

Plant MRPL Mangalore	Client MRPL	Contract Code WSS for PFCC Flue Gas	Document ID			
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>					
				Rev	00	Page

**Addendum 02**

**To**

**MRPL Tender No. 3200000535 dated 10.12.2021**

**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**

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.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID			
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>					
				Rev	<b>00</b>	Page

\_\_\_\_\_  
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	<b>NOTICE INVITING TENDER (NIT)</b> <b>4.0 SALIENT FEATURES OF BIDDING DOCUMENT</b> 7.0 Bid closing date / time	4 of 18	06.01.2022 @ 15:00 Hrs (IST)	<b>14.01.2022 @ 15:00 Hrs (IST)</b>
2	1	<b>NOTICE INVITING TENDER (NIT)</b> <b>4.0 SALIENT FEATURES OF BIDDING DOCUMENT</b> 8.0 Date / Time of Technical Bid opening	4 of 18	06.01.2022 @ 15:30 Hrs (IST)	<b>14.01.2022 @ 15:30 Hrs (IST)</b>
3		<b>Cover Page_Master Index</b> Bid Closing date & Time	1 of 13	06.01.2022; 15:00 Hrs	<b>14.01.2022; 15:00 Hrs</b>
4		<b>Cover Page_Master Index</b> Unpriced Bid Opening date & Time	1 of 13	06.01.2022; 15:30 Hrs	<b>14.01.2022; 15:30 Hrs</b>

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID	
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>			
				Rev

**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 Dossier 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 Dossier Document ID: 6723-PIP-331-MB-0003 Oily Waste Transfer System (Near DCU Unit)	Sheet 6 of 17	<b>8" Hot tapping for 4" conn</b>	<b>8" Hot tapping for 6" conn</b> Bidder to consider 6" instead of 4"

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID		
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>				
					Rev

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)	Sheet 9 of 17	TP-331-14 TP-331-08	Existing header size is extended to make new tap-off.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID		
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>				
					Rev

		Plant Air / Instrument Air Distribution			
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.
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	<b>Comment: This was shown in field. However this is OWS man hole</b>	Bidder to ignore this comment.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID	
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>			
				Rev

Sr. No.	Volume	Section No. / Clause No.	Page No.	Existing Tender Clause	Addition / Deletion / Modification / Clarification
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

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID		
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>				
					Rev

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	8 of 9		Shifting of any existing Firewater lines or any other UG lines in current plot is scope of LSTK contractor

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID	
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>			
				Rev

		Document ID: 6723-PIP-331-CA-0002 Clause No. 7 Revised Underground Piping Concept			
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.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID	
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>			
				Rev

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

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID			
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>					
				Rev	<b>00</b>	Page

					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

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID	
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>			
				Rev

**ATTACHMENT – 1**  
**ADEQUACY CHECK REPORT**

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>
	<h2>ADEQUACY CHECK REPORT</h2>			

<p><b>tkIS India / Vendor</b></p> <p><b>Category Codes (Submission Purpose)</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> 1 For Approval</li> <li><input type="checkbox"/> 2 For Review / Comments</li> <li><input type="checkbox"/> 3 For Information</li> <li><input type="checkbox"/> 4 For Engineering</li> <li><input type="checkbox"/> 5 For Enquiry</li> <li><input type="checkbox"/> 6 For Order Placement</li> <li><input type="checkbox"/> 7 Final &amp; Approved</li> <li><input type="checkbox"/> 8 Released for Construction</li> </ul> <hr/> <p><b>Acceptance Codes (Approval Codes)</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> 1 Approved</li> <li><input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked</li> <li><input type="checkbox"/> 3 Not Approved / Resubmit</li> <li><input type="checkbox"/> 4 Retained for Information / Records</li> <li><input type="checkbox"/> 5 Reviewed</li> <li><input type="checkbox"/> 6 Reviewed as Noted / Resubmit</li> </ul> <p><b>Remarks for AC2 :</b> This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-submitted 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.</p> <p><b>This approval / review does not absolve the supplier from the full responsibility for design and fabrication.</b></p> <p>Date : ___/___/___      Name : _____</p>	<p><b>tkIS India / Owner / Client</b></p> <p><b>Category Codes (Submission Purpose)</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> 1 For Approval</li> <li><input type="checkbox"/> 2 For Review / Comments</li> <li><input checked="" type="checkbox"/> 3 For Information</li> <li><input type="checkbox"/> 4 For Engineering</li> <li><input type="checkbox"/> 5 For Enquiry</li> <li><input type="checkbox"/> 6 For Order Placement</li> <li><input type="checkbox"/> 7 Final &amp; Approved</li> <li><input type="checkbox"/> 8 Released for Construction</li> </ul> <hr/> <p><b>Acceptance Codes (Approval Codes)</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> 1 Approved</li> <li><input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked</li> <li><input type="checkbox"/> 3 Not Approved / Resubmit</li> <li><input type="checkbox"/> 4 Retained for Information / Records</li> <li><input type="checkbox"/> 5 Reviewed</li> <li><input type="checkbox"/> 6 Reviewed as Noted / Resubmit</li> </ul> <p>Date : ___/___/___      Name : _____</p>
----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

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

	<h1>Barcode</h1>	Category Code: 3
© thyssenkrupp Industrial Solutions (India) Private Limited 2016		

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>	
	<b>ADEQUACY CHECK REPORT</b>				
					Rev

## Contents

1	Introduction .....	3
2	Basis of Adequacy Check .....	4
2.1	Adequacy Check of Service Water Pump .....	6
2.2	Adequacy Check of OWS line to ETP .....	10
2.3	Adequacy Check of Instrument Air .....	12
2.4	Pressure Drop Calculation of Stripped Sour Water Line .....	13

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>
	<b>ADEQUACY CHECK REPORT</b>			
				Rev <b>00</b> Page <b>3</b> of <b>14</b>

## 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.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>	
	<b>ADEQUACY CHECK REPORT</b>				
					Rev

## 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

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>	
	<b>ADEQUACY CHECK REPORT</b>				
					Rev

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

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>
	<b>ADEQUACY CHECK REPORT</b>			
				Rev <b>00</b> Page <b>6</b> of <b>14</b>

## 2.1 Adequacy Check of Service Water Pump

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

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

### **Basis**

1. The peak flow of Service Water to WSS unit is considered 130 m<sup>3</sup>/hr based on licensor's data of 125.7 m<sup>3</sup>/hr in Utility Consumption List plus valve seat purge flow.
2. The normal flow of Service Water to WSS unit is considered 70 m<sup>3</sup>/hr based on licensor's data of 65.4 m<sup>3</sup>/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.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>
	<b>ADEQUACY CHECK REPORT</b>			
				Rev <b>00</b> Page <b>7</b> of <b>14</b>

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 m<sup>3</sup>/hr flow) : Single Pump Operation**

The peak flow of Service Water after WSS Unit is operational will be 255 m<sup>3</sup>/hr. From the vendor datasheet and performance curves, it is observed that each Service Water Pump can deliver 255 m<sup>3</sup>/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<sup>3</sup>/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 licenser datasheet of Service Water control valve FV331902 mentions the upstream pressure of 6.92 kg/cm<sup>2</sup>g and a pressure drop of 5.74 kg/cm<sup>2</sup>. With available differential head of 91 mLC, the upstream pressure of FV331902 will be reduced to 5 kg/cm<sup>2</sup>g. Accordingly, the pressure drop across the control valve will be reduced to 3.82 kg/cm<sup>2</sup>. 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<sup>2</sup>g as an operating point.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>
	<b>ADEQUACY CHECK REPORT</b>			
				Rev <b>00</b> Page <b>8</b> of <b>14</b>

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<sup>2</sup>g and a pressure drop of 5.8 kg/cm<sup>2</sup>. With available differential head of 91 mLc, the upstream pressure of FV331916 will be reduced to 5 kg/cm<sup>2</sup>g. Accordingly, the pressure drop across the control valve will be reduced to 3.95 kg/cm<sup>2</sup>. This operating point to be specified in the control valve datasheet.

The operating pressure of FT331916 to be specified to include 5 kg/cm<sup>2</sup>g as an operating point.

4. Service Water to Flocculant Preparation Tank:

The operating pressures of FT331922 to be specified to include 5 kg/cm<sup>2</sup>g 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 m<sup>3</sup>/hr flow) : Single Pump Operation**

The normal flow of Service Water after WSS Unit is operational will be 195 m<sup>3</sup>/hr. From the vendor datasheet and performance curves, it is observed that each Service Water Pump can deliver 200 m<sup>3</sup>/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 m<sup>3</sup>/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<sup>2</sup>g and a pressure drop of 5.74 kg/cm<sup>2</sup>. With available differential head of 100.7 mLc, the upstream pressure of FV331902 will be 7.15 kg/cm<sup>2</sup>g. Accordingly, the pressure drop across the control valve will increase to 5.94 kg/cm<sup>2</sup> 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<sup>2</sup>g.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>
	<b>ADEQUACY CHECK REPORT</b>			
				Rev <b>00</b> Page <b>9</b> of <b>14</b>

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<sup>2</sup>g and a pressure drop of 5.8 kg/cm<sup>2</sup>. With available differential head of 100.7 mLC, the upstream pressure of FV331916 will be 7.15 kg/cm<sup>2</sup>g. Accordingly, the pressure drop across the control valve will be reduced to 6.1 kg/cm<sup>2</sup> which is in operable range of a control valve.

The operating pressures of FT331916 will be 7 kg/cm<sup>2</sup>g.

4. Service Water to Flocculant Preparation Tank:

The operating pressures of FT331922 will be 7 kg/cm<sup>2</sup>g.

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 m<sup>3</sup>/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<sup>3</sup>/hr considering two Service Water pumps in operation and one standby (proposed scheme). Each pump is designed for 200 m<sup>3</sup>/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<sup>2</sup>g.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>
	<b>ADEQUACY CHECK REPORT</b>			
				Rev <b>00</b> Page <b>10</b> of <b>14</b>

## 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<sup>3</sup>/hr (180 m<sup>3</sup>/hr existing OWS +110 m<sup>3</sup>/hr from WSS).

### **Basis**

1. The effluent flow from WSS unit is considered 110 m<sup>3</sup>/hr based on licensor's data of 99.9 m<sup>3</sup>/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 expected to be 110 m<sup>3</sup>/hr. The licensor's datasheet of pump GA-33145 A/B, mentions the rated capacity of 100 m<sup>3</sup>/hr and differential head of 70 m. With 110 m<sup>3</sup>/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 m, which is much higher than

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>	
	<h2>ADEQUACY CHECK REPORT</h2>				
					Rev

the differential head of 70 mL 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 m<sup>3</sup>/hr flow and a backpressure of 1.7 kg/cm<sup>2</sup>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

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>	
	<b>ADEQUACY CHECK REPORT</b>				
					Rev

### 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/cm <sup>2</sup> g
Normal temperature of instrument air	: 38 Deg C
Density of instrument air at normal conditions	: 1.29 kg/Nm <sup>3</sup>

#### Observation

As per the Utility Consumption List by the licensor, the peak demand of instrument air for WSS unit is 54 Nm<sup>3</sup>/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.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>
	<b>ADEQUACY CHECK REPORT</b>			
				Rev <b>00</b> Page <b>13</b> of <b>14</b>

## 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 m<sup>3</sup>/hr to WSS is drawn : 6.2 kg/cm<sup>2</sup>g

(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<sup>3</sup>/hr

Max. Stripped Sour Water flow to Scrubber : 14.7 m<sup>3</sup>/hr

Max. Stripped Sour Water flow to Effluent Tank : 70.5 m<sup>3</sup>/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<sup>2</sup>g. As per the licensors' datasheet, inlet pressure of FV331904 varies from 3 to 5.98 kg/cm<sup>2</sup>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/cm<sup>2</sup>g. As per the licensors' datasheet, inlet pressure of FV331916 for max. flow is 6.45 kg/cm<sup>2</sup>g. Vendor to size the valve for inlet pressure of 5.91 kg/cm<sup>2</sup>g at maximum flow condition, as an alternate case.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-PRC-331-DD-0001</b>	Contract No. <b>66-6723</b>	
	<b>ADEQUACY CHECK REPORT</b>				
					Rev

The Stripped Sour Water pressure of 6.2 kg/cm<sup>2</sup>g 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

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID				
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>						
				Rev	<b>00</b>	Page	

**ATTACHMENT – 2**  
**Annex-I to EDB 0003**

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>Annex-I to EDB-0003</b>	Contract No. <b>66-6723</b>
ThyssenKrupp Industrial Solutions (India)	<b>ANNEX-I TO DESIGN BASIS FOR ELECTRICAL</b>			
Rev <b>00</b>				Page <b>1</b> of <b>1</b>

<b>EQUIPMENT SELECTION FOR HAZARDOUS AREA</b>					
The electrical equipment for hazardous areas shall be selected as per IS-5571 and petroleum rules. The minimum requirement is summarised as below.					
		<b>Zone 1</b>		<b>Zone 2</b>	
	<b>Equipment</b>	<b>Gas Group IIA, IIB</b>	<b>Gas Group IIC</b>	<b>Gas Group IIA,IIB</b>	<b>Gas Group IIC</b>
	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
	<b>Lighting Fixtures</b>				
	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
	<b>NOTES:</b>				
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 <b>OR</b> 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 <b>OR</b> 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.				
7	Min. Temp class shall be T3				

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID	
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>			

### ATTACHMENT – 3

### Technical Specifications-High Voltage Induction Motors

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0008</b>	Contract No. <b>66-6723</b>
	<b>TECHNICAL SPECIFICATIONS – HIGH VOLTAGE INDUCTION MOTORS</b>			

<p><b>tkIS India / Vendor</b></p> <p><b>Category Codes (Submission Purpose)</b></p> <table style="width: 100%;"> <tr><td><input type="checkbox"/></td><td>1</td><td>For Approval</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>For Review / Comments</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>For Information</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>For Engineering</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>For Enquiry</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>For Order Placement</td></tr> <tr><td><input type="checkbox"/></td><td>7</td><td>Final &amp; Approved</td></tr> <tr><td><input type="checkbox"/></td><td>8</td><td>Released for Construction</td></tr> </table> <hr/> <p><b>Acceptance Codes (Approval Codes)</b></p> <table style="width: 100%;"> <tr><td><input type="checkbox"/></td><td>1</td><td>Approved</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>Approved for Manufacturing / Fabrication with Comments as marked</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>Not Approved / Resubmit</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>Retained for Information / Records</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>Reviewed</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>Reviewed as Noted / Resubmit</td></tr> </table> <p><b>Remarks for AC2 :</b> This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-sbmitted 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.</p> <p><b>This approval / review does not absolve the supplier from the full responsibility for design and fabrication.</b></p> <p>Date : ___/___/___      Name : _____</p>	<input type="checkbox"/>	1	For Approval	<input type="checkbox"/>	2	For Review / Comments	<input type="checkbox"/>	3	For Information	<input type="checkbox"/>	4	For Engineering	<input type="checkbox"/>	5	For Enquiry	<input type="checkbox"/>	6	For Order Placement	<input type="checkbox"/>	7	Final & Approved	<input type="checkbox"/>	8	Released for Construction	<input type="checkbox"/>	1	Approved	<input type="checkbox"/>	2	Approved for Manufacturing / Fabrication with Comments as marked	<input type="checkbox"/>	3	Not Approved / Resubmit	<input type="checkbox"/>	4	Retained for Information / Records	<input type="checkbox"/>	5	Reviewed	<input type="checkbox"/>	6	Reviewed as Noted / Resubmit	<p><b>tkIS India / Owner / Client</b></p> <p><b>Category Codes (Submission Purpose)</b></p> <table style="width: 100%;"> <tr><td><input type="checkbox"/></td><td>1</td><td>For Approval</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>For Review / Comments</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>For Information</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>For Engineering</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>For Enquiry</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>For Order Placement</td></tr> <tr><td><input type="checkbox"/></td><td>7</td><td>Final &amp; Approved</td></tr> <tr><td><input type="checkbox"/></td><td>8</td><td>Released for Construction</td></tr> </table> <hr/> <p><b>Acceptance Codes (Approval Codes)</b></p> <table style="width: 100%;"> <tr><td><input type="checkbox"/></td><td>1</td><td>Approved</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>Approved for Manufacturing / Fabrication with Comments as marked</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>Not Approved / Resubmit</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>Retained for Information / Records</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>Reviewed</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>Reviewed as Noted / Resubmit</td></tr> </table> <p>Date : ___/___/___      Name : _____</p>	<input type="checkbox"/>	1	For Approval	<input type="checkbox"/>	2	For Review / Comments	<input type="checkbox"/>	3	For Information	<input type="checkbox"/>	4	For Engineering	<input type="checkbox"/>	5	For Enquiry	<input type="checkbox"/>	6	For Order Placement	<input type="checkbox"/>	7	Final & Approved	<input type="checkbox"/>	8	Released for Construction	<input type="checkbox"/>	1	Approved	<input type="checkbox"/>	2	Approved for Manufacturing / Fabrication with Comments as marked	<input type="checkbox"/>	3	Not Approved / Resubmit	<input type="checkbox"/>	4	Retained for Information / Records	<input type="checkbox"/>	5	Reviewed	<input type="checkbox"/>	6	Reviewed as Noted / Resubmit
<input type="checkbox"/>	1	For Approval																																																																																			
<input type="checkbox"/>	2	For Review / Comments																																																																																			
<input type="checkbox"/>	3	For Information																																																																																			
<input type="checkbox"/>	4	For Engineering																																																																																			
<input type="checkbox"/>	5	For Enquiry																																																																																			
<input type="checkbox"/>	6	For Order Placement																																																																																			
<input type="checkbox"/>	7	Final & Approved																																																																																			
<input type="checkbox"/>	8	Released for Construction																																																																																			
<input type="checkbox"/>	1	Approved																																																																																			
<input type="checkbox"/>	2	Approved for Manufacturing / Fabrication with Comments as marked																																																																																			
<input type="checkbox"/>	3	Not Approved / Resubmit																																																																																			
<input type="checkbox"/>	4	Retained for Information / Records																																																																																			
<input type="checkbox"/>	5	Reviewed																																																																																			
<input type="checkbox"/>	6	Reviewed as Noted / Resubmit																																																																																			
<input type="checkbox"/>	1	For Approval																																																																																			
<input type="checkbox"/>	2	For Review / Comments																																																																																			
<input type="checkbox"/>	3	For Information																																																																																			
<input type="checkbox"/>	4	For Engineering																																																																																			
<input type="checkbox"/>	5	For Enquiry																																																																																			
<input type="checkbox"/>	6	For Order Placement																																																																																			
<input type="checkbox"/>	7	Final & Approved																																																																																			
<input type="checkbox"/>	8	Released for Construction																																																																																			
<input type="checkbox"/>	1	Approved																																																																																			
<input type="checkbox"/>	2	Approved for Manufacturing / Fabrication with Comments as marked																																																																																			
<input type="checkbox"/>	3	Not Approved / Resubmit																																																																																			
<input type="checkbox"/>	4	Retained for Information / Records																																																																																			
<input type="checkbox"/>	5	Reviewed																																																																																			
<input type="checkbox"/>	6	Reviewed as Noted / Resubmit																																																																																			

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		
Rev.	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC	
© thyssenkrupp Industrial Solutions (India) Private Limited 2016					<h1 style="margin: 0;">Barcode</h1>					Category Code: -

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0008</b>	Contract No. <b>66-6723</b>	
	<b>TECHNICAL SPECIFICATIONS – HIGH VOLTAGE INDUCTION MOTORS</b>				
					Rev

### 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

Part	Doc. Size	Description	No. Of Pages	Rev. No.	Revised Clauses
	A4	Index sheet and status of revision	2	01	-
Part-I	A4	General specifications	6	01	
Part-IIA	A4	Design Data Sheet (Requirement)	2	01	-
Part-IIB	A4	Design Data Sheet (Vendor's Data)	5	01	-
Part-III	A4	Inspection Test Plan	2	01	-

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0008</b>	Contract No. <b>66-6723</b>
	<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>Part-I - General Specifications</b>			
				Rev <b>01</b> Page <b>1</b> of <b>6</b>

## 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<sub>E</sub>' for increased safety motors shall be more than or equal to the thermal withstand time (Hot) in locked rotor condition

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0008</b>	Contract No. <b>66-6723</b>
	<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>Part-I - General Specifications</b>			
				Rev <b>01</b> Page <b>2</b> of <b>6</b>

at maximum permissible voltage. However, in all cases the time 't<sub>E</sub>' 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

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0008</b>	Contract No. <b>66-6723</b>
	<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>Part-I - General Specifications</b>			
				Rev <b>01</b> Page <b>3</b> of <b>6</b>

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<sub>E</sub>' 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.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0008</b>	Contract No. <b>66-6723</b>	
	<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>Part-I - General Specifications</b>				
					Rev

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 Classes 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.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0008</b>	Contract No. <b>66-6723</b>	
	<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>Part-I - General Specifications</b>				
					Rev

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 interchangeable 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 the 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.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0008</b>	Contract No. <b>66-6723</b>	
	<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>Part-I - General Specifications</b>				
					Rev

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.

		<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>PART - II B</b> <b>DESIGN DATA SHEET</b>				Code		WSS for PFCC Flue Gas	
						Contract no.		66-6723	
ThyssenKrupp Industrial Solutions (India)				Doc.		6723-ELT-331-EC-0008			
				Rev.		01	Page	1 OF 5	
<b>POWER SUPPLY</b>	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					
<b>GENERAL</b>	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) 				*	
	012								
	013	No. of poles/ Synchronous speed	:	rpm				*	
	014	Rated speed	:	rpm				*	
	015	Type	:	Hazardous / Non-Hazardous				*	
	016	Frame Size	:					*	
	017	Location	:	Indoor / Outdoor				*	
	018	Duty cycle	:					*	
	019	Motor is auto-start	:	Yes/ No (as per requirement)				*	
<b>ENCLOSURE / CONSTRUCTION</b>	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	<b>Hazardous area classification</b>	:						
		a) Zone / Div			To be assessed & selected by LSTK contractor as required (Min Zone 2)				
		b) Gas group			To be assessed & selected by LSTK contractor as required (Min. IIA/IIB)				
		b) Temperature Class				To be assessed & selected by LSTK contractor as required			
	025	Hazardous area enclosure type			To be selected by LSTK contractor as required			*	
	026	Grounding requirement	:	2 nos. diagonally opposite grounding pads					
with tapped holes & hardware to be provided.									
<b>ELECTRICAL DATA</b>		Details	Starting	No Load	1/2 Full Load	3/4 Full Load	Full Load		
	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 * & Stray Losses at 95°C	-	kW	kW	kW	kW		
	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	<b>Minimum permissible voltage for</b>	:							
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						

 <b>ThyssenKrupp Industrial Solutions (India)</b>		<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>PART - II B</b> <b>DESIGN DATA SHEET</b>		Code		WSS for PFCC Flue Gas		
				Contract no.		66-6723		
		Doc.		6723-ELT-331-EC-0008				
		Rev.		01		Page 2 OF 5		
<b>STATOR</b>	044	<b>Stator winding</b>						
		a. Connection	: Star, <b>Strip wound</b>					
		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)					
		<b>Note:</b> 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		:						
<b>ROTOR</b>	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 maximum rated speed above 950 rpm	: GR. 2.5 as per ISO 1940					
	060	Shaft extension	: Single/ Double (As required)				*	
<b>OPERATING CHARACTERISTICS</b>	061	Method of starting	: DOL					
	062	In case of VFD application:	<b>Not Applicable</b>					
		Make of VFD	:					
		Operating speed range	:					
		Type of Application	: <b>Constant Torque/ Variable Torque/ Constant Power</b>					
		Stress category	: <b>minimum Category C as per IEC 60034-18-41</b>					
		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	<b>Starting duty cycle</b>						
		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	<b>Accelerating time when</b>						
	a. Uncoupled at rated voltage	: s				*		
	b. Coupled at rated voltage	: s				*		
	c. Coupled at min. permissible voltage	: s				*		

		<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>PART - II B</b> <b>DESIGN DATA SHEET</b>		Code		WSS for PFCC Flue Gas	
				Contract no.		66-6723	
ThyssenKrupp Industrial Solutions (India)				Doc.		6723-ELT-331-EC-0008	
				Rev.		01	Page
<b>OPERATING CHARACTERISTICS</b>	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	*		
<b>MECHANICAL DATA</b>	070	GD <sup>2</sup> of motor	:	kg-m <sup>2</sup>	*		
	071	GD <sup>2</sup> of load	:	kg-m <sup>2</sup>	*		
	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	*		
<b>THERMAL DATA</b>	078	<b>Safe stall time (Hot/Cold) at</b>	:		*		
		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			
		<b>Note:</b> 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	<b>Limiting temperature used to determine safe stall time :</b>					
		a. Stator	:	°C	*		
		b. Rotor	:	°C	*		
	081	<b>Recommended temperature setting for stator winding :</b>					
		a. Alarm	:	°C	*		
		b. Trip	:	°C	*		
082	<b>Recommended temperature setting for BTD :</b>						
	a. Alarm	:	°C	*			
	b. Trip	:	°C	*			
083	Cooling time constant	:	minutes	*			
084	Heating time constant	:	minutes	*			
<b>TERMINAL BOX</b>	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 			
	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						

		<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>PART - II B</b> <b>DESIGN DATA SHEET</b>			Code	WSS for PFCC Flue Gas		
					Contract no.	66-6723		
ThyssenKrupp Industrial Solutions (India)					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)	:					*	



 ThyssenKrupp Industrial Solutions (India)		<b>HIGH VOLTAGE INDUCTION MOTORS</b> <b>PART - III</b> <b>INSPECTION TEST PLAN</b>			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	
<b>A Type Tests</b>								
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>B Routine Tests</b>								
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			



Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID	
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>			
				Rev

## ATTACHMENT – 4

### Technical Specifications for Flameproof LED Luminaires

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0015</b>	Contract No. <b>66-6723</b>
ThyssenKrupp Industrial Solutions (India)	<b>TECHNICAL SPECIFICATIONS FLAMEPROOF LED LUMINAIRES</b>			
				Rev <b>00</b> Page <b>1</b> of <b>2</b>

<p><b>tkIS India / Vendor</b></p> <table style="width: 100%;"> <tr><td style="text-align: center;">Category Codes (Submission Purpose)</td><td style="text-align: center;"><input type="checkbox"/></td><td>1</td><td>For Approval</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>2</td><td>For Review / Comments</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>3</td><td>For Information</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>4</td><td>For Engineering</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>5</td><td>For Enquiry</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>6</td><td>For Order Placement</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>7</td><td>Final &amp; Approved</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>8</td><td>Released for Construction</td></tr> </table> <hr/> <table style="width: 100%;"> <tr><td style="text-align: center;">Acceptance Codes (Approval Codes)</td><td style="text-align: center;"><input type="checkbox"/></td><td>1</td><td>Approved</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>2</td><td>Approved for Manufacturing / Fabrication with Comments as marked</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>3</td><td>Not Approved / Resubmit</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>4</td><td>Retained for Information / Records</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>5</td><td>Reviewed</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>6</td><td>Reviewed as Noted / Resubmit</td></tr> </table> <p><b>Remarks for AC2 :</b> 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.</p> <p><b>This approval / review does not absolve the supplier from the full responsibility for design and fabrication.</b></p> <p>Date : ___/___/____ Name : _____</p>	Category Codes (Submission Purpose)	<input type="checkbox"/>	1	For Approval		<input type="checkbox"/>	2	For Review / Comments		<input type="checkbox"/>	3	For Information		<input type="checkbox"/>	4	For Engineering		<input type="checkbox"/>	5	For Enquiry		<input type="checkbox"/>	6	For Order Placement		<input type="checkbox"/>	7	Final & Approved		<input type="checkbox"/>	8	Released for Construction	Acceptance Codes (Approval Codes)	<input type="checkbox"/>	1	Approved		<input type="checkbox"/>	2	Approved for Manufacturing / Fabrication with Comments as marked		<input type="checkbox"/>	3	Not Approved / Resubmit		<input type="checkbox"/>	4	Retained for Information / Records		<input type="checkbox"/>	5	Reviewed		<input type="checkbox"/>	6	Reviewed as Noted / Resubmit	<p><b>tkIS India / Owner / Client</b></p> <table style="width: 100%;"> <tr><td style="text-align: center;">Category Codes (Submission Purpose)</td><td style="text-align: center;"><input type="checkbox"/></td><td>1</td><td>For Approval</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>2</td><td>For Review / Comments</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>3</td><td>For Information</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>4</td><td>For Engineering</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>5</td><td>For Enquiry</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>6</td><td>For Order Placement</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>7</td><td>Final &amp; Approved</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>8</td><td>Released for Construction</td></tr> </table> <hr/> <table style="width: 100%;"> <tr><td style="text-align: center;">Acceptance Codes (Approval Codes)</td><td style="text-align: center;"><input type="checkbox"/></td><td>1</td><td>Approved</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>2</td><td>Approved for Manufacturing / Fabrication with Comments as marked</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>3</td><td>Not Approved / Resubmit</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>4</td><td>Retained for Information / Records</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>5</td><td>Reviewed</td></tr> <tr><td></td><td style="text-align: center;"><input type="checkbox"/></td><td>6</td><td>Reviewed as Noted / Resubmit</td></tr> </table> <p>Date : ___/___/____ Name : _____</p>	Category Codes (Submission Purpose)	<input type="checkbox"/>	1	For Approval		<input type="checkbox"/>	2	For Review / Comments		<input type="checkbox"/>	3	For Information		<input type="checkbox"/>	4	For Engineering		<input type="checkbox"/>	5	For Enquiry		<input type="checkbox"/>	6	For Order Placement		<input type="checkbox"/>	7	Final & Approved		<input type="checkbox"/>	8	Released for Construction	Acceptance Codes (Approval Codes)	<input type="checkbox"/>	1	Approved		<input type="checkbox"/>	2	Approved for Manufacturing / Fabrication with Comments as marked		<input type="checkbox"/>	3	Not Approved / Resubmit		<input type="checkbox"/>	4	Retained for Information / Records		<input type="checkbox"/>	5	Reviewed		<input type="checkbox"/>	6	Reviewed as Noted / Resubmit
Category Codes (Submission Purpose)	<input type="checkbox"/>	1	For Approval																																																																																																														
	<input type="checkbox"/>	2	For Review / Comments																																																																																																														
	<input type="checkbox"/>	3	For Information																																																																																																														
	<input type="checkbox"/>	4	For Engineering																																																																																																														
	<input type="checkbox"/>	5	For Enquiry																																																																																																														
	<input type="checkbox"/>	6	For Order Placement																																																																																																														
	<input type="checkbox"/>	7	Final & Approved																																																																																																														
	<input type="checkbox"/>	8	Released for Construction																																																																																																														
Acceptance Codes (Approval Codes)	<input type="checkbox"/>	1	Approved																																																																																																														
	<input type="checkbox"/>	2	Approved for Manufacturing / Fabrication with Comments as marked																																																																																																														
	<input type="checkbox"/>	3	Not Approved / Resubmit																																																																																																														
	<input type="checkbox"/>	4	Retained for Information / Records																																																																																																														
	<input type="checkbox"/>	5	Reviewed																																																																																																														
	<input type="checkbox"/>	6	Reviewed as Noted / Resubmit																																																																																																														
Category Codes (Submission Purpose)	<input type="checkbox"/>	1	For Approval																																																																																																														
	<input type="checkbox"/>	2	For Review / Comments																																																																																																														
	<input type="checkbox"/>	3	For Information																																																																																																														
	<input type="checkbox"/>	4	For Engineering																																																																																																														
	<input type="checkbox"/>	5	For Enquiry																																																																																																														
	<input type="checkbox"/>	6	For Order Placement																																																																																																														
	<input type="checkbox"/>	7	Final & Approved																																																																																																														
	<input type="checkbox"/>	8	Released for Construction																																																																																																														
Acceptance Codes (Approval Codes)	<input type="checkbox"/>	1	Approved																																																																																																														
	<input type="checkbox"/>	2	Approved for Manufacturing / Fabrication with Comments as marked																																																																																																														
	<input type="checkbox"/>	3	Not Approved / Resubmit																																																																																																														
	<input type="checkbox"/>	4	Retained for Information / Records																																																																																																														
	<input type="checkbox"/>	5	Reviewed																																																																																																														
	<input type="checkbox"/>	6	Reviewed as Noted / Resubmit																																																																																																														

00	-	Issued for Tender	08.02.21	Jkp	08.02.21	Alg	08.02.21	Jkp	-
Rev.	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC
Barcode				Category Code: -					
© thyssenkrupp Industrial Solutions (India) Private Limited 2016									

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0015</b>	Contract No. <b>66-6723</b>
ThyssenKrupp Industrial Solutions (India)	<b>TECHNICAL SPECIFICATIONS FLAMEPROOF LED LUMINAIRES</b>			
				Rev <b>00</b> Page <b>2</b> of <b>2</b>

## 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

Part	Docu Size	Description	No. Of Pages	Rev. No.	Revised Clauses
	A4	Index sheet and status of revision	2	00	
Part-I	A4	General specifications	3	00	
Part-IIA	A4	Design Data Sheet	2	00	
Part-IIB	A4	Design Data Sheet (Vendor's data)	1	00	
Part-V	A4	Inspection Test Plan	1	00	

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0015</b>	Contract No. <b>66-6723</b>
ThyssenKrupp Industrial Solutions (India)	<b>FLAMEPROOF LED LUMINAIRES</b> <b>Part-I – General Specifications</b>			
				Rev <b>00</b> Page <b>1</b> of <b>3</b>

## 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 mm<sup>2</sup> 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.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0015</b>	Contract No. <b>66-6723</b>
ThyssenKrupp Industrial Solutions (India)	<b>FLAMEPROOF LED LUMINAIRES</b> <b>Part-I – General Specifications</b>			
				Rev <b>00</b> Page <b>2</b> of <b>3</b>

- 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  $25 \pm 2^{\circ}\text{C}$ .
- 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.

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID <b>6723-ELT-331-EC-0015</b>	Contract No. <b>66-6723</b>
ThyssenKrupp Industrial Solutions (India)	<b>FLAMEPROOF LED LUMINAIRES</b> <b>Part-I – General Specifications</b>			
				Rev <b>00</b> Page <b>3</b> of <b>3</b>

## 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.

 		<b>FLAMEPROOF LED LUMINAIRES</b>  <b>PART - IIA</b>  <b>DESIGN DATA SHEET</b>		Code	66-6723		
				Contract no.	WSS for PFCC Flue Gas		
				Doc.	6723-ELT-331-EC-0015		
				Rev.	00	Page	1 OF 2
<b>GENERAL</b>	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							
<b>CODES</b>	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						
<b>ACCESSORIES</b>	026	<b>1) LED MODULE</b>					
		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	<b>2) CONTROLGEAR</b>					
		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	<b>3) WIRE GUARD</b>					
		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			

		<b>FLAMEPROOF LED LUMINAIRES</b>			Code	66-6723		
ThyssenKrupp Industrial Solutions (India)		<b>PART - IIA</b>			Contract no.	WSS for PFCC Flue Gas		
		<b>DESIGN DATA SHEET</b>			Doc.	6723-ELT-331-EC-0015		
					Rev.	00	Page 2 OF 2	
<b>CONSTRUCTION (LIGHT FITTINGS, CONTROL GEARS, JUNCTION BOXES)</b>	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 :						*	
		<b>CABLE ENTRY FOR</b>	<b>SIZE</b>	<b>POSITION</b>				
		<b>LUMINAIRE / C.G.BOX</b>		<b>&amp; NO. OF ENTRIES</b>				
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							
<b>DOCUMENTS /DRAWINGS</b>		<b>Description</b>			<b>For Review/Approval/ Information</b>	<b>Final / As-Built Prints. (see note 2)</b>		
	053	Catalogues indicating dimensional details alongwith brief specs.			Soft	6		
		& Enclosure protection						
	054	Lighting distribution diagrams polar curves, isolux diagrams & coefficient of utilisation charts for each type of fixtures.			Soft	6		
	055	Quality Assurance Plan & Inspection 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 recognised testing authority)			Soft	6		
	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			
<b>NOTE :</b>								
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.								

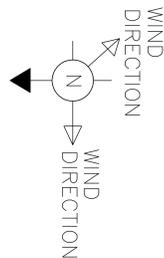
 ThyssenKrupp Industrial Solutions (India)	<b>FLAMEPROOF LED LUMINAIRES</b>						Code	66-6735			
	<b>PART - II B</b> <b>DESIGN DATA SHEET (VENDOR'S DATA)</b>						Contract no.	WSS for PFCC Flue Gas			
							Doc.	6723-ELT-331-EC-0015			
							Rev.	00	Page	1 OF 1	
<b>VENDOR DATA</b>	<b>LED VENDOR DATA</b> :										
	<b>A</b>	<b>LED Tube light / down light :</b>									*
	1	Rating	6W	9 W	12W	15W	18W	40W			
	2	Losses									
	3	LED Module Nominal Power (W)									
	4	Rated Maximum Temp ( °C)									
	5	Power Factor									
	6	Total Circuit Power (W)									
	7	Lumen Output									
	<b>B</b>	<b>LED Street light :</b>									*
	1	Rating	30 W	60W	90W	120W	150W	170W	210W		
	2	Losses									
	3	LED Module Nominal Power (W)									
	4	Rated Maximum Temp ( °C)									
	5	Power Factor									
	6	Total Circuit Power (W)									
	7	Lumen Output									
	<b>C</b>	<b>LED Flood light:</b>									*
	1	Rating	10 W	30W	60W	80W	120W	160W			
	2	Losses									
	3	LED Module Nominal Power (W)									
	4	Rated Maximum Temp ( °C)									
	5	Power Factor									
	6	Total Circuit Power (W)									
	7	Lumen Output									
	<b>D</b>	<b>LED Medium / High bay light :</b>									*
	1	Rating	80 W	100W	150W						
	2	Losses									
	3	LED Module Nominal Power (W)									
	4	Rated Maximum Temp ( °C)									
5	Power Factor										
6	Total Circuit Power (W)										
7	Lumen Output										
<b>E</b>	<b>LED well glass :</b>									*	
1	Rating	35W	80 W	100W	150W						
2	Losses										
3	LED Module Nominal Power (W)										
4	Rated Maximum Temp ( °C)										
5	Power Factor										
6	Total Circuit Power (W)										
7	Lumen Output										
For items marked " * " thus, data to be furnished by vendor.											

 ThyssenKrupp Industrial Solutions (India)		FLAMEPROOF LED LUMINAIRES			Code	66-6735	
		PART- III			Contract no.	WSS for PFCC Flue Gas	
INSPECTION TEST PLAN				Doc.	6723-ELT-331-EC-0015		
				Rev.	00	Page	1 of 1
	Tests	Reference Documents	Sample size	Scope of Inspection			
				Vendor	Third Party	Remark	
<b>A</b>	<b>Type Tests</b>						
i	Ingress Protection	IS/IEC-60529	Each type	P <sub>PROTO</sub>	R		
ii	Test for Temperature rise	IS-2206	Each type	P <sub>PROTO</sub>	R		
iii	Test for Flameproofness	IS-2206	Each type	P <sub>PROTO</sub>	R		
iv	Luminaire Power	IS-16107	Each type	P <sub>PROTO</sub>	R		
v	Moisture resistance	IS-15885-2-13	Each type	P <sub>PROTO</sub>	R		
vi	Creepage distances and clearances	IS-15885-2-13	Each type	P <sub>PROTO</sub>	R		
vii	Marking	IS-2206	Each type	P <sub>PROTO</sub>	R		
viii	Luminous Flux	IS-16107	Each type	P <sub>PROTO</sub>	R		
ix	Lighting Intensity	IS-16107	Each type	P <sub>PROTO</sub>	R		
x	Angular beam distribution	IS-16107	Each type	P <sub>PROTO</sub>	R		
xi	Luminaire intensity distribution	IS-16107	Each type	P <sub>PROTO</sub>	R		
xii	Luminaire efficacy	IS-16107	Each type	P <sub>PROTO</sub>	R		
xiii	Chromocity coordinates and correlated colour temperature (CCT)	IS-16107	Each type	P <sub>PROTO</sub>	R		
xiv	Colour rendering index (CRI)	IS-16107	Each type	P <sub>PROTO</sub>	R		
xv	Life	IS-16107	Each type	P <sub>PROTO</sub>	R		
xvi	Lumen maintenance	IS-16107	Each type	P <sub>PROTO</sub>	R		
xvii	Endurance test	IS-16107	Each type	P <sub>PROTO</sub>	R		
<b>B</b>	<b>Acceptance Tests</b>						
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		
<b>C</b>	<b>Test certificates</b>						
i	Test certificates for bought out items and internal components	-	100%	P	R		
<b>Notes:</b>							
1) W = Witness, R = Review, P = Perform on project equipment, P <sub>PROTO</sub> = 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.							

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID	
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>			

## ATTACHMENT – 5

### Area Classification Layout of PFCC Unit



प्रस्तुत आरेख एवं इन्हें सहित विद्यमान इंजीनियरिंग ड्राइंग निम्नलिखित को संदर्भित है: ये मान आधार दिए गए हैं और उपकरणों ने एक स्टैंड चार्ट/ड्राइंग किया है कि न वो उन्हें पुनः मुद्रित किया जाएगा, न कलक की जाएगी, न उधार दिए जाएंगे, न प्रदर्शित किए जाएंगे और न ही कॉपीय और न ही प्रिंटीय प्रयोग के अलावा इन्हें कहीं अन्य प्रयोग में लाया जाए और यह प्रयोग उधार देने वाले द्राफ्ट उधारकर्ता को लिखित रूप में ही पूर्व सहमति से होगा।

The drawing, design and details given on this format are the property of ENGINEERS INDIA LIMITED. They are merely loaned on the borrower's express agreement that they will not be reproduced, copied, exhibited or used, except in the limited way permitted by a written consent given by the lender to the borrower for the intended use.

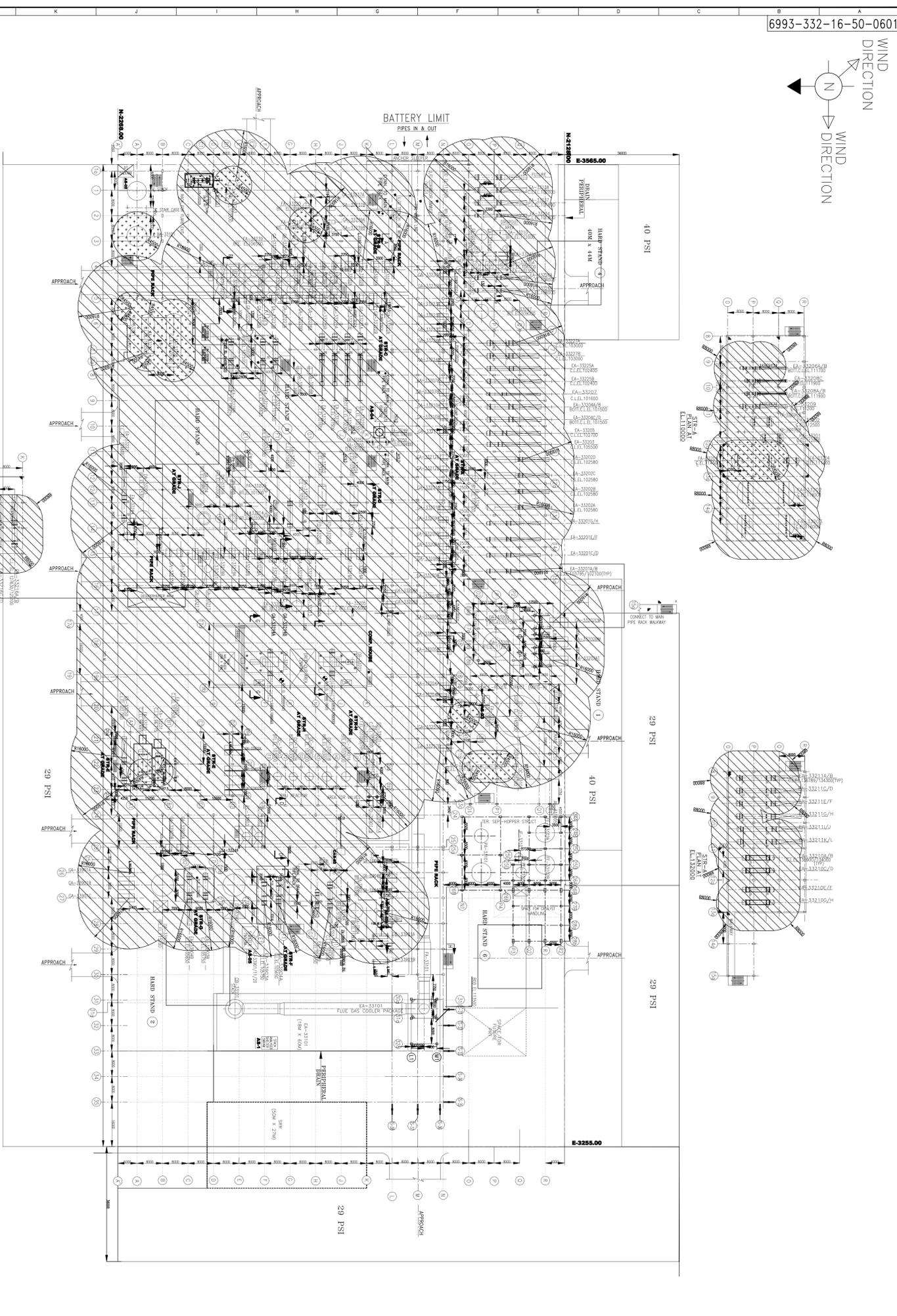


Table with 4 columns: EQUIP. NO., DESCRIPTION, GRADES, and FOUNDATION. Lists various equipment like columns, vessels, heat exchangers, and pumps.

Table with 4 columns: EQUIP. NO., DESCRIPTION, GRADES, and FOUNDATION. Lists various equipment like pumps, reactors, and distillation columns.

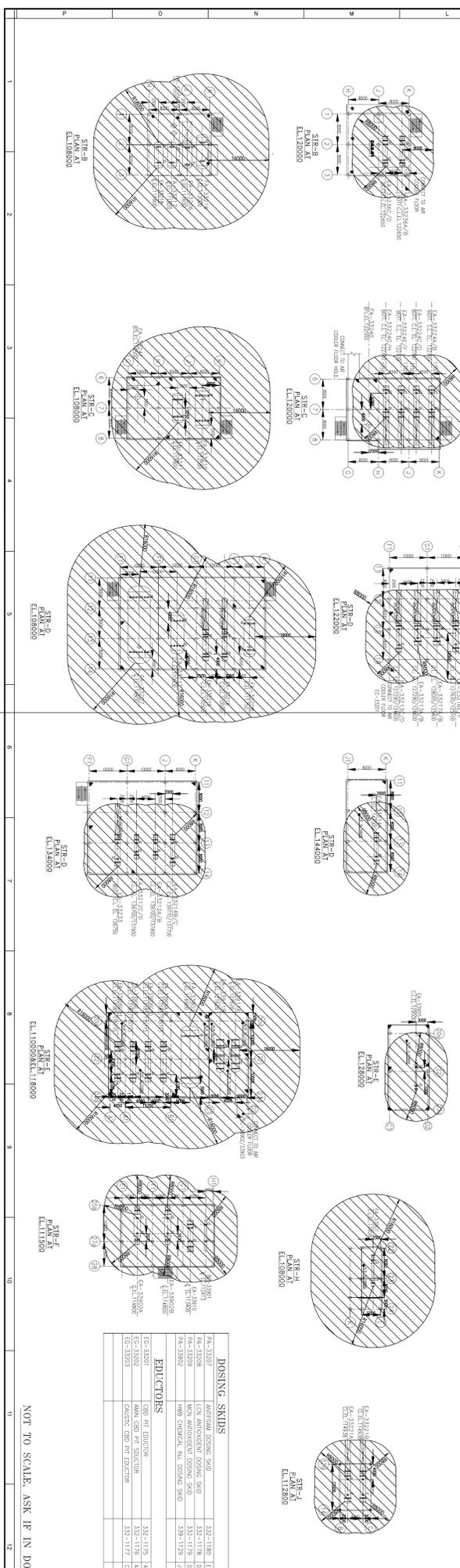


Table with 4 columns: EQUIP. NO., DESCRIPTION, GRADES, and FOUNDATION. Lists various equipment like dosing skids, reactors, and heat exchangers.

Project information including company name (Engineers India Limited), project name (Mangalore Refinery & Petrochemicals Ltd.), and contact details.

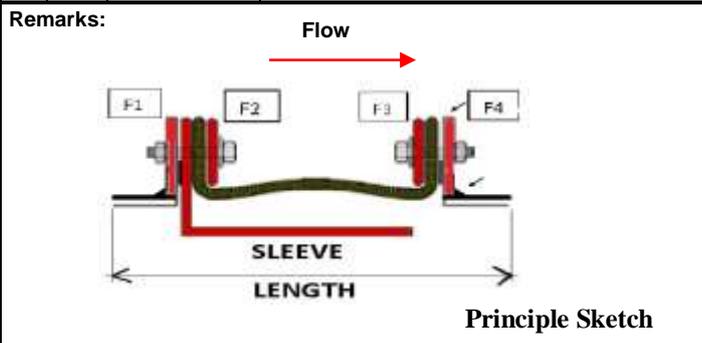
Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID	
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>			
				Rev

## ATTACHMENT – 6

### Expansion Bellows Specs SXB-33101A & SXB-33102

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

1	Part-No.	SXB-33101A				
2	Quantity	4				
3	Expansion joint type	UNTIED				
4	Construction	FABRIC				
5	Internal Sleeve Material (Note 2)	<input checked="" type="checkbox"/> yes <input type="checkbox"/> 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	<input checked="" type="checkbox"/> gaseous <input type="checkbox"/> 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	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no			
20	Spring rate incl.	Axial spring rate (Max)	N/mm	Note 1		
21		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 <sup>2</sup>	Note 1		
24	Type of end (Note 3)	Designation	Inlet		Outlet	
25		Flange connection	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no	
26		Flange standard	Manufacturing Standard		Manufacturing 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	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no	
32		Outside diameter x Wallthickness	mm	-		
33		Welding end standard	-			
34		Material	-			
35	Dimensions	Total length	mm	500 mm		
36		Maximum width	mm	Note 1		
37		Corrosion allowance	mm	1.5		
38	Certificates	Inspection certificate acc. EN 10204(DN 50049)	<input checked="" type="checkbox"/>	3.1	<input type="checkbox"/> 3.2	
39		Inspection certificate acc. EN 10204(DN 50049)	<input type="checkbox"/> 2.2			
40	Inspection	thyssenkrupp	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/> no	
41		Third Party	<input type="checkbox"/>	yes	<input type="checkbox"/> no	
42		Client	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/> no	
43	Painting	Of elements (without bellows) acc. Paint.Spec. (Note 4)	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/> no	



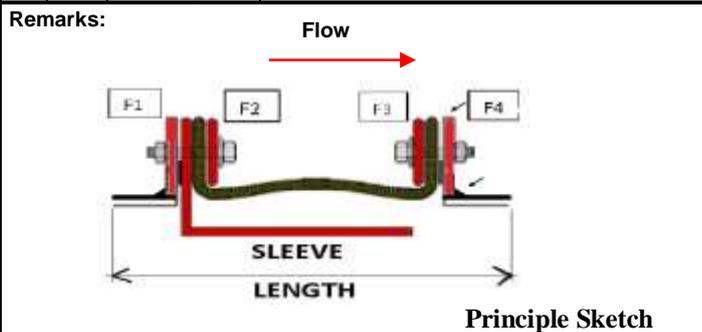
- NOTE :-**
- Vendor to specify.
  - Flow velocity approx. 30.7m/s.
  - Refer Sketch Flanges F1 to F4 & Pipe Ends with bolts and nuts are in vendor delivery scope. Bolt torque to be given by supplier.
  - Painting for CS part only as per painting Spec.
  - Material for Lap Joint flange (with stub end)-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

0	31-10-20	BKS	AVE	AVE	ISSUED FOR ENQUIRY
Rev.	Date	Prepared	Checked	Approved	Description
©..2014.. Uhde GmbH					

A2-02 E 98-05 WW

	Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Code WSS for PFCC Flue Gas	Project No. 66-6723	Page <b>1</b>
	<b>TECHNICAL SPECIFICATION FOR FABRIC EXPANSION JOINT FOR MRPL PLANT</b>			TON	
				ITEM	<b>SXB-33102</b>
				REV.	<b>0</b>

1	Part-No.	SXB-33102			
2	Quantity	1			
3	Expansion joint type	UNTIED			
4	Construction	FABRIC			
5	Internal Sleeve Material (Note 2)	<input checked="" type="checkbox"/> yes <input type="checkbox"/> 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	<input checked="" type="checkbox"/> gaseous <input type="checkbox"/> 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	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no		
20	Spring rate incl.	Axial spring rate (Max)	N/mm	Note 1	
21		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 <sup>2</sup>	Note 1	
24	Type of end (Note 3)	Designation	Inlet		Outlet
25		Flange connection	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no	<input checked="" type="checkbox"/> yes	<input type="checkbox"/> no
26		Flange standard	Manufacturing Standard	Manufacturing 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	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no	<input type="checkbox"/> yes	<input checked="" type="checkbox"/> no
32		Outside diameter x Wallthickness	mm	-	-
33		Welding end standard		-	-
34		Material		-	-
35	Dimensions	Total length	mm	500 mm	
36		Maximum width	mm	Note 1	
37		Corrosion allowance	mm	1.5	
38	Certificates	Inspection certificate acc. EN 10204(DN 50049)	<input checked="" type="checkbox"/>	3.1	<input type="checkbox"/> 3.2
39		Inspection certificate acc. EN 10204(DN 50049)	<input type="checkbox"/> 2.2		
40	Inspection	thyssenkrupp	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/> no
41		Third Party	<input type="checkbox"/>	yes	<input type="checkbox"/> no
42		Client	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/> no
43	Painting	Of elements (without bellows) acc. Paint.Spec. (Note 4)	<input checked="" type="checkbox"/>	yes	<input type="checkbox"/> no



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

0	31-10-20	BKS	AVE	AVE	ISSUED FOR ENQUIRY
Rev.	Date	Prepared	Checked	Approved	Description
©..2014.. Uhde GmbH					

A2-02 E 98-05 WW

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID	
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>			
				Rev

## ATTACHMENT – 7

### Damper Specs

Plant MRPL Mangalore	Client MRPL	Contract Code WSS for PFCC Flue Gas	Document ID 6723-PIP-331-EC-0001_002	Contract No. 66-6723	
	<h2>Technical Specification for Damper</h2>				
					Rev

<p><b>TKIS - India / Vendor</b></p> <table style="width: 100%;"> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Category Codes (Submission Purpose)</td> <td> <input type="checkbox"/> 1 For Approval  <input type="checkbox"/> 2 For Review / Comments  <input type="checkbox"/> 3 For Information  <input type="checkbox"/> 4 For Engineering  <input type="checkbox"/> 5 For Enquiry  <input type="checkbox"/> 6 For Order Placement  <input type="checkbox"/> 7 Final &amp; Approved  <input type="checkbox"/> 8 Released for Construction </td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Acceptance Codes (Approval Codes)</td> <td> <input type="checkbox"/> 1 Approved  <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked  <input type="checkbox"/> 3 Not Approved / Resubmit  <input type="checkbox"/> 4 Retained for Information / Records  <input type="checkbox"/> 5 Reviewed  <input type="checkbox"/> 6 Reviewed as Noted / Resubmit </td> </tr> </table> <p><b>Remarks for AC2 :</b> This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-submitted 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.</p> <p><b>This approval / review does not absolve the supplier from the full responsibility for design and fabrication.</b></p> <p>Date : ___/___/___ Name : _____</p>	Category Codes (Submission Purpose)	<input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction	Acceptance Codes (Approval Codes)	<input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit	<p><b>TKIS - India / Owner / Client</b></p> <table style="width: 100%;"> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Category Codes (Submission Purpose)</td> <td> <input type="checkbox"/> 1 For Approval  <input type="checkbox"/> 2 For Review / Comments  <input type="checkbox"/> 3 For Information  <input type="checkbox"/> 4 For Engineering  <input type="checkbox"/> 5 For Enquiry  <input type="checkbox"/> 6 For Order Placement  <input type="checkbox"/> 7 Final &amp; Approved  <input type="checkbox"/> 8 Released for Construction </td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Acceptance Codes (Approval Codes)</td> <td> <input type="checkbox"/> 1 Approved  <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked  <input type="checkbox"/> 3 Not Approved / Resubmit  <input type="checkbox"/> 4 Retained for Information / Records  <input type="checkbox"/> 5 Reviewed  <input type="checkbox"/> 6 Reviewed as Noted / Resubmit </td> </tr> </table> <p>Date : ___/___/___ Name : _____</p>	Category Codes (Submission Purpose)	<input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction	Acceptance Codes (Approval Codes)	<input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit
Category Codes (Submission Purpose)	<input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction								
Acceptance Codes (Approval Codes)	<input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit								
Category Codes (Submission Purpose)	<input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction								
Acceptance Codes (Approval Codes)	<input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit								

00		Issued for BID purpose	17/11/2020						
Rev.	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC
				Barcode					Category Code: -
© thyssenkrupp Industrial Solutions (India) Private Limited 2016									

Plant MRPL Mangalore	Client MRPL	Contract Code WSS for PFCC Flue Gas	Document ID 6723-PIP-331-EC-0001_002	Contract No. 66-6723
	Technical Specification for Damper			
				Rev 00 Page 2 of 2

- 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
<b>WET SCRUBBING SYSTEM</b>					
FLUE GAS DUCT	0.07 kg/cm <sup>2</sup> 196 Deg C -300 Deg C	FLUE GAS	14.76% CO <sub>2</sub> , 61 -305 ppm SO <sub>2</sub> , 60-1000 mg/Nm <sup>3</sup> (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/cm<sup>2</sup> g; Design temp. 315 Deg C.  
Operating pressure 0.07 Kg/cm<sup>2</sup> ,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:

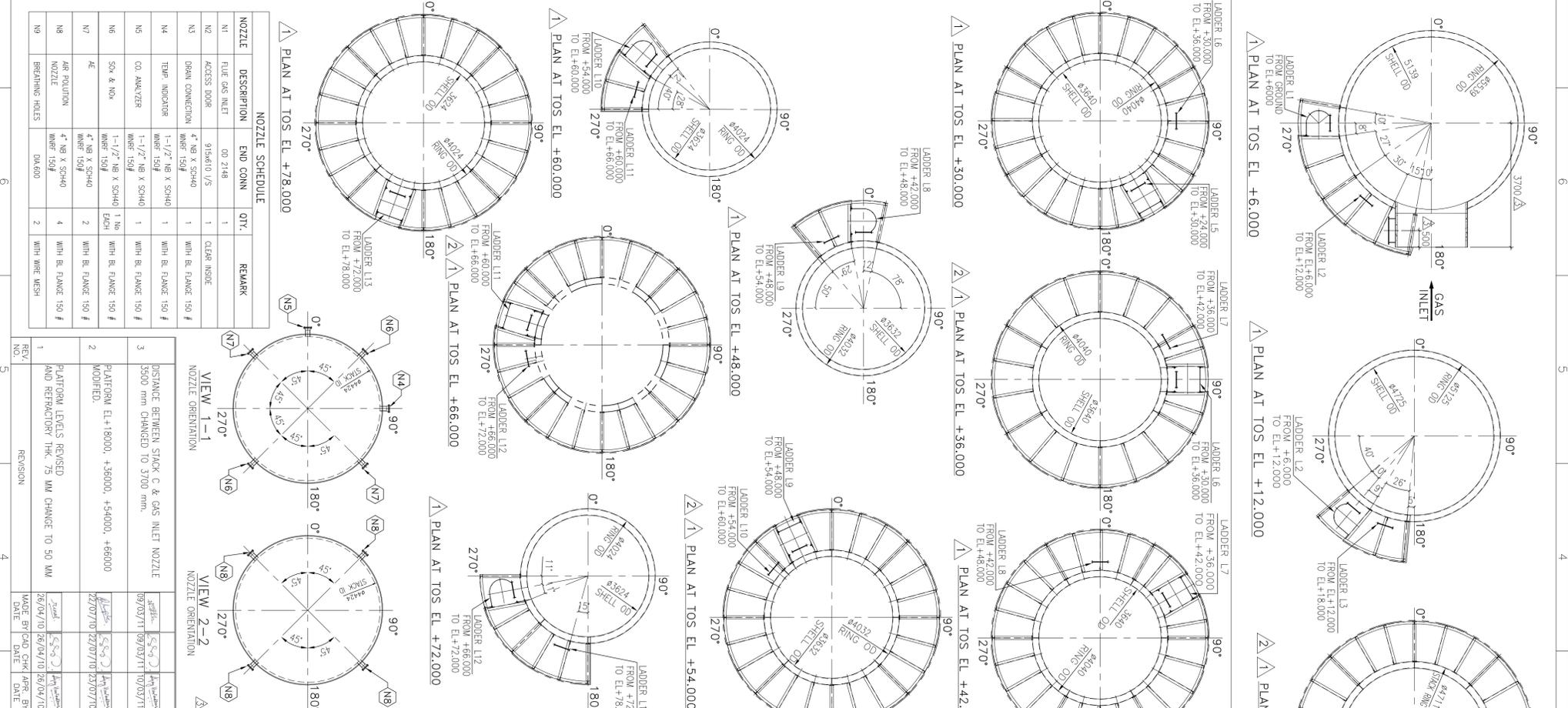
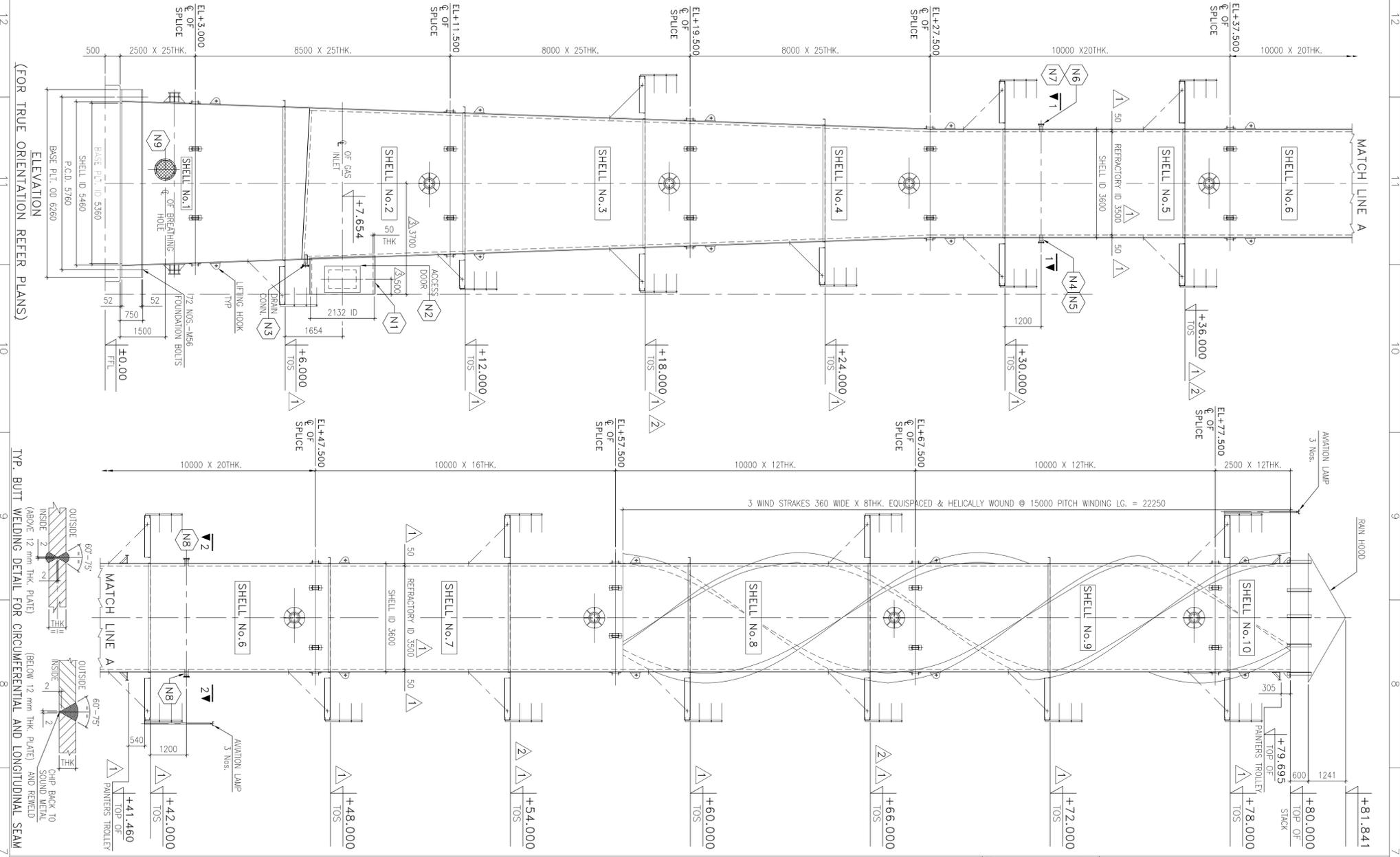
- BD-331900 - on line No. 60"-RF-3310501-HRCSS150-IH
- BD-331901 - on line No. 60"-RF-3310502-HRCSS150-IH
- BD-331902 - on line No. 60"-RF-3310503-HRCSS150-IH
- BD-331903 - on line No. 60"-RF-3310504-HRCSS150-IH
- BD-331904 - on line No. 89"-RF-331-TP-01-HRCSS150-IH
- BD-331905 - on line No. 89"-RF-331-TP-20-B21Y-IL\_

Plant <b>MRPL Mangalore</b>	Client <b>MRPL</b>	Contract Code <b>WSS for PFCC Flue Gas</b>	Document ID				
	<b>LSTK PACKAGE FOR PFCC UNIT FLUE GAS WET GAS SCRUBBER SYSTEM AT MRPL, MANGALURU</b>						
				Rev	<b>00</b>	Page	

**ATTACHMENT – 8**  
**GA of Existing Stack**

TOLERANCES ARE NON CUMULATIVE	
ACCEPTABLE DEVIATION FOR UNTOLERANCED DIMENSION	
FINISH	RA μm
1	12.5
2	6.3
3	3.2
4	1.6
5	0.8
6	0.4
7	0.2
8	0.1
9	0.05
10	0.025

Authorized Controlled



NOZZLE	DESCRIPTION	END CONN.	QTY.	REMARK
N1	FLUE GAS INLET	OD 2148	1	CLEAR INSIDE
N2	ACCESS DOOR	915x610 / S	1	WITH BR FLANGE 150 #
N3	DRAIN CONNECTION	4" NB X SCH40	1	WITH BR FLANGE 150 #
N4	TEMP INDICATOR	1-1/2" NB X SCH40	1	WITH BR FLANGE 150 #
N5	CO ANALYZER	1-1/2" NB X SCH40	1	WITH BR FLANGE 150 #
N6	SO <sub>2</sub> & NO <sub>x</sub>	1-1/2" NB X SCH40	1	WITH BR FLANGE 150 #
N7	AE	4" NB X SCH40	2	WITH BR FLANGE 150 #
N8	AIR ROTATION	4" NB X SCH40	4	WITH BR FLANGE 150 #
N9	BREATHING HOLES	WHIP 150#	2	WITH WIRE MESH

**VIEW 1-1 NOZZLE ORIENTATION**

**VIEW 2-2 NOZZLE ORIENTATION**

**ISSUED FOR:**  APPROVAL  REVISE  INFORMATION  CONSTRUCTION

**SIGN:** \_\_\_\_\_ **DATE:** \_\_\_\_\_

**STATEMENT OF SUB:**  FINAL FOR CODE-1  AS BUILT

**DOCUMENT STATUS:**  ISSUED  REVISED  APPROVED

**REVISIONS:**

REV.	NO.	DESCRIPTION	DATE
1	1	ISSUED FOR CONSTRUCTION	26/04/10
2	2	REVISION	26/04/10
3	3	REVISION	26/04/10
4	4	REVISION	26/04/10
5	5	REVISION	26/04/10
6	6	REVISION	26/04/10
7	7	REVISION	26/04/10
8	8	REVISION	26/04/10
9	9	REVISION	26/04/10
10	10	REVISION	26/04/10
11	11	REVISION	26/04/10
12	12	REVISION	26/04/10
13	13	REVISION	26/04/10
14	14	REVISION	26/04/10
15	15	REVISION	26/04/10
16	16	REVISION	26/04/10
17	17	REVISION	26/04/10
18	18	REVISION	26/04/10
19	19	REVISION	26/04/10
20	20	REVISION	26/04/10

**NOTES :-**

- ALL DIMENSIONS ARE IN mm & LEVELS ARE IN MRS.
- ALL DIMENSIONS ARE IN mm & LEVELS ARE IN MRS.
- ALL FLANGE BOLT HOLES TO STRADDLE VERTICAL AND HORIZONTAL CENTER LINE.
- ALL SKEW AND DIRECT WELDING DONE BY PREPARING THE CONNECTING MEMBER ENDS TO SUITABLE PROFILE AND THEN WELDED.
- ALL MATCHING PARTS PROPERLY MATCH MARKED AND MATCH DRILLED BEFORE DISPATCH TO SITE.
- ALL WELDS ARE 6 mm CONTINUOUS FILET UNLESS NOTED OTHERWISE.
- ALL ITEMS TRANSPORTED SHALL HAVE MARK NO. AND DRAWING NO. PAINTED ON IT IN WHITE PAINT.
- ALL T. ADJMS 100% RADIOGRAPHED. C-SEAM & L-SEAM SHALL BE 100% RADIOGRAPHED.
- OTHER NOT & TESTING SHALL BE AS PER QAP ISSUED BY QC DEPARTMENT.
- PAINING--AS PER SPECS NO. N11-1WH-CS-40477
- FOR REFRACTORY LINING DETAILS REFER SEPARATE DRG.
- MAJOR TOLERANCES (IN mm) ON STEEL WORK FABRICATION AS FOLLOWS: TOLERANCE FOR ALL OTHER FABRICATION SHALL BE AS PER IS:2715, WOWER FOR OTHER TOLERANCES REFER EL'S SPECS. 6-17-0002-REX3.
- MARKING
- FLAME CUTTING
- SHEARING (PLATE)
- C/C HOLES (EXCEPT FOR DRILLING--THIS TOLERANCE MUST NOT BE CUMULATIVE)
- FLATNESS OF BASE PLATE FROM MEAN SURFACE
- QUALITY (STACK SHELLS)
  - VERTICALITY OF STACK (VARI. STACK BASE) 5.0 (MAX)
  - OVERBALL HEIGHT OF STACK SECTIONS (NON-CUMULATIVE) UP TO 5 MTR HEIGHT = ±3
  - OVERBALL HEIGHT OF STACK SECTIONS (NON-CUMULATIVE) 5 TO 15 MTR HEIGHT = ±6
  - ALIGNMENT OF PLATES AT ANY WELD 1.5 (MAX)
- STACK CHAIR RINGS DRILLING DONE TOGETHER.
- ALL SHELL WELDS FULL PENETRATION WELD. LONGITUDINAL WELDS STAGGERED TO EACH OTHER.
- Ø12 VENT HOLE PROVIDED ON PAD PLATE ONLY & FILLED WITH HARD GREASE AFTER WELDING.
- ALL PLATE MATERIALS IS:2082 G/A OR EQ. UNO.
- STACK SEPARATE 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 LINES. IN THIS PORTION APPLIED INSITU AFTER FULL STRENGTH WELDING OF SPlice IS COMPLETE.

**OWNER:** **DURG**

**CONSULTANT:** **INDIA LIMITED**

**CLIENT:** **MANGALORE REFINERY & PETROCHEMICALS LTD.**

**PROJECT:** **AS BUILT DRAWING**

**PRODUCT:** **FLUE GAS COOLER**

**BOILER NO: LW-240**

**SCALE:** **1:80**

**DRG. NO.:** **G27-1WH-68248**