		Starting torque	:	% FLT	*
	076		Pull out torque	:	% FLT	*
	077		Pull up torque	:	% FLT	*
THERMAL DATA	078		**Safe stall time (Hot/Cold) at**	:		
			a. Rated voltage	:	/ s	*
			b. Max. permissible voltage (110%)	:	/ s	*
	079		Temperature rise over design ambient by winding resistance measurement			
			i) For Industrial/ Ex-'d'/ Ex-'p' motors	:	~~80°C~~ / 75°C ~~/ 70°C~~ over an ambient of ~~40°C~~ / 45°C /~~ 50~~°C	
			ii) For Ex-'e' motors	:	~~80°C~~/75°C~~/70°C~~ over an ambient of ~~40°C~~/45°C~~/50°C~~ for single layer	
				:	~~70°C~~/65°C~~/60°C~~ over an ambient of ~~40°C~~/45°C~~/50°C~~ for other insulated winding	
			Note: The difference in reading between the RTD measurements and the temperature rise calculated with the help of resistance value shall not exceed 10°C or proportional based on noted temperature rise for motors upto 5000kW and 5°C for motors above 5000kW.			
	080		**Limiting temperature used to determine safe stall time :**			
			a. Stator	:	°C	*
			b. Rotor	:	°C	*
	081		**Recommended temperature setting for stator winding :**			
			a. Alarm	:	°C	*
			b. Trip	:	°C	*
	082		**Recommended temperature setting for BTD :**			
			a. Alarm	:	°C	*
			b. Trip	:	°C	*
	083		Cooling time constant	:	minutes	*
	084		Heating time constant	:	minutes	*
TERMINAL BOX	085		Separate Terminal box required for the following	:		
			a. Stator leads (Phase segregated type for Safe Area and Ex e)			
			b. Neutral star formation (Non Phase segregated type)			
			c. Space heater			
			d. RTD & BTD leads (common)			
	086		Type of shorting links for neutral CTs	:	Copper	
	087		Type of Enclosure for TB	:	Same as motor enclosure 1	
	088		Differential CTs for non VFD driven motors	:	Yes/No (Required for motor rating above 1000 kW)	*
			a. To be mounted	:	In Neutral TB	
			b. Scope of supply	:	By Motor Manufacturer	
			c. Dimensions	:		*
	089		Terminal Arrangement for Ex 'e' motors : ANTI-LOOSENING TYPE 1			

ONGC एमआरपीएल MRPL

ThyssenKrupp Industrial Solutions (India)

HIGH VOLTAGE INDUCTION MOTORS

PART - II B

DESIGN DATA SHEET

Code	WSS for PFCC Flue Gas		
Contract no.	66-6723		
Doc.	6723-ELT-331-EC-0008		
Rev.	01	Page	4 OF 5

TERMINAL BOX	090		Fault withstand capacity of TBs	:	40 kA for 0.25 s	
	091		Location of main TB as viewed from DE	:	RHS / LHS (as per layout)	*
	092		Cable entry	:	Bottom	
	093		Power cable size	:	By LSTK contractor	*
	094		Scope of supply of cable glands for Power Cable TB	:		*
	095		Scope of supply of cable glands for Space heater Cable TB	:		*
	096		Scope of supply of cable glands for RTD/BTD Cable TB	:		*
	097		Minimum distance between cable gland plate and terminal stud	:	600 mm	
	098		Grounding provision	:	One Internal and one external	
BEARING	099		Make	:	RENK (Sleeve bearing)/ SKF/ FAG	*
	100		Type, DE / NDE	:		*
	101			:		*
	102		On line lubrication facility provided	:	Yes / No	*
	103		Shaft voltage shall not exceed	:	250mV - In case of antifriction ball bearing	
					400mV - In case of sleeve bearing	
	104		Lubricant	:	UNIREXN-3 (Suitable for operation at temperature of 130 Deg C minimum)	
	105		Bearing end play	:	mm	*
	106		Max. axial play (both vertical & horizontal)	:	mm	*
	107		Expected life	:	Running Hours	*
SPACE HEATER	108		Rating	:	kW	*
	109		Power supply	:	1 phase 240 volts AC	
	110		Location of space heater Terminal box	:		*
	111		Quantity	:		
	112		Connection	:	Parallel	
			Note: For installation in hazardous atmosphere (Zone 1, Zone 2), the space heater shall conform to the provisions of applicable IS/ IEC codes and temperature classification			
SHIPPING DETAILS	113		Overall dimensions (lxbxh)	:	mm	*
	114		Dimension of biggest package (lxbxh)	:	mm	*
	115		Overall weight	:	kg	*
	116		Weight of biggest package	:	kg	*
EX 'e', Ex 'p' ENCLOSURE	118		Test on stator as per IEC 60079-7	:	Wherever required	
	119		Risk assessment Factor as per IEC 60079-7 is >6	:	Yes/ No	*
	120		If Yes,	:		
			Test on rotor as per IEC 60079-7	:	Yes / No	*
			Purging arrangement by motor manufacturer	:	Yes / No	*
	121		'Ex' certified pre-start purge panel	:	By Vendor (Refer Note 4)	*
	122		Necessary valves, instrumentation, accessories, pipes & other hardware as required for purging from motor till the control purge panel.	:	By Vendor (Refer Note 4)	*
	123		Medium of purging	:	Clean, Dry air, Oil free (Instrument air, non flammable & non hazardous)	
	124		Purge rate/ purge volume	:		*
	125		Dew point	:		*
	126		Pressure (Air inlet/ supply)	:		*
	127		Leakage rate (for Ex'P' motor)	:		*
	128		Min. over pressure (for Ex'P' motor)	:		*
	129		Flow rate	:		*
	130		Duration of pre-start purging	:		*
	131		Pipe connection size (one inlet and one outlet)	:		*

1

ONGC MRPL / ThyssenKrupp Industrial Solutions (India)	HIGH VOLTAGE INDUCTION MOTORS PART - II B DESIGN DATA SHEET	Code	WSS for PFCC Flue Gas		
		Contract no.	66-6723		
		Doc.	6723-ELT-331-EC-0008		
		Rev.	01	Page	5 OF 5

PURGE CONTROL SYSTEM	132		Type of purge system	:	Microprocessor based/ Timer based	*
	133		Make of purging system	:	Expo/ Ex-grata/ P&F/ Bartec/ equi.	*
	134	1	Model no. of purge controller	:		*
	135		Control supply required for controller (if applicable)	:		
	136		Power consumption	:	Universal (110/ 230 V AC)	*
	137		Purge system start	:	Local	
	138		Safety level	:	Fail safe control (SIL2)	*
	139		CCOE/ PESO certification for complete purge control system	:	Yes	
	140		Following minimum potential free contacts shall be provided for Instrument interface as: a. Purging/ ventillation in progress b. Purging/ ventillation completed c. Purge failure (common alarm) d. Remote start (purge system) command			*
	141		Control supply required for solenoid valve in case Remote start	:	24V DC/ 110V AC or 230V AC	*
	142		Enclosure material & protection class	:	suitable for hazardous area	
	143		Enclosure protection class	:	Min. IP-55	*
TEST	145		Heat Run test	:		
			Direct loading	:	Up to ____ kW	*
			Indirect loading	:	Above ____kW	*
	146		~~Combine testing of VFD & Motor at motor manufacturers work (if applicable)~~	:	~~For Ex 'e', Ex 'n' (mandatory) & Ex 'd' motors (if required based on vendor confirmation)~~	
	147		~~Cost of combine test at manufacturer's works~~	:	~~By contractor~~	
			~~Procedure for combine testing attached~~	:	~~Yes/No~~	*

NOTES :

1. For items marked " * " thus, data to be furnished / confirmed by the Vendor / LSTK Contractor for each motor
2. All motors with VFD application shall be provided with insulated bearings
3. Direction of rotation shall be mentioned on fan cover as well as on nameplate with the corresponding phase sequence
4. Accessories/ equipment not mentioned in the specification but required for successful installation and operation of the purging system shall be in vendor's scope.
5. VFD application Motors which are not tested in combination with VFD, shall be fed with additional 15% of total losses (as Harmonic loading), during heat run test without VFD.
6. Motor shall have FRP canopies fully covering motors including bearing housing.

ONGC MRPL

ThyssenKrupp Industrial Solutions (India)

HIGH VOLTAGE INDUCTION MOTORS
PART - III
INSPECTION TEST PLAN

Code	WSS for PFCC Flue Gas		
Contract no.	66-6723		
Doc.	6723-ELT-331-EC-0008		
Rev.	01	Page	1 OF 2

	Tests	Reference documents	Sample size	Scope of Inspection		
				Vendor	Third Party	Remark
A	**Type Tests**					
i	Full load test to determine efficiency, power factor & slip	IS 4029, IEC-60034-2	For each frame size	P	W	
ii	Temperature rise test	IS 4029, IEC-60034-1		P	W	
iii	Momentary Excess Torque test	IEC-60034-1		P	W	
iv	Overspeed test (120% of rated speed for 2 min.)	IEC-60034-1		P	W	
v	Test for degree of protection for enclosure	IEC-60034-5	Each type	P	R	
vi	Test on Insulation system - Tan delta and delta tan delta test	IS 13508	Each voltage rating	P	R	
vii	Test on Insulation system - Impulse voltage withstand test	IEC-60034-15		P	R	
viii	Test for cage rotor construction	IEC-60079-7	Each type	P	R	
ix	Test for stator winding insulation system incendivity	IEC-60079-7	Each type	P	R	
B	**Routine Tests**					
i	Visual inspection & dimensional checks including shaft centre height, terminal box, clearance between terminals, direction of rotation, paint shade, nameplate details etc.	Approved GA drawings	100%	P	W	
ii	Measurement of resistance of windings of stator & wound rotor	IS 4029, IEC-60034-1		P	W	
iii	No load test at rated Voltage to determine input current, power & speed	IS 4029, IEC-60034-1		P	W	
iv	Locked rotor readings of Voltage, current & power input at a suitable reduced voltage	IS 4029		P	W	
v	Reduced voltage running up test (for squirrel cage motor)	IEC 60034		P	W	
vi	Open circuit voltage ratio of stator & rotor windings (for slip ring motors)	IS 4029, IEC-60034-1		P	W	
vii	Resistance measurement of space heaters, RTD's & BTD's	-		P	W	
viii	High Voltage test (HV)	IS 4029, IEC-60034-1		P	W	
ix	Insulation Resistance test before & after HV Test	IS 4029		P	W	
x	Test for vibration severity of motor	IS 12075, IEC-60034-14		P	W	
xi	Test for noise level of motor	IS 12065, IEC-60034-9		P	W	

ONGC MRPL | ThyssenKrupp Industrial Solutions (India)

HIGH VOLTAGE INDUCTION MOTORS
PART - III
INSPECTION TEST PLAN

Code	WSS for PFCC Flue Gas		
Contract no.	66-6723		
Doc.	6723-ELT-331-EC-0008		
Rev.	01	Page	2 OF 2

	Tests	Reference documents	Sample size	Scope of Inspection		
				Vendor	Third Party	Remark
C	**Additional Tests**					
i	No load running for ½ hr. after completing all tests for all motors	IS 4029, IEC-60034-1	100%	P	W	Refer Note-2
ii	Shaft voltage measurement	IS - 4029 OR IEEE 112		P	W	
iii	Polarisation Index Test	IS-7816 or IEEE 43		P	W	
iv	Balancing of Rotor	ISO-1940		P	R	
v	Combine testing of Motor and VFD	-		P	W	
D	**Certificates**					
i	Certificate from approved testing authority like CMRI/ CPRI/ BASEEFA/ PTB/ UL/ FM/ LCIE for installation in hazardous area	-	100%	P	R	
ii	Approval from statutory authority like CCOE for use in hazardous area	-		P	R	
iii	Certificate for short-circuit withstand capability of main terminal box	-	Each size/ type/ model	P	R	
	Notes:					
	1) R = Review; W = Witness, P = Perform.					
	2) Not required for motors on which temperature rise test has been performed.					

ATTACHMENT – 4

Technical Specifications for Flameproof LED Luminaires

tkIS India / Vendor

Category Codes (Submission Purpose)

- ☐ 1 For Approval
- ☐ 2 For Review / Comments
- ☐ 3 For Information
- ☐ 4 For Engineering
- ☐ 5 For Enquiry
- ☐ 6 For Order Placement
- ☐ 7 Final & Approved
- ☐ 8 Released for Construction

Acceptance Codes (Approval Codes)

- ☐ 1 Approved
- ☐ 2 Approved for Manufacturing / Fabrication with Comments as marked
- ☐ 3 Not Approved / Resubmit
- ☐ 4 Retained for Information / Records
- ☐ 5 Reviewed
- ☐ 6 Reviewed as Noted / Resubmit

Remarks for AC2 : This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-sbumitted after revision. This drawing should be revised only to the extent of tkIS India / Owner / Client comments. Any other changes made by you will not be considered unless clearly highlighted in covering letter asking for approval.

This approval / review does not absolve the supplier from the full responsibility for design and fabrication.

Date : ___/___/_____ Name : _____

tkIS India / Owner / Client

Category Codes (Submission Purpose)

- ☐ 1 For Approval
- ☐ 2 For Review / Comments
- ☐ 3 For Information
- ☐ 4 For Engineering
- ☐ 5 For Enquiry
- ☐ 6 For Order Placement
- ☐ 7 Final & Approved
- ☐ 8 Released for Construction

Acceptance Codes (Approval Codes)

- ☐ 1 Approved
- ☐ 2 Approved for Manufacturing / Fabrication with Comments as marked
- ☐ 3 Not Approved / Resubmit
- ☐ 4 Retained for Information / Records
- ☐ 5 Reviewed
- ☐ 6 Reviewed as Noted / Resubmit

Date : ___/___/_____ Name : _____

Rev.	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC
00	-	Issued for Tender	08.02.21	Jkp	08.02.21	Alg	08.02.21	Jkp	-

Barcode

Category Code: -

INDEX SHEET

The document Cover Sheet indicates revisions made in this document along with the purpose of issue of the revised document. The details of revisions made in the enclosures of this document are listed in the table of *Contents* below and the enclosures listed therein are an integral part of this document.

CONTENTS

1. INTRODUCTION

This specification covers the design, manufacturing, inspection, testing and performance of **Flameproof LED Luminaires**. Equipment to be supplied shall comply with latest revision of applicable Indian & IEC standards and also specific Codes & Standards mentioned in clause 'Codes and Standards' of Part-II of this specification.

Equipment and services to be furnished under this specification shall be as per various parts of this specification. Standard and descriptive requirement is covered in Part-I while specific requirement is covered in Part-II.. Requirements for testing at vendor's work is covered in Part-III.

2. GENERAL REQUIREMENTS

2.1. All LED (Light Emitting Diodes) luminaires shall be suitable for satisfactory operation under site ambient conditions, supply voltage and frequency variations as specified in Part-II.

2.2. All luminaires, LED Modules and control gear boxes shall be suitable for hazardous areas and shall have approval of CMRI/CCE/ DGFASLI with minimum degree of ingress protection as specified in Part-II.

2.3. All luminaires shall be provided with minimum 3 nos. 650V grade terminals suitable for termination of purchaser's incoming 2.5 mm² copper conductor cable/wires.

2.4. A warning inscription "Isolate power supply elsewhere before opening the enclosure" shall be provided on each enclosure for all luminaries and control gear boxes.

2.5. A protective wire guard shall be provided for well glass and bulkhead fittings for extra mechanical protection to the glass cover.

2.6. The material of wire guard shall be as specified in Part-II. Wireguard for well glass luminaire shall have provision for suspension.

2.7. Power factor for all lighting fixture shall be minimum 0.9 at full load.

2.8. **LED Modules:**

2.8.1 Modules shall be either built-in, integral or independent type according to the method of installation.

2.8.2 Modules shall be so designed and constructed that in normal use they operate without danger to the user or surroundings.

2.8.3 For LED modules, all electrical measurements,unless otherwise specified, shall be carried out at voltage limits (Min/Max), current limits (Min/Max) or power limits (Min/Max) and minimum frequency, in a draught-free room at the temperature limits of the allowed range specified by the manufacturer. Unless the manufacturer indicates the most critical combination, all combinations (Min/Max) of voltage/current/power and temperature shall be tested.

2.8.4 Integral modules not having their own enclosure shall be treated as integral components of luminaires and shall be tested and assembled in the luminaire.

2.8.5 For self-ballasted LED modules, the electrical measurements shall be carried out at the tolerance limit values of the marked supply voltage.

2.8.6 Unless otherwise specified, the tests on modules shall be carried out at an ambient temperature of 25 ± 2°C.

2.9. **Controlgear:**

2.9.1 Lamp controlgear shall be so designed and constructed that in normal use they operate without danger to the user or surroundings.

2.9.2 Output voltage of controlgear shall not differ by more than +/- 10% from the rated voltage of LED modules.

2.9.3 Control gear shall be integral or non-integral as specified in Part-IIIB.

2.10. All luminaries/ LED Module / Control gear boxes shall be permanently marked either by raised lettering cast integrally or by a plate attached to the body of the fitting / Module; in a manner which will not impair the flameproof property of the enclosure; to indicate the particulars as per IS 16103 / 16104 / 16107:

LED Luminaires shall be clearly and durably marked with the following mandatory markings:

a. Name of the Manufacturer, or responsible Vendor / supplier.

b. Rated supply voltage / voltage range with supply frequency.

c. Rated Wattage (Watts).

d. Rated Lumen

e. Flameproof mark with Hazardous zone, Gas group & Temperature class details.

f. Flameproof certificate no. given by statutory authority.

g. Well-glasses shall be marked with type of glass & flameproof mark.

3. ACCESSORIES

LED luminaire shall be complete with LED module and control gear box (integral, in-built or independent type) as specified in Part-IIIB.

4. CABLE ENTRY

a. All light fittings shall be provided with cable entry of size and type as specified in Part-II. Top entry is not acceptable.

b. Control gear box for non self-ballasted type luminaries shall be provided with three bottom cable entries for loop in, loop-out with one entry suitably plugged with metallic plug.

c. All light fittings and control gears shall be provided with 650V, 10A terminals suitable for termination of cables of size as specified in Part-II.

5. EARTHING

All fittings, LED module and control gear boxes shall be provided with one internal and one external earthing terminals, suitable for cable termination of size as specified in Part-II.

6. PAINTING

All metallic surfaces shall be sand blasted, phosphated and painted with two coats of primer and two coats of paint. Final shade and type of paint shall be as specified in Part-II.

7. PRODUCT IMPROVEMENT

If any change is made in the standard model (after order placement), same shall be acceptable if the improved product complies with the specification without any additional cost to purchaser. Change of model after drawing approval is not acceptable.

8. FACTORY ACCEPTANCE TEST & DESPATCH

Purchaser shall have the right to carry out stage inspection and shop visit to review the manufacturing progress. However manufacturer need not hold any of the manufacturing activity for stage inspection.

Inspection and testing shall be carried out based on latest revision of this specification and approved vendor drawings approved for manufacturing. In case of any ambiguity between vendor drawing and specification, the requirement indicated in technical specifications shall govern.

All tests as specified in Part-III shall be carried out during final inspection at manufacturer's works in the presence of purchaser/his consultant on sample quantities before dispatching the equipment to site.

Fifteen days advance notice shall be given for witnessing the final inspection and testing.

Vendor shall ensure that all meters associated with testing of the equipment are calibrated by a competent testing authority and the calibration certificates are valid at the time of carrying out the inspection.

After successful completion of inspection and testing, vendor shall furnish all as- built documents in required number of sets. Only after receipt of final documents in TKIS (India) Office, the release order for dispatch of material will be issued.

9. PERFORMANCE GUARANTEE

The performance figures indicated in Part-II shall be guaranteed within the tolerance specified or as permitted by relevant standards. In case of failure of equipment to meet guaranteed performance, owner, reserves the right to reject the equipment. However, owner also reserves the right to use the rejected equipment until a new equipment meeting the guaranteed performance requirements is supplied by the vendor.

If any equipment supplied by the vendor fails at site due to manufacturing defect during erection, commissioning or service (within guarantee period), the vendor shall repair and put back into successful operation the failed equipment within the time frame and procedure of repair agreed with the purchaser depending on nature of failure, at no extra cost to the purchaser.

ThyssenKrupp Industrial Solutions (India)	FLAMEPROOF LED LUMINAIRES PART - IIA DESIGN DATA SHEET	Code	66-6723		
		Contract no.	WSS for PFCC Flue Gas		
		Doc.	6723-ELT-331-EC-0015		
		Rev.	00	Page	1 OF 2

GENERAL	001		Make	:	As per Approved Vendor List	*
	002		Rated Voltage	:	1-ph, 240V	
	003		Voltage Variation	:	+/ -10%	
	004		Frequency	:	50Hz	
	005		Frequency Variation	:	+/ -3%	
	006		Combined Voltage & Frequency variation	:	10% (absolute)	
	007		Quantity	:		*
	008		Acceptable quantity variation after the order placement	:		*
	009		Hazardous area classification			
			a) Zone / Div	:	To be assessed by LSTK contractor (Min. Zone 2)	
			b) Gas group	:	To be assessed by LSTK contractor (Min. IIA/IIB)	
			c) Temperature Class	:	To be assessed by LSTK contractor	
	010					
CODES	011		IS 10322 : Specification for luminaires			
	012		IS/IEC 60529 : Degree of Protection provided by enclosures (IP code)			
	013		IS 15885-2 : AC or DC supplied Electronic controlgear for LED modules - Particular requirements			
	014		IS 16101/ IEC 62504 : General Lighting - LEDs and LED Modules - Terms and definitions			
	015		IS 16102-1 : Self-ballasted LED lamps for general lighting services - safety requirements			
	016		IEC 62612 : Self-ballasted LED lamps for general lighting services - performance requirements			
	017		IS 16103-1 : LED modules for general lighting - safety requirements			
	018		IS 16103-2 : LED modules for general lighting - performance requirements			
	019		IS 16104 : AC or DC supplied Electronic controlgear for LED modules - Performance requirements			
	020		IS 16105 : Method of measurement of Lumen maintenance of LED sources			
	021		IS 16106 : Method of electrical and photometric measurements of LED products			
	022		IS 16107 :Luminaires performance - particular requirements of LED luminaire			
	023		IS 16004 : DC or AC supplied electronic control gear for LED modules			
	024		IES LM-79: Electrical and photometric measurements of solid state lighting products			
	025		IES LM-80: Approved method for measuring lumen depreciation of LED light sources			
			IS 16108 : Photobiological safety of lamps and lamp systems			
ACCESSORIES	026		**1) LED MODULE**			
			a) Type of module (Self-ballasted / Non-ballasted type)	:	Refer Annexure-1 to Part-IIIB	*
			b) Type of installation (built-in / integral / independent)	:	Refer Annexure-1 to Part-IIIB	*
			c) Degree of enclosure protection (independent module)	:	IP55 min.	
			d) Nominal power (watts)	:		*
			e) Rated Maximum Temperature (Tc)	:		*
	027		**2) CONTROLGEAR**			
			a) Type of controlgear	:	constant voltage / constant current type	*
			b) Power factor	:	Refer Part-II B	*
			c) Degree of enclosure protection (independent module)	:	IP55 min.	
			d) Total circuit power (watts)	:	Refer Part-II B	*
	028		**3) WIRE GUARD**	:		
			a) Wire guard for protection of glass cover in well	:	Required	
			glass & bulkhead fitting			
			b) Finish of wire guard	:	SS	
			c) Assembly for suspension of wire guard	:	Required	
			required in case of well glass luminaire			
			d) Thickness of wire guard			
			i) For well glass	:	3 mm	
			ii) For Bulkhead	:	3 mm	

ONGC MAPL	FLAMEPROOF LED LUMINAIRES	Code	66-6723		
		Contract no.	WSS for PFCC Flue Gas		
ThyssenKrupp Industrial Solutions (India)	PART - IIA	Doc.	6723-ELT-331-EC-0015		
	DESIGN DATA SHEET	Rev.	00	Page	2 OF 2

CONSTRUCTION (LIGHT FITTINGS, CONTROL GEARS, JUNCTION BOXES)

029		Material of Construction		*
030		Degree of Protection (IP code)	: IP55 min.	
031		Enclosure type for hazardous area		*
032		Type of Luminaire	:	*
033		Final Paint Shade	: Shade-631 of IS-5 (for indoor) / Shade-632 of IS-5 (for outdoor)	
034		Hardware for light fittings and control gear box	: Stainless steel	
		Gasket	: Neoprene	
035		Internal Wiring	:	
		a) Type	: ISI approved, 650V grade, PVC insulated, copper conductor	
		b) Size	: min. 0.5 sq.mm	
036		Terminal size	: Suitable for termination of 3Cx2.5 sqmm copper cable	
037		Reflector type		*
038		Cable Gland	: Nickel plated brass double compression	
039		Make of Components	:	
040		Cable Glands	: As per Approved Vendor List	*
041		LED	:	*
042		Driver	:	*

		CABLE ENTRY FOR LUMINAIRE / C.G.BOX	SIZE	POSITION & NO. OF ENTRIES
043		LED Tube light	3/4"ET / M20	Side, 2
044		LED well Glass (self-ballasted)	3/4"ET / M20	Side, 2
045		LED well Glass (Non self-ballasted)	3/4"ET / M20	Side, 1
046		LED Floodlight (self-ballasted)	3/4"ET / M20	Bottom /Side, 2
047		LED Floodlight (Non self-ballasted)	3/4"ET / M20	Bottom /Side, 1
048		LED Streetlight	3/4"ET / M20	Side, 1
049		Low, Medium, High Bay Fittings (self-ballasted)	3/4"ET / M20	Side, 2
050		Low, Medium, High Bay Fittings (Non self-ballasted)	3/4"ET / M20	Side, 1
051		Control gear box	3/4"ET / M20	Bottom, 3
052		Internal Earthing terminal : Screw type suitable for 2.5 sq. mm Copper conductors		

DOCUMENTS /DRAWINGS

		Description	For Review/Approval/ Information	Final / As-Built Prints. (see note 2)
053		Catalogues indicating dimensional details alongwith brief specs.	Soft	6
		& Enclosure protection		
054		Lighting distribution diagrams polar curves, isolux diagrams & coefficient of	Soft	6
		utilisation charts for each type of fixtures.		
055		Quality Assurance Plan & Inpsection Test Plan	Soft	6
056		Type Test certificates	Soft	6
057		Routine Test certificates	Soft	6
058		Certificates for use in hazardous area (from CMRI,CCE or any other	Soft	6
		recognised testing authority)		
059		FIA certificate	Soft	6
060		Impact test certificate for glass (for well glass fitting)	Soft	6
061		LM79 Certificate	Soft	6
062		LM80 Certificate	Soft	6

NOTE :

1. For items marked " * " thus, data to be furnished / confirmed by Vendor / LSTK contractor
2. All document requirement are indicative only.This will be finalised by LSTK contractor in conformance with tender requirements.

ThyssenKrupp Industrial Solutions (India)	FLAMEPROOF LED LUMINAIRES PART - II B DESIGN DATA SHEET (VENDOR'S DATA)	Code	66-6735		
		Contract no.	WSS for PFCC Flue Gas		
		Doc.	6723-ELT-331-EC-0015		
		Rev.	00	Page	1 OF 1

VENDOR DATA			**LED VENDOR DATA** :								
	A		**LED Tube light / down light :**								*
		1	Rating	6W	9 W	12W	15W	18W	40W		
		2	Losses								
		3	LED Module Nominal Power (W)								
		4	Rated Maximum Temp (^{0}C)								
		5	Power Factor								
		6	Total Circuit Power (W)								
		7	Lumen Output								
	B		**LED Street light :**								*
		1	Rating	30 W	60W	90W	120W	150W	170W	210W	
		2	Losses								
		3	LED Module Nominal Power (W)								
		4	Rated Maximum Temp (^{0}C)								
		5	Power Factor								
		6	Total Circuit Power (W)								
		7	Lumen Output								
	C		**LED Flood light:**								*
		1	Rating	10 W	30W	60W	80W	120W	160W		
		2	Losses								
		3	LED Module Nominal Power (W)								
		4	Rated Maximum Temp (^{0}C)								
		5	Power Factor								
		6	Total Circuit Power (W)								
		7	Lumen Output								
	D		**LED Medium / High bay light :**								*
		1	Rating	80 W	100W	150W					
		2	Losses								
		3	LED Module Nominal Power (W)								
		4	Rated Maximum Temp (^{0}C)								
		5	Power Factor								
		6	Total Circuit Power (W)								
		7	Lumen Output								
	E		**LED well glass :**								*
		1	Rating	35W	80 W	100W	150W				
		2	Losses								
		3	LED Module Nominal Power (W)								
		4	Rated Maximum Temp (^{0}C)								
		5	Power Factor								
		6	Total Circuit Power (W)								
		7	Lumen Output								
			For items marked " * " thus, data to be furnished by vendor.								

ONGC एमआरपीएल MRPL

ThyssenKrupp Industrial Solutions (India)

FLAMEPROOF LED LUMINAIRES
PART- III
INSPECTION TEST PLAN

Code	66-6735		
Contract no.	WSS for PFCC Flue Gas		
Doc.	6723-ELT-331-EC-0015		
Rev.	00	Page	1 of 1

	Tests	Reference Documents	Sample size	Scope of Inspection		
				Vendor	Third Party	Remark
A	**Type Tests**					
i	Ingress Protection	IS/IEC-60529	Each type	P_{PROTO}	R	
ii	Test for Temperature rise	~~IS-2206~~	Each type	P_{PROTO}	R	
iii	Test for Flameproofness	~~IS-2206~~	Each type	P_{PROTO}	R	
iv	Luminaire Power	IS-16107	Each type	P_{PROTO}	R	
v	Moisture resistance	IS-15885-2-13	Each type	P_{PROTO}	R	
vi	Creepage distances and clearances	IS-15885-2-13	Each type	P_{PROTO}	R	
vii	Marking	~~IS-2206~~	Each type	P_{PROTO}	R	
viii	Luminous Flux	IS-16107	Each type	P_{PROTO}	R	
ix	Lighting Intensity	IS-16107	Each type	P_{PROTO}	R	
x	Angular beam distribution	IS-16107	Each type	P_{PROTO}	R	
xi	Luminaire intensity distribution	IS-16107	Each type	P_{PROTO}	R	
xii	Luminaire efficacy	IS-16107	Each type	P_{PROTO}	R	
xiii	Chromocity coordinates and correlated colour temperature (CCT)	IS-16107	Each type	P_{PROTO}	R	
xiv	Colour rendering index (CRI)	IS-16107	Each type	P_{PROTO}	R	
xv	Life	IS-16107	Each type	P_{PROTO}	R	
xvi	Lumen maintenance	IS-16107	Each type	P_{PROTO}	R	
xvii	Endurance test	IS-16107	Each type	P_{PROTO}	R	
B	**Acceptance Tests**					
i	Visual inspection and dimensional check-up	Approved GA drawings	One sample of each type/rating	P	W	
ii	Marking	IS-16107		P	W	
iii	Luminaire Power	IS-16107		P	W	
iv	Luminous flux	IS-16107		P	W	
v	Lighting intensity	IS-16107		P	W	
vi	Angular beam distribution	IS-16107		P	W	
vii	Luminaire efficacy	IS-16107		P	W	
viii	Chromocity coordinates and correlated colour temperature (CCT)	IS-16107		P	W	
ix	Colour rendering index (CRI)	IS-16107		P	W	
x	Luminaire intensity distribution	IS-16107		P	W	
xi	Static hydraulic test	~~IS-2206~~		P	W	
xii	Thermal shock test	~~IS-2206~~		P	W	
C	**Test certificates**					
i	Test certificates for bought out items and internal components	-	100%	P	R	

Notes:

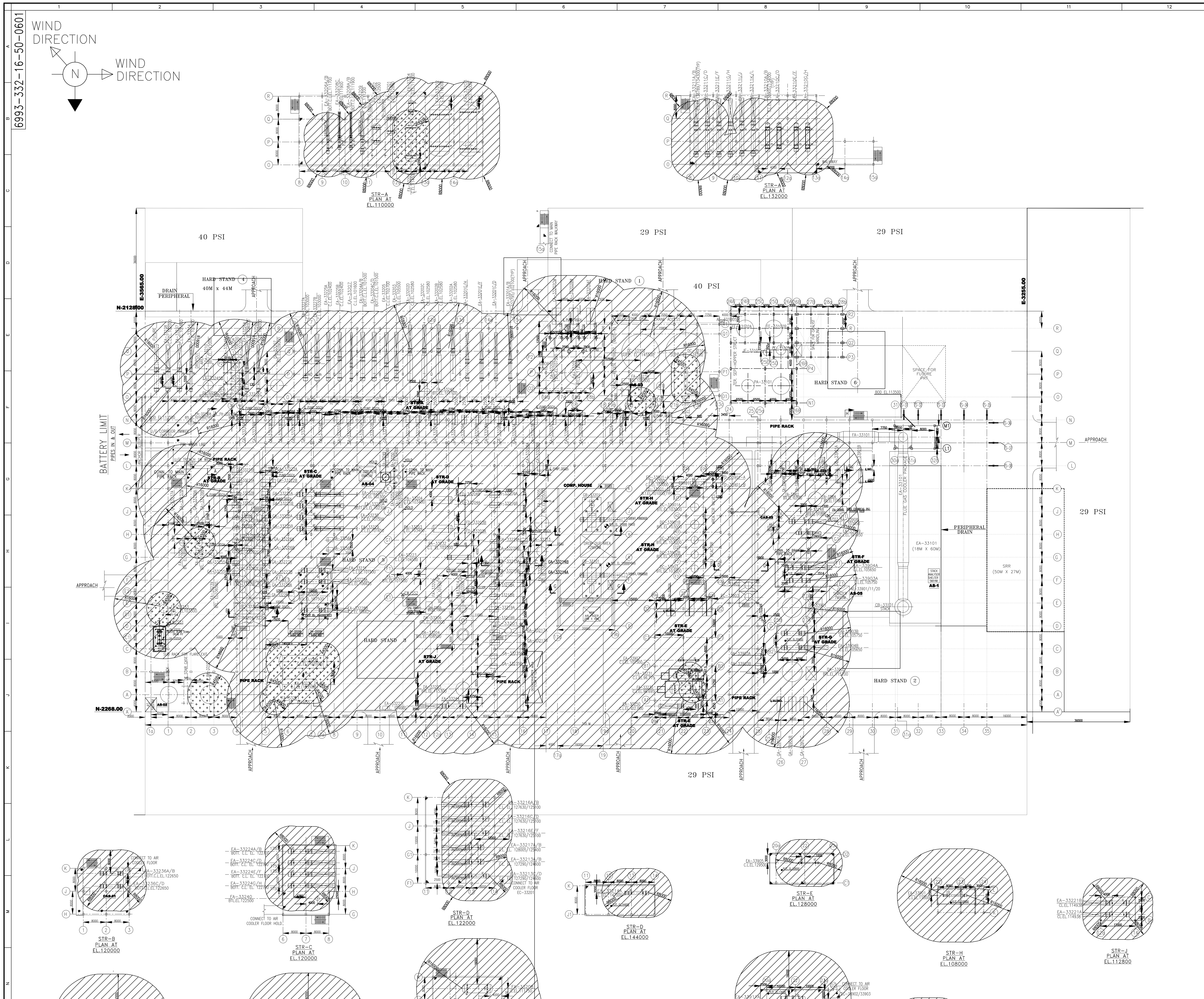
1) W = Witness, R = Review, P = Perform on project equipment, P_{PROTO} = Perform on prototype.

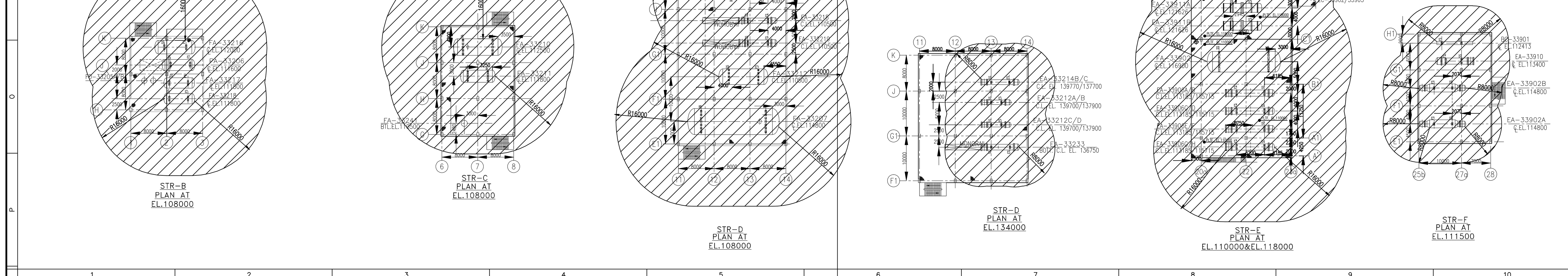
2) Test certificates shall be not less than 5 years old. In case, no type test certificate is available, vendor shall carry out the type test without any cost implication.

ATTACHMENT – 5

Area Classification Layout of PFCC Unit

6993-332-16-50-0601





DOSING SKIDS

PA-33207	ANTIFOAM DOSING SKID	332-1180	E2-11
PA-33208	LCN ANTIOXIDENT DOSING SKID	332-1178	D-6
PA-33209	MCN ANTIOXIDENT DOSING SKID	332-1179	D-7
PA-33902	HWB CHEMICAL INJ. DOSING SKID	339-1129	J-28

EDUCTORS

EG-33201	CBD PIT EDUCTOR	332-1175	A-22
EG-33202	AMIN CBD PIT SDUCTOR	332-1176	A-22
EG-33203	CAUSTIC CBD PIT EDUCTOR	332-1177	C-1

NOT TO SCALE, ASK IF IN DOUBT

EQUIPMENT LIST

EQUIP. NO.	DESCRIPTION	P&ID	REMARKS/ LOCATION
COLUMNS			
DA-33201	MAIN FRACTIONATOR (8000 ID/48100 T-T)	332-1113/14	P-18
DA-33202	LCO STRIPPER (1000 ID/11850 T-T)	332-1119	O-17
DA-33203	STRIPPER (4900 ID/48800 T-T)	332-1141	C-14
DA-33204	ABSORBER (3400 ID/39400 T-T)	332-1144	D-13
DA-33205	SPONGE ABSORBER (1900 ID/22200 T-T)	332-1149	E-14
DA-33206	FUEL GAS ABSORBER (1400 ID/21600 T-T)	332-1172	E-14
DA-33207	DEBUTANIZER (4500 ID/14950 T-T)	332-1152	O-6
DA-33208	NAPHTHA SPLITTER (3800 ID/30000 T-T)	332-1165	E-6
DA-33210	DEPROPANIZER (3700 ID/12950 T-T)	332-1161A	O-3
DA-33901	C3 STRIPPER (7000 ID/70800 T-T)	339-1114	D-27
DA-33902	C3 RECTIFIER (7000 ID/67000 T-T)	339-1115	B-26
VESSELS			
FE-33101	FRESH CATALYST STORAGE HOPPER (3400 ID/13650 T-T)	331-1127	Q-26
FE-33102 A/B	SPENT CATALYST STORAGE HOPPERS (6000 ID/23900 T-T)	331-1126	Q-25
FA-33101	FLUE GAS ORIFICE CHAMBER (3660 ID/10000 T-T)	331-1124	M-30
FA-33201	FEED SURGE DRUM (3800 ID/11600 T-T)	332-1111	P-12(TECH-A)
FA-33202	MAIN FRACTIONATOR REFLUX DRUM (6800 ID/14500 T-T)	332-1131	P-13a(TECH.-A)
FA-33203	MAIN FRACTIONATOR DISTILLATE DRUM (6000 ID/15000 T-T)	332-1134	P-14a(TECH-A)
FA-33204	SOUR WATER FLASH DRUM (1700 ID/4250 T-T)	332-1132	O-11(TECH-A)
FA-33205	WET GAS COMPRESSOR KO DRUM (4900 ID/5050 T-T)	332-1136	J-17
FA-33206	WET GAS COMPR. INTERSTAGE DRUM (3400 ID/4450 T-T)	332-1140	G-17
FA-33207	HIGH PRESSURE SEPARATOR (5800 ID/17400 T-T)	332-1143	J-13(TECH-D)
FA-33208	ABSORBER REFLUX DRUM (3000 ID/9000 T-T)	332-1148	J-13(TECH-D)
FA-33209	ABSORBER GAS KO DRUM (1300 ID/2750 T-T)	332-1151	F-13
FA-33210	DEBUTANIZER REFLUX DRUM (3700 ID/9000 T-T)	332-1157	K-07(TECH-C)
FA-33211	NAPHTHA SPLITTER REFLUX DRUM (2700 ID/6500 T-T)	332-1169	J-07(TECH-C)
FA-33212	RICH AMINE FLASH DRUM (2800 ID/7200 T-T)	332-1175	F-15
FA-33214	LEAN AMINE SURGE DRUM (1600 ID/3200 T-T)	332-1176	F-14
FA-33215	FUEL GAS KNOCKOUT DRUM (1400 ID/2750 T-T)	332-1173	A-14
FA-33216	DPROPANIZER REFLUX DRUM (3000 ID/7500 T-T)	332-1163	K-02(TECH-B)
FA-33217	LPG/CAUSTIC SETTLER (2300 ID/5700 T-T)	332-1159	H-02(TECH-B)
FA-33218	LPG WASH WATER SETTLER (2300 ID/5000 T-T)	332-1159	H-01(TECH-B)
FA-33219	CAUSTIC FLASH DRUM (2000 ID/4800 T-T)	332-1160B	J-2
FA-33220	DILUTION DRUM (2000 ID/4800 T-T)	332-1160A	G-02(TECH-B)
FA-33221	REFINERY FUEL GAS KNOCKOUT DRUM (1000 ID/2750 T-T)	332-1177	A-5
FA-33230	CLOSED BLOW DOWN (3000 ID/7500 T-T)	332-1175	B-17
FA-33231	AMINE CBD (2000 ID/5000 T-T)	332-1176	B-17
FA-33232	CAUSTIC CBD (1300 ID/3900 T-T)	332-1163	D-01
FA-33233	FG MIXING DRUM (3000 ID/6000 T-T)	332-1159	R-
FA-33234	PLANT AIR KOD (1100 ID/2800 T-T)	332-1159	N-23
FA-33235	PUMP SEAL OIL DRUM (1000 ID/3800 T-T)	332-1160B	E-03
FA-33236	INSTRUMENT FLUSHING OIL DRUM (1000 ID/3800 T-T)	332-1160A	F-03
FA-33237	HYDROCARBON FLARE KOD-1 (4000 ID/11300 T-T)	332-1177	A-6
FA-33238	HYDROCARBON FLARE KOD-2 (4500 ID/14300 T-T)	332-1175	B-6
FA-33239	SUSPECT ATM CONDENSATE FLASH DRUM (2300 ID/4700 T-T)	332-1176	F-03
FA-33240	PURE LP CONDENSATE FLASH DRUM (1500 ID/4500 T-T)	332-1163	H-08(TECH-C)
FA-33241	PURE ATM CONDENSATE FLASH DRUM (1400 ID/4300 T-T)	–	H-06(TECH-C)
FA-33242	STEAM BLOW DOWN DRUM (500 ID/2200 T-T)	–	O-12(TECH-A)
FA-33243A/B	DEBUTANIZER REBOILER CONDENSATE POT (500 ID/2400 T-T)	332-1155	P-08(TECH-A)
FA-33244	STRIPPER REBOILER CONDENSATE POT (500 ID/2400 T-T)	332-1147	C-14
FA-33245A/B/C	DPROPANIZER REBOILER CONDENSATE POT (500 ID/2400 T-T)	332-1161B	P-04
FA-33246A/B	C3 STRIPPER STEAM REBOILER COND. POT (500 ID/2400 T-T)	332-1177	E-27(TECH-F)
FA-33247	SLURRY INSTRUMENT FLUSHING OIL DRUM (900 ID/3500 T-T)	332-1177	O-21
FA-33248	NITROZEN REGENERATION STEAM HEATER CONDENSATE POT (500 ID/2400 T-T)	332-1177	H-22
FA-33902	C3 RECTIFIER REFLUX DRUM (4600 ID/14000 T-T)	339-1120	F-21a
FA-33903	NITROGEN REGENERATION KO DRUM (1300 ID/2800 T-T)	339-1126	J-27
FA-33904	HOT WATER BELT DRUM (4800 ID/14800 T-T)	339-1123	K-27
FIRED HEATERS			
BA-33101	FRESH FEED PREHEATER	331-1118	A-3
BC-33101	REGENERATOR AIR HEATER	331-1117	P-22
BC-33901	NITROGEN REGENARATION ELECTRIC HEATER	339-1125	J-27
HEAT EXCHANGERS			
EA-33201 A-F	SLURRY/FEED EXCHANGER	332-1124	P-14(TECH.-A)
EA-33202 A-D	SLURRY HP STEAM GENERATOR	332-1125/26	P-12(TECH.-A)
EA-33203	SLURRY/BFW EXCHANGER	332-1127	P-11(TECH.-A)
EA-33204 A/B/C/D	SLURRY HWB EXCHANGER	332-1128	P-10(TECH.-A)
EA-33205	HCO PA/FEED EXCHANGER	332-1122	P-10(TECH.-A)
EA-33206 A/B	LCO PRODUCT/HWB EXCHANGER	332-1120	P-09(TECH.-A)
EA-33207	LCO PRODUCT TRIM COOLER	332-1121	P-09(TECH.-A)
EA-33208 A/B/C	LEAN OIL/HWB EXCHANGER	332-1117	P-10(TECH.-A)
EA-33209	LEAN OIL TRIM COOLER	332-1129	P-11(TECH.-A)
EA-33210 A-H	MAIN FRACTIONATOR OVERHEAD CONDENSER	332-1130	P-14a(TECH.-A)
EA-33211 A-L	MAIN FRACTIONATOR OVERHEAD TRIM CONDENSER	332-1133	P-11(TECH.-A)
EA-33212 A-D	WGC INTERSTAGE COOLER	332-1139	F1-13(TECH.-D)
EA-33213 A-D	WGC INTERSTAGE TRIM COOLER	332-1139	F1-13(TECH.-D)
EA-33214 A-C	WGC DISCHARGE COOLER	332-1139	G1-13(TECH.-D)
EA-33216 A-F	HIGH PRESSURE SEPARATOR CONDENSER	332-1142	J-13(TECH.-D)
EA-33217 A/B	ABSORBER REFLUX CONDENSER	332-1148	J-13(TECH.-D)
EA-33218	UPPER ABSORBER INTERCOOLER	332-1145	G1-13(TECH.-D)
EA-33219	LOWER ABSORBER INTERCOOLER	332-1146	F1-13(TECH.-D)
EA-33220 A/B/C	SUPPLEMENTAL LEAN OIL HWB EXCHANGER	332-1153	K-07
EA-33221 A/B	LCO PA STRIPPER REBOILER	332-1147	A-13
EA-33222	LP STEAM STRIPPER REBOILER	332-1147	E-13
EA-33223	ABSORBER OFFGAS COOLER	332-1150	H-14(TECH.-D)
EA-33224 A-H	DEBUTANIZER OVERHEAD CONDENSER	332-1156	J-07(TECH.-C)
EA-33225 A/B	HCO PUMPAROUND DEBUTANIZER REBOILERS	332-1154	P-08(TECH.-A)
EA-33226 A/B	HP STEAM DEBUTANIZER REBOILERS	332-1155	P-4
EA-33227 A/B	DEBUTANIZER FEED/BOTTOM EXCHANGER	332-1152	P-07b(TECH.-A)
EA-33228 A/B	NAPHTHA SPLITTER REBOILER	332-1166	F-7
EA-33229	LCN PRODUCT TRIM COOLER	332-1170	H-7
EA-33230	MCN PRODUCT TRIM COOLER	332-1170	J-7
EA-33231	HCN PRODUCT TRIM COOLER	332-1171	F-7
EA-33232	WASH WATER COOLER	332-1174	H-14(TECH.-D)
EA-33233	LCO PA/HWB EXCHANGER	332-1118	E1-12(TECH.-D0
EA-33234	DEPROPANIZER FEED/BTMS EXCHANGER	332-1164	P-2
EA-33235 A-C	DEPROPANIZER REBOILERS	332-1161B	P-4
EA-33236 A-D	DEPROPANIZER CONDENSER	332-1162	J-02(TECH.-B)
EA-33237	B-B PRODUCT COOLER	332-1164	P-2
EA-33238	FULL NAPHTHA RUNDOWN COOLER	332-1153	P-1
EA-33250	CBD COOLER	332-1153	A-17
EA-33901	DRYER FEED COOLER	339-1111	K-23
EA-33902 A/B	C3 STRIPPER HWB SIDE REBOILER	339-1118	D1-27(TECH-F)
EA-33903 A/B	C3 STRIPPER HWB REBOILER	339-1116	C-26/E-26
EA-33904 A/B	C3 STRIPPER STEAM REBOILER	339-1117	C-26/E-26
EA-33905	PROPYLENE PRODUCT COOLER	339-1121	D1-21a
EA-33906 A-H	C3 RECTIFIER CONDENSER	339-1119	E-22
EA-33907	C3 LPG COOLER	339-1114	B-22
EA-33908	NITROGEN REGENARATION STEAM HEATER	339-1124	H-27
EA-33909	NITROGEN REGENARATION CROSS EXCHANGER	339-1124	G-27
EA-33910	NITROGEN REGENARATION COOLER	339-1126	G-27
EA-33911 A-D	HWB COOLER	339-1116	D1-22a(TECH.-E)
AIR COOLERS			
EC-33201	LCO PA AIR COOLER (3460 X 10000)	332-1118	G-15(PIPERACK)
EC-33202A/B/C/D/E/F	NAPHTHA SPLITTER OVERHEAD AIR CONDENSER(5710X10000)	332-1168	H-07(TECH.-C)
EC-33203	MCN PRODUCT AIR COOLER(4210X10000)	332-1170	E-05
EC-33204	HCN PRODUCT AIR COOLER(4210X10000)	332-1167	E-05
EC-33210A/B/C/D	SUSPECT VENT CONDENSER(4500X8000)	331-1169	J-05
EC-33211A/B	PURE VENT CONDENSER(3960X8000)	331-1170	H-05
EC-33902	BLOWER DISCHARGE AIR COOLER(1980X6000)	339-1125	G-25(PIPERACK)
EC-33903	NITROGEN REGENARATION AIR COOLER (1980X6000)	339-1124	H-25(PIPERACK)
MISCELLANEOUS			
EA-33101	FLUE GAS COOLER PACKAGE	331-1125	G-35
CB-33101	FLUE GAS STACK (INCLUDED IN FGC)	331-1125	G-35
PA-33101	TERTIARY SEPERATOR SYSTEM	331-1123	O-25
PA-33201	LEAN OIL COALESCER	332-1129	P-11(TECH-A)
PA-33202	LCO COALESCER	332-1121	P-9(TECH-A)
PA-33203	UPPER ABSORBER INTERCOOLER COALESCER	332-1145	J-13(TECH-D)
PA-33204	LOWER ABSORBER INTERCOOLER COALESCER	332-1146	H-13(TECH-D)
PA-33206	LPG COALESCER	332-1160A	J-02(TECH-B)
PA-33901	DRYER FEED COASLESCER	339-1111	K-23
PA-33902	HWB CHEMICAL INJECTION PACKAGE	339-1123	H-21
GD-33201	LPG/CAUSTIC MIXER	332-1159	NOT SHOWN
GD-33202	LPG/WATER MIXER	332-1159	NOT SHOWN
FILTERS			
FD-33201 A/B	LEAN OIL FILTER	332-1129	O-11(TECH.-A)
FD-33202 A/B	LCO FILTER	332-1121	O-11(TECH.-A)
FD-33203 A/B	UPPER ABSORBER INTERCOOLER FILTER	332-1145	J-12
FD-33204 A/B	LOWER ABSORBER INTERCOOLER FILTER	332-1146	J-12
FD-33205 A/B	LPG FILTER	332-1160A	NOT SHOWN
FD-33901 A/B	PP MIX FILTER	339-1111	NOT SHOWN
INJECTORS			
PA-33102 A-F	FEED INJECTORS NOZZLES	331-1120	NOT SHOWN
PA-33103	LOWER LCN RECYCLE INJECTOR	331-1120	NOT SHOWN
PA-33104 A/B	UPPER LCN RECYCLE INJECTORS	331-1120	NOT SHOWN
PA-33105 A/B	C4 RECYCLE INJECTORS	331-1120	NOT SHOWN
PA-33106 A-H	RISER STEAM NOZZLES	331-1121	NOT SHOWN
PA-33107 A/B	LOWER SLURRY RECYCLE INJECTORS	331-1121	NOT SHOWN
PA-33108 A-D	UPPER SLURRY RECYCLE INJECTORS	331-1121	NOT SHOWN
PA-33109 A-D	TORCH OIL INJECTORS	331-1122	NOT SHOWN
PA-33114	REACTOR RISER	331-1120/21/22	NOT SHOWN

संदर्भ आरेख REFERENCE DRAWINGS	संख्या No.
OVER PLOT PLAN	6922-000-16-47-0001
EQUIPMENT LAYOUT-PFCC/PR UNIT	6993-331-16-43-0001/1

NOTES :-

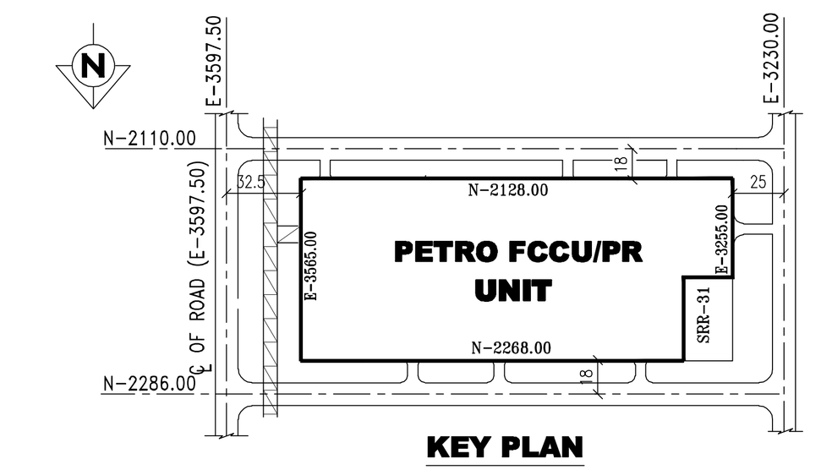
1. FOR ADDITIONAL NOTES, LEGENDS AND CROSS SECTIONAL DETAILS OF HAZARDOUS AREA REFER DRG. NO. 7-51-0701
2. ELECTRICAL EQUIPMENT IN THE HAZARDOUS AREA SHALL BE AS PER CLAUSE-11.0 OF ELECTRICAL DESIGN BASIS 6782-00-16-50-DB-01.
3.. ALL EQUIPMENTS WITHIN UNIT BATTERY LIMIT AS A MINIMUM SHALL BE SUITABLE FOR ZONE-2 GAS GROUP IIA/IIB.

LEGENDS:-

- ZONE-1, GAS GROUP-IIA/IIB HAZARDOUS AREA
- ZONE-2 GAS GROUP-IIA/IIB HAZARDOUS AREA
- ADDITIONAL ZONE -2 GAS GROUP IIA/IIB AREA (AREA SUGGESTED WHERE LARGE RELEASE OF VOLATILE PRODUCTS MAY OCCUR)
- ZONE-1 GAS GROUP-IIC HAZARDOUS AREA
- ZONE-2 GAS GROUP-IIC HAZARDOUS AREA
- NON HAZARDOUS AREA

EQUIP. NO.	DESCRIPTION	P&ID	REMARKS LOCATION	MONO-RAIL REQD.
PUMPS				
GA-33201 A/B	FRESH FEED PUMPS	332-1112	N-12	YES
GA-33202 A-C	SLURRY PUMP AROUND PUMPS	332-1123	R-18	NO
GA-33203 A-C	HCO PUMP AROUND PUMPS	332-1116	N-16	YES
GA-33204 A/B	LCO PRODUCT PUMPS	332-1119	N-19	NO
GA-33205 A/B	LCO PUMP AROUND PUMPS	332-1115	N-18	YES
GA-33206 A/B	LEAN OIL PUMPS	332-1117	L-17	YES
GA-33207 A/B	SLURRY PRODUCT PUMPS	332-1128	N-9	NO
GA-33208 A/B	MAIN FRACTIONATOR REFLUX PUMPS	332-1131	N-14	YES
GA-33209 A/B	SEPARATOR DISTILLATE PUMPS	332-1134	N-13	YES
GA-33210 A/B	DISTILLATE DRUM SOUR WATER PUMPS	332-1135	N-10	NO
GA-33211	WASH WATER PUMP	332-1135	N-11	YES
GA-33212 A/B	SOUR WATER PUMPS	332-1132	N-11	NO
GA-33213	WET GAS COMPRESSOR KO PUMPS	332-1136	H-16	NO
GA-33214 A/B	WGC INTERSTAGE CONDENSATE PUMPS	332-1140	G-16	YES
GA-33215 A/B	STRIPPER FEED PUMPS	332-1143	J-15	YES
GA-33216 A/B	ABSORBER REFLUX PUMPS	332-1148	H-15	YES
GA-33217 A/B	ABSORBER UPPER INTERCOOLER PUMPS	332-1145	C-15	YES
GA-33218 A/B	ABSORBER LOWER INTERCOOLER PUMPS	332-1146	F-15	YES
GA-33219 A/B	ABSORBER BOTTOMS PUMPS	332-1144	D-15	YES
GA-33221 A/B	DEBUTANIZER REFLUX PUMPS	332-1158	K-5	YES
GA-33222 A/B	LPG PUMPS	332-1157	L-5	YES
GA-33223 A-C	DEBUTANIZER REBOILER FEED PUMPS	332-1154	N-8	YES
GA-33224 A/B	SUPPLEMENTAL LEAN OIL RECYCLE PUMPS	332-1153	N-6	YES
GA-33225 A/B	LCN PUMPS	332-1169	H-5	NO
GA-33226 A/B	NAPHTHA SPLITTER REFLUX PUMPS	332-1168	J-5	NO
GA-33227 A/B	MCN PRODUCT PUMPS	332-1170	F-5	NO
GA-33228 A/B	HCN PRODUCT PUMPS	332-1167	E-5	NO
GA-33229 A/B	RICH AMINE PUMPS	332-1175	A-15	NO
GA-33230 A/B	LEAN AMINE BOOSTER PUMPS	332-1176	B-15	YES
GA-33231 A/B	DEPROPANIZER REFLUX PUMPS	332-1163	K-4	YES
GA-33232 A/B	P-P MIX PUMPS	332-1163	J-4	YES
GA-33233 A/B	B-B MIX PUMPS	332-1164	N-3	NO
GA-33235 A/B	OFF GAS WASH PUMPS	332-1174	C-15	NO
GA-33236 A/B	SPENT CAUSTIC PUMP	332-1160B	H-3	NO
GA-33237 A/B	CAUSTIC INJUCTION PUMPS	332-1159	H-3	NO
GA-33238 A/B	CAUSTIC CIRCULATION PUMPS	332-1159	H-4	NO
GA-33239 A/B	LPG/WASH WATER PUMPS	332-1159	H-1	NO
GA-33250 A/S	CBD PUMP	339-1115	C-07	YES
GA-33251 A/S	AMINE CBD PUMP	339-1120	B-07	YES
GA-33252 A/S	CAUSTIC CBD PUMPS	339-1121	D-01	YES
	PUMPS DELETED			
	PUMPS DELETED			
GA-33255 A/B	SUSPECT STABILISED CONDENSATE PUMPS	332-1159	G-03	NO
GA-33256 A/B	PURE STABILISED CONDENSATE PUMPS	332-1159	H-08	NO
GA-33257 A/B	SLURRY INSTRUMENTS FLUSHING OIL PUMPS	332-1159	N-21	NO
GA-33901 A-C	C3 SPLITTER TRANSFER PUMPS	339-1115	A-26	NO
GA-33902 A-C	C3 RECTIFIER REFLUX PUMPS	339-1120	E-24	YES
GA-33903 A/B	PROPYLENE PRODUCT PUMPS	339-1121	C-24	NO
GA-33904 A-C	HOT WATER BELT PUMPS	339-1123	K-28	YES
CYCLONES				
FC-33101 A-N	REACTOR PRIMARY CYCLONES	331-1119	NOT SHOWN	
FC-33102 A-N	REACTOR SECONDARY CYCLONES	331-1119	NOT SHOWN	
FC-33103 A-Q	REGENERATOR PREMARY CYCLONES	331-1119/22	NOT SHOWN	
FC-33104 A-Q	REGENERATOR SECONDARY CYCLONE	331-1119/22	NOT SHOWN	
FC-33105	FRESH CATALYST HOPPER CYCLONE	331-1127	NOT SHOWN	
FC-33106 A/B	SPENT CATALYST HOPPER CYCLONE	331-1126	NOT SHOWN	
REACTORS				
DC-33101	REGENERATOR (ID STEEL 14200)	331-1119/22	Q-22	
DC-33102	REACTOR (ID STEEL 13200)	331-1119/21/22	Q-20	
DC-33901 A/B	PP MIX DRYERS (2800 ID/10550 T-T)	339-1112	J-23	
DC-33902 A/B	PP MIX RSH/COS REMOVAL BEDS (2500 ID/9000 T-T)	339-1113	H-23	
DC-33903	ARSINE REMOVAL BED (2000 ID/9200 T-T)	339-1122	F-22	
EJECTORS				
EE-33101	STEAM EJECTOR	331-1127	NOT SHOWN	
BLOWERS/FANS				
GB-33101	AIR BLOWER	331-1116	J-18	
GB-33901 A/B	NITROGEN REGENARATION BLOWERS	339-1126	J-25	
COMPRESSORS				
GB-33201	WET GAS COMPRESSOR	332-1137/38	F-19	
SOLIDS HANDLING				
JF-33101	FRESH CATALYST LOADER	331-1127	R-27	
SLIDE VALVES				
PA-33124	REG. CAT SLIDE VALVE		NOT SHOWN	
PA-33123	SPENT CAT SLIDE VALVE		NOT SHOWN	
PA-33125	FLARE GAS SLIDE VALVE		NOT SHOWN	

CAPACITY:- 2.2 MMTPA (DCC) & 0.445 MMTPA (PRU)
LICENSOR-SHAW STONE & WEBSTER, HOUSTAN



KEY PLAN

AS BUILT

NO.	DATE	REVISIONS	BY	CHKD	APPD	PEM/PC
C	05.05.14	REVISED AS BUILT	T.D.	SHIRALI/SA	NS	
B	25.08.10	REVISED AS PER EUIPT L/O & REISSUED FOR ENGINEERING	RSD	SHIRALI/SA	NS	
A	02.04.09	ISSUED FOR ENGINEERING	JSK	SHIRALI/SA	NS	

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

ONGC MRPL

मैंगलोर रिफाइनरी एवं पैट्रोकेमिकल्स लिमिटेड
MANGALORE REFINERY & PETROCHEMICALS LTD.

फेस-3 रिफाईनरी परियोजना मैंगलोर — PHASE-III REFINERY PROJECT MANGALORE

क्षेत्रिय वर्गीकरण पी.एफ.सी.सी./पी.आर. यूनिट — AREA CLASSIFICATION PFCC / PR UNIT

SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
1:500	6993	331	16	50	0601	C

3-1641-0500 REV.2 A0-1189 x 841

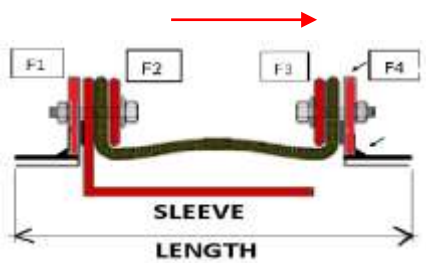
ATTACHMENT – 6

Expansion Bellows Specs SXB-33101A & SXB-33102

thyssenkrupp	Plant: MRPL Mangalore	Client: MRPL	Code: WSS for PFCC Flue Gas	Project No.: 66-6723	Page: 1
	TECHNICAL SPECIFICATION FOR FABRIC EXPANSION JOINT FOR MRPL PLANT			TON	
				ITEM	**SXB-33101A**
				REV.	**0**

1		**Part-No.**			SXB-33101A		
2		**Quantity**			4		
3		**Expansion joint type**			UNTIED		
4		**Construction**			FABRIC		
5		**Internal Sleeve Material (Note 2)**			☒ **yes**	☐ **no**	
6		**Nominal Size**		**Inch**	60“		
7		**Unit weight**		**Kg**	**Note 1**		
8		**Line No./ Stress System No**			60”-RF-3310502-HRCSS150-IH		
9		**Plant location**			MRPL		
10		**Fluid**			REGENERATOR FLUE GAS		
11		**State**			☒ **gaseous**	☐ **liquid**	
12		**Pressure**	**Allowable working pressure**	**Bar (g)**	0.086		
13			**Vacuum**	**Bar (g)**	-		
14			**Test pressure**	**Bar (g)**	-		
15		**Temp.**	**Allowable working temperature**	**°C**	300		
16		**Movements**	**Axial movement**	**mm**	+/- 150		
17			**Lateral movement**	**mm**	+/- 150		
18			**Angular movement**	**deg**	-		
19			**Pretension**		☐ **yes**	☒ **no**	
20		**Spring rate**	**Axial spring rate (Max)**	**N/mm**	**Note 1**		
21		incl.	**Lateral spring rate (Max)**	**N/mm**	**Note 1**		
22		Friction	**Angular spring rate**	**N-m/deg**	**Note 1**		
23			**Effective area (Axial expansion joint)**	**mm²**	**Note 1**		
24		**Type of end (Note 3)**	**Designation**		**Inlet**	**Outlet**	
25			**Flange connection**		☒ **yes** ☐ **no**	☒ **yes** ☐ **no**	
26			**Flange standard**		Manufactuting Standard	Manufactuting Standard	
27			**Facing**		RF	RF	
28			**Nominal size**		RF	RF	
29			**Nominal pressure**		Class 150	Class 150	
30			**Material**		Note 5	Note 5	
33			**Welding end**		☐ **yes** ☒ **no**	☐ **yes** ☒ **no**	
32			**Outside diameter x Wallthickness**	**mm**	-	-	
33			**Welding end standard**		-	-	
34			**Material**		-	-	
35		**Dimensions**	**Total length**	**mm**	500 mm		
36			**Maximium width**	**mm**	**Note 1**		
37			**Corrosion allowance**	**mm**	1.5		
38		**Certificates**	**Inspection certificate acc. EN 10204(DN 50049)**		☒ **3.1**	☐ **3.2**	
39			**Inspection certificate acc. EN 10204(DN 50049)**		☐ **2.2**		
40		**Inspection**	**thyssenkrupp**		☒ **yes**	☐ **no**	
41			**Third Party**		☐ **yes**	☐ **no**	
42			**Client**		☒ **yes**	☐ **no**	
43		**Painting**	**Of elements (without bellows) acc. Paint.Spec. (Note 4)**		☒ **yes**	☐ **no**	

Remarks:



Principle Sketch

NOTE :-

1. **Vendor to specify.**
2. **Flow velocity approx. 30.7m/s.**
3. **Refer Sketch Flanges F1 to F4 & Pipe Ends with bolts and nuts are in vendor delivery scope. Bolt torque to be given by supplier.**
4. **Painting for CS part only as per painting Spec.**
5. **Material for Lap Joint flange (with stub end)- A358 Gr.316L-WX and for Flange – A515 Gr.60.**

Rev.	Date	Prepared	Checked	Approved	Description
0	31-10-20	BKS	AVE	AVE	ISSUED FOR ENQUIRY

A2-02 E 98-05 WW

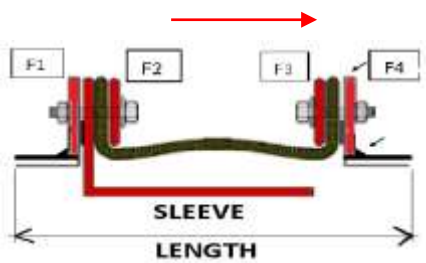
	Plant	Client	Code	Project No.	Page
thyssenkrupp	MRPL Mangalore	MRPL	WSS for PFCC Flue Gas	66-6723	1

TECHNICAL SPECIFICATION FOR FABRIC EXPANSION JOINT FOR MRPL PLANT

TON	
ITEM	SXB-33102
REV.	0

1		Part-No.			SXB-33102	
2		Quantity			1	
3		Expansion joint type			UNTIED	
4		Construction			FABRIC	
5		Internal Sleeve Material (Note 2)			☒ yes	☐ no
6		Nominal Size		Inch	89“	
7		Unit weight		Kg	Note 1	
8		Line No./ Stress System No			100”-RF-3310500-HRCSS150-IH	
9		Plant location			MRPL	
10		Fluid			REGENERATOR FLUE GAS	
11		State			☒ gaseous	☐ liquid
12		Pressure	Allowable working pressure	Bar (g)	0.086	
13			Vacuum	Bar (g)	-	
14			Test pressure	Bar (g)	-	
15		Temp.	Allowable working temperature	°C	300	
16		Movements	Axial movement	mm	+/- 150	
17			Lateral movement	mm	+/- 150	
18			Angular movement	deg	-	
19			Pretension		☐ yes	☒ no
20		Spring rate	Axial spring rate (Max)	N/mm	Note 1	
21		incl.	Lateral spring rate (Max)	N/mm	Note 1	
22		Friction	Angular spring rate	N-m/deg	Note 1	
23			Effective area (Axial expansion joint)	mm^2	Note 1	
24		Type of end (Note 3)	Designation		Inlet	Outlet
25			Flange connection		☒ yes ☐ no	☒ yes ☐ no
26			Flange standard		Manufactuting Standard	Manufactuting Standard
27			Facing		RF	RF
28			Nominal size		RF	RF
29			Nominal pressure		Class 150	Class 150
30			Material		Note 5	Note 5
33			Welding end		☐ yes ☒ no	☐ yes ☒ no
32			Outside diameter x Wallthickness	mm	-	-
33			Welding end standard		-	-
34			Material		-	-
35		Dimensions	Total length	mm	500 mm	
36			Maximium width	mm	Note 1	
37			Corrosion allowance	mm	1.5	
38		Certificates	Inspection certificate acc. EN 10204(DN 50049)		☒ 3.1	☐ 3.2
39			Inspection certificate acc. EN 10204(DN 50049)		☐ 2.2	
40		Inspection	thyssenkrupp		☒ yes	☐ no
41			Third Party		☐ yes	☐ no
42			Client		☒ yes	☐ no
43		Painting	Of elements (without bellows) acc. Paint.Spec. (Note 4)		☒ yes	☐ no

Remarks:



Principle Sketch

NOTE :-

1. **Vendor to specify.**
2. **Flow velocity approx. 30.7m/s.**
3. **Refer Sketch Flanges F1 to F4 & Pipe Ends with bolts and nuts are in vendor delivery scope. Bolt torque to be given by supplier.**
4. **Painting for CS part only as per painting Spec.**
5. **Material for Lap Joint flange (with stub end)- A358 Gr.316L-WX and for Flange – A515 Gr.60.**

Rev.	Date	Prepared	Checked	Approved	Description
0	31-10-20	BKS	AVE	AVE	ISSUED FOR ENQUIRY

ATTACHMENT – 7

Damper Specs

TKIS - India / Vendor

Category Codes (Submission Purpose)

- ☐ 1 For Approval
- ☐ 2 For Review / Comments
- ☐ 3 For Information
- ☐ 4 For Engineering
- ☐ 5 For Enquiry
- ☐ 6 For Order Placement
- ☐ 7 Final & Approved
- ☐ 8 Released for Construction

Acceptance Codes (Approval Codes)

- ☐ 1 Approved
- ☐ 2 Approved for Manufacturing / Fabrication with Comments as marked
- ☐ 3 Not Approved / Resubmit
- ☐ 4 Retained for Information / Records
- ☐ 5 Reviewed
- ☐ 6 Reviewed as Noted / Resubmit

Remarks for AC2 : This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-sbumitted after revision. This drawing should be revised only to the extent of TKIS - India / Owner / Client comments. Any other changes made by you will not be considered unless clearly highlighted in covering letter asking for approval.

This approval / review does not absolve the supplier from the full responsibility for design and fabrication.

Date : ___/___/_____ Name : _____

TKIS - India / Owner / Client

Category Codes (Submission Purpose)

- ☐ 1 For Approval
- ☐ 2 For Review / Comments
- ☐ 3 For Information
- ☐ 4 For Engineering
- ☐ 5 For Enquiry
- ☐ 6 For Order Placement
- ☐ 7 Final & Approved
- ☐ 8 Released for Construction

Acceptance Codes (Approval Codes)

- ☐ 1 Approved
- ☐ 2 Approved for Manufacturing / Fabrication with Comments as marked
- ☐ 3 Not Approved / Resubmit
- ☐ 4 Retained for Information / Records
- ☐ 5 Reviewed
- ☐ 6 Reviewed as Noted / Resubmit

Date : ___/___/_____ Name : _____

Rev.	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC
00		Issued for BID purpose	17/11/2020	OAG	17/11/2020	NAS	17/11/2020	PSC	

Barcode

Category Code: -

1) The damper is required for Flue gas control in duct and can be butterfly type.

2) Flue gas parameters are as follows;

EQUIPMENT TAG NO / EQUIPMENT TITLE	PRESSURE TEMPERATURE OPERATING RANGE	FLUID HANDLED	CORROSIVE/EROSIVE COMPONENTS	CORROSION ALLOWANCE	ASSESSMENT OF CORROSION/EROSION
WET SCRUBBING SYSTEM					
FLUE GAS DUCT	0.07 kg/cm2g 196 Deg C -300 Deg C	FLUE GAS	14.76% CO2, 61 -305 ppm SO2, 60-1000 mg/Nm3 (dry) of Catalyst Particles	NIL	Risk of Erosion

3) The damper sealing efficiency shall be minimum 99.5%.

4) Damper shall have a motorised actuator with manual gearbox operation as override option.

5) Bidder shall submit the actual drawing along with the offer.

6) Design pressure 0.085 Kg/cm2 g; Design temp. 315 Deg C.

Operating pressure 0.07 Kg/cm2 ,Operating temp.196 Deg C. to 300 Deg C.

7) PMI shall be carried out as per document 6-81-001

8) 60" 4 numbers and 89" 1 number of damper valves shall be of MOC SS 316L.

9) 89" size 1 number of damper valve shall have SS 304H body and stellited trim.

10) Flange dimensions of 60",89" shall be decided by DE contractor matching with duct flanges.

11) Valve shall be tested pneumatically with test pressure 1.1 times design pressure and sealing efficiency of 99.5% minimum shall be verified during inspection.

12) The damper shall be designed as per manufacturer standard.

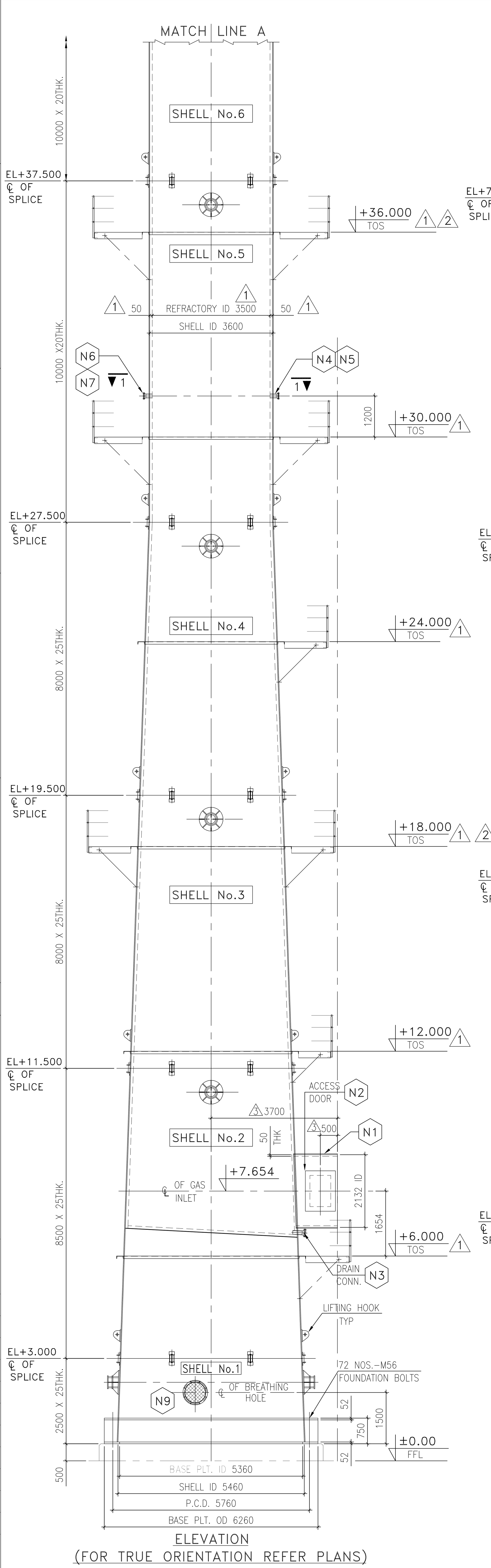
Dampers are on below lines:

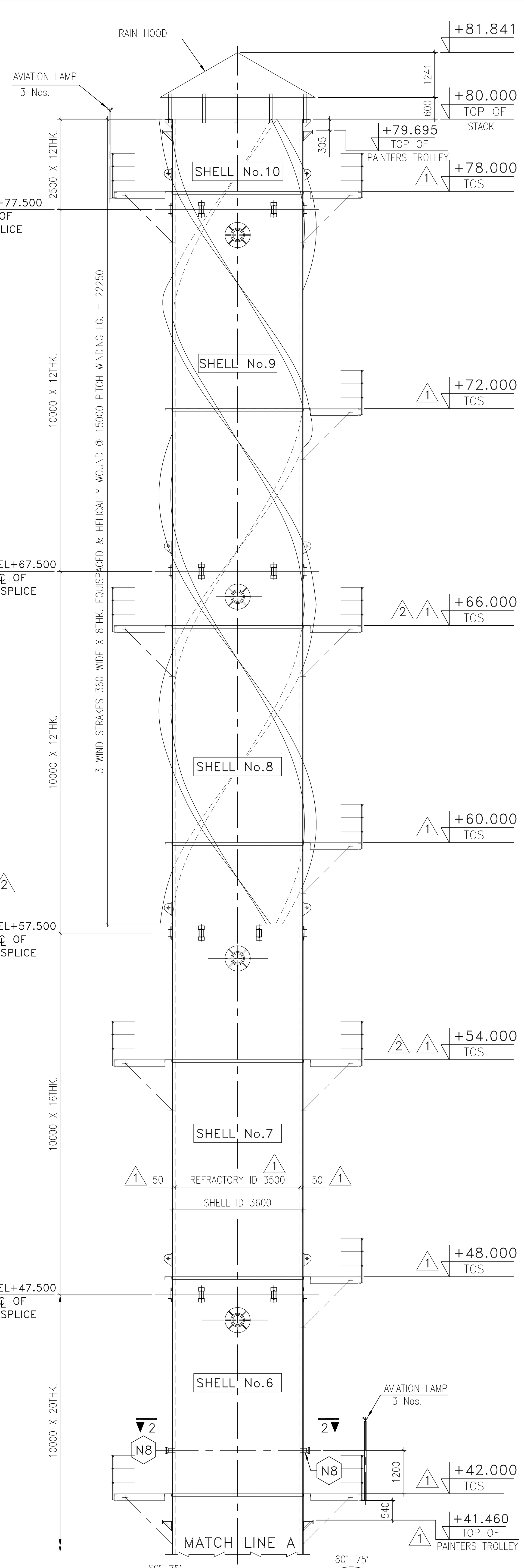
BD-331900 - on line No. 60”-RF-3310501-HRCSS150-IH
BD-331901 - on line No. 60”-RF-3310502-HRCSS150-IH
BD-331902 - on line No. 60”-RF-3310503-HRCSS150-IH
BD-331903 - on line No. 60”-RF-3310504-HRCSS150-IH
BD-331904 - on line No. 89”-RF-331-TP-01-HRCSS150-IH
BD-331905 - on line No. 89”-RF-331-TP-20-B21Y-IL_

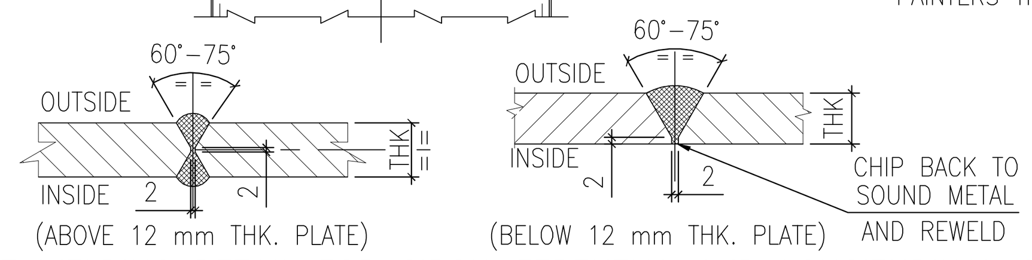
ATTACHMENT – 8

GA of Existing Stack

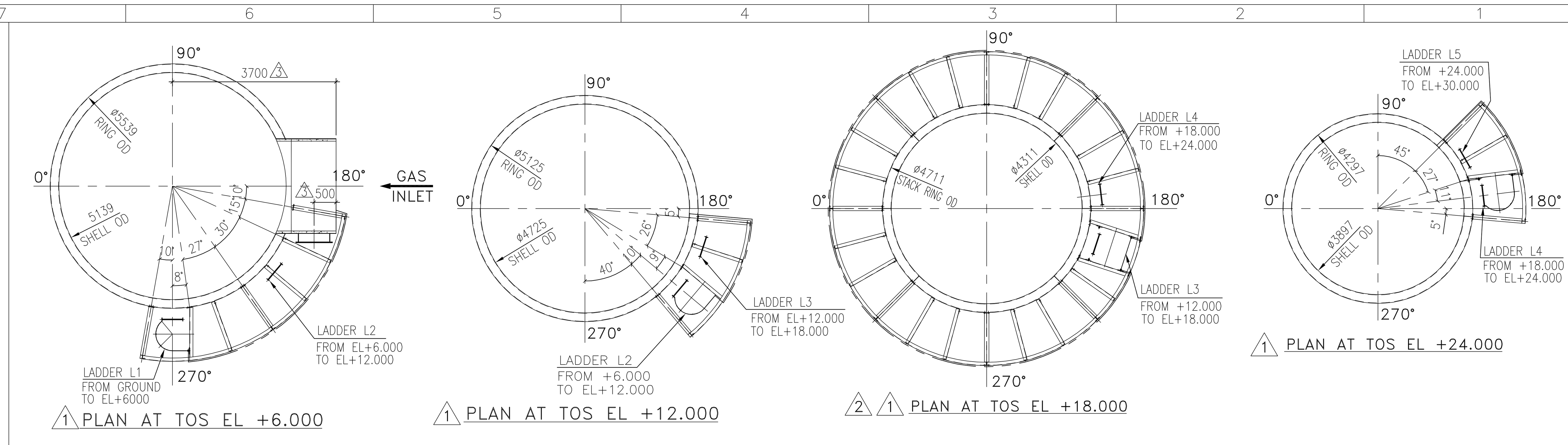
DO NOT SCALE
IF IN DOUBT, ASK

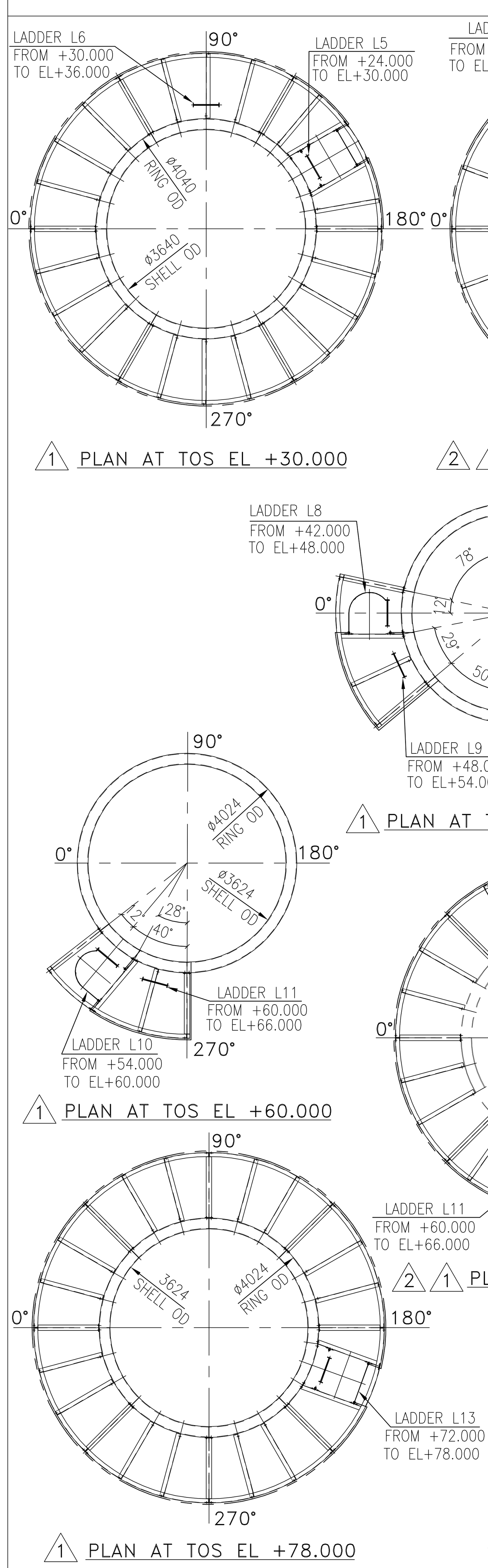


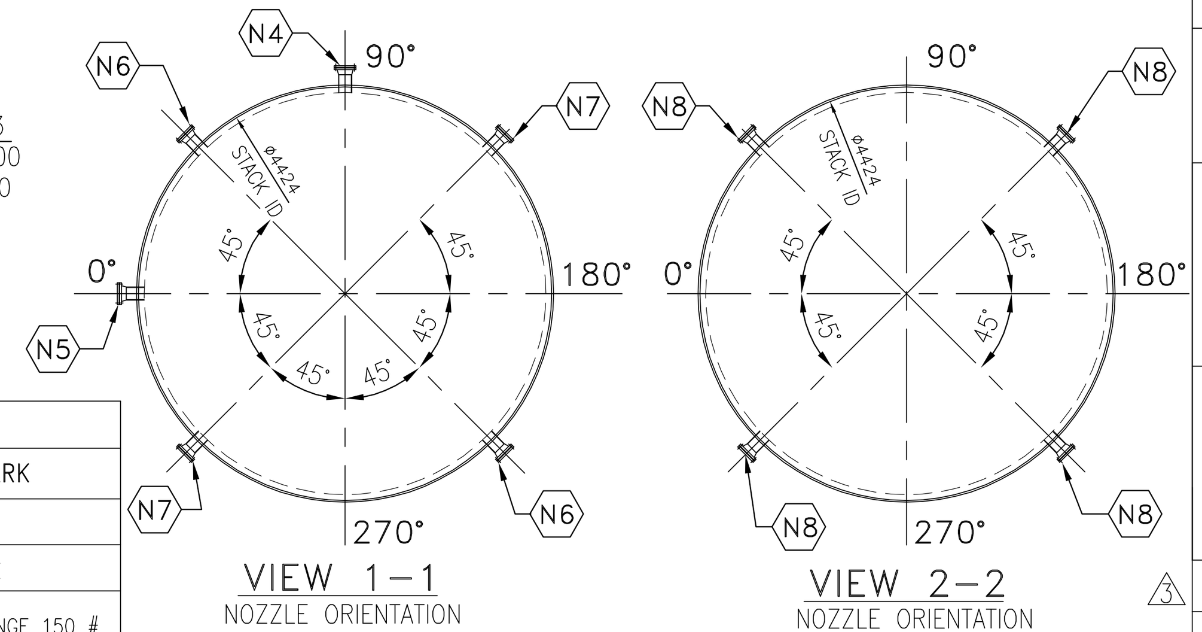




TYP. BUTT WELDING DETAIL FOR CIRCUMFERENTIAL AND LONGITUDINAL SEAM







NOZZLE SCHEDULE

NOZZLE	DESCRIPTION	END CONN	QTY.	REMARK
N1	FLUE GAS INLET	OD 2148	1	
N2	ACCESS DOOR	915x610 I/S	1	CLEAR INSIDE
N3	DRAIN CONNECTION	4" NB X SCH40 WNRF 150#	1	WITH BL FLANGE 150 #
N4	TEMP. INDICATOR	1-1/2" NB X SCH40 WNRF 150#	1	WITH BL FLANGE 150 #
N5	CO. ANALYZER	1-1/2" NB X SCH40 WNRF 150#	1	WITH BL FLANGE 150 #
N6	SOx & NOx	1-1/2" NB X SCH40 WNRF 150#	1 No EACH	WITH BL FLANGE 150 #
N7	AE	4" NB X SCH40 WNRF 150#	2	WITH BL FLANGE 150 #
N8	AIR POLUTION NOZZLE	4" NB X SCH40 WNRF 150#	4	WITH BL FLANGE 150 #
N9	BREATHING HOLES	DIA.600	2	WITH WIRE MESH

NOTES :-

1. ALL DIMENSIONS ARE IN mm & LEVELS ARE IN Mtrs.
3. ALL FLANGE BOLT HOLES TO STRADDLE VERTICAL AND HORIZONTAL CENTER LINE.
4. ALL SKEW AND DIRECT WELDING DONE BY PREPARING THE CONNECTING MEMBER ENDS TO SUITABLE PROFILE AND THEN WELDED.
5. ALL MATCHING PARTS PROPERLY MATCH MARKED AND MATCH DRILLED BEFORE DESPATCH TO SITE.
6. ALL WELDS ARE 6 mm CONTINUOUS FILLET UNLESS NOTED OTHERWISE.
7. ALL ITEMS TRANSPORTED SHALL HAVE MARK No. AND DRAWING No. PAINTED ON IT IN WHITE PAINT.
8. ALL "T" JOINTS 100% RADIOGRAPHED, C-SEAM & L-SEAM SHALL BE 10% RADIOGRAPHED.
   OTHER NDT & TESTING SHALL BE AS PER QAP ISSUED BY QC DEPARTMENT.
9. PAINTING:-AS PER SPECS No. N11-1WH-CS-40477
10. FOR REFRACTORY LINING DETAILS REFER SEPERATE DRG.
11. MAJOR TOLERANCES (IN mm) ON STEEL WORK FABRICATION AS FOLLOWS. TOLERANCE FOR ALL OTHER FABRICATION SHALL BE AS PER IS:7215, WOWEVER FOR OTHER TOLERANCES REFER EIL'S SPECS. 6-17-0002-REV.3.

a) MARKING	±1.0
b) FLAME CUTTING	±1.5
c) SHEARING (PLATE)	±1.0
d) C/C HOLES (EXPECT FOR DRILLING-THIS TOLERANCE MUST NOT BE CUMULATIVE)	±1.0
e) FLATNESS OF BASE PLATE FROM MEAN SURFACE – SIZE UPTO 250 mm	±1.0
– SIZE UPTO 250 mm	±1.5
f) OVALITY (STACK SHELLS)	±5.0 (MAX)
g) VERTICALITY OF STACK (w.r.t. STACK BASE) (w.r.t. 0.00 LEVEL)	HEIGHT/1000 BUT MAX 20mm 25mm
h) OVERALL HEIGHT OF STACK SEGMENTS (NON-CUMULATIVE)	UP TO 5 MTR HEIGHT = ±3 5 TO 15 MTR HEIGHT = ±6
i) MISALIGNMENT OF PLATES AT ANY WELD	1.5 (MAX)

12. STACK CHAIR RINGS DRILLING DONE TOGETHER.
13. ALL SHELL WELDS FULL PENETRATION WELD. LONGITUDINAL WELDS STAGGERED TO EACH OTHER.
14. ø12 VENT HOLE PROVIDED ON PAD PLATE ONLY & FILLED WITH HARD GREASE AFTER WEDLING.
15. ALL PLATE MATERIALS IS:2062 Gr.A OR EQ. U.N.O.
16. STACK SEGMANTE REFRACTORY LINED AT GROUND & HEAT DRIED OUT AT 400° BEFORE ERECTION. APPROX 300mm OF STACK SEGMENT ON EITHER SIDE OF FIELD SPLICE LEFT UNLINED AT GRADE LINING IN THIS PORTION APPLIED INSITU AFTER FULL STRENGTH WELDING OF SPLICE IS COMPLATE.

1	Reviewed, No Comments
2	Reviewed as commented, but revised drawing required
3	Not Meeting Specification, Resubmit
R	Retained For Information / Records

Name Discipline Sign Date

ISSUED FOR
☐ APPROVAL ☐ REVIEW ☐ INFORMATION ☐ CONSTRUCTION

DOCUMENT STATUS
SIGN: DATE: STATEMENT OF SUB: 1st 2nd 3rd
☐ FINAL FOR CODC-1 ☐ AS BUILT

REV. NO.	REVISION	MADE BY DATE	CAD CHK. DATE	APR. BY DATE
3	DISTANCE BETWEEN STACK C & GAS INLET NOZZLE 3500 mm CHANGED TO 3700 mm.	09/03/11	09/03/11	10/03/11
2	PLATFORM EL+18000, +36000, +54000, +66000 MODIFIED.	22/07/10	22/07/10	23/07/10
1	PLATFORM LEVELS REVISED AND REFRACTORY THK. 75 MM CHANGE TO 50 MM	26/04/10	26/04/10	26/04/10

OWNER:
MANGALORE REFINERY & PETROCHEMICALS LTD.

CONSULTANT:
इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उद्यम)
ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) NEW DELHI

AS BUILT DRAWING — O.C.No.:-PL0531
PRODUCT:- FLUE GAS COOLER
CLIENT :- M/S- MANGLORE REFINERY & PETROCHEMICALS LIMITED.
CONSULTANT:- M/S- ENGINEERS INDIA LIMITED, NEW DELHI.

BOILER NO.LW-240
RART. NO.

Thermax Limited
BOILER & HEATER GROUP
MIDC, CHINCHWAD, PUNE - 411 019 , (INDIA)

GENERAL ARRANGEMENT OF STACK

SCALE		
1 : 80	DRAWN	11/03/10
	CHECKED	11/03/10
	APPROVED	11/03/10

DRG.NO. G27-1WH-68248 REV.NO. 3