

TECHNICAL AMENDMENT NO: 02

ITEM DESCRIPTION : RWTP/RODMP/CPU/ZLDP FOR P-25
BIDDING DOCUMENT NO. : B269-475-17-44-PA-T-8701
DISCIPLINE : WATER DEPT.

0	10.03.2022	ISSUED AS TECHNICAL AMENDMENT	SC/DD	VS	PKG
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

The terms, conditions and specifications of Bidding Document stand modified to the extent indicated under column “MODIFICATIONS/ADDITION/DELETION”. All other terms & conditions, stipulations and specifications of bidding document shall remain unaltered.

S. No.	Part No / Vol No	Page No.	Section / Document no.	Clause No / Item No	Subject	Modifications / Additions/Deletion
1.	Tender Doc_Part 2	Pg. 759 of 7166	Document No. B269-472-17-44-SS-1001, Rev 1		Scope of Work & Supply- RWTP	<u>Modification:</u> The document B269-472-17-44-SS-1001 Rev 2 is attached which shall supersede the previous revision.
2.	Tender Doc_Part 2	Pg. 979 of 7166	Document No. B269-475-17-44-DB-1001, Rev 3		Process Design Basis: RODMP & ZLDP	<u>Modification:</u> The document B269-475-17-44-DB-1001 Rev 4 is attached which shall supersede the previous revision.
3.	Tender Doc_Part 2	Pg. 781 of 7166	Document No. B269-475-17-44-SS-1001, Rev 4		Scope of Work & Supply- RODMP	<u>Modification:</u> The document B269-475-17-44-SS-1001 Rev 5 is attached which shall supersede the previous revision.
4.	Tender Doc_Part 2	Pg. 822 of 7166	Document No. B269-475-17-44-SS-1002, Rev 3		Scope of Work & Supply- ZLDP	<u>Modification:</u> The document B269-475-17-44-SS-1002 Rev 3 is attached which shall supersede the previous revision.
5.	Tender Doc_Part 2	Pg. 883 of 7166	Document No. B269-476-17-44-SS-1001, Rev 1		Scope of Work & Supply- CPU (P25)	<u>Modification:</u> The document B269-476-17-44-SS-1001 Rev 2 is attached which shall supersede the previous revision.

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6.	Tender Doc_Part 2	Pg. 848 of 7166	Document No. B269-81-17-44-SS-1001, Rev 1		Scope of Work & Supply – CPU (PNCP Complex)	<u>Modification:</u> The document B269-81-17-44-SS-1001 Rev 2 is attached which shall supersede the previous revision.
7.	Technical Amendmen t-01	52 of 94	Doc No. B269-475-17-44-EL-1001, Rev 4	-	Equipment List of RO-DM plant	<u>Modification:</u> The document B269-475-17-44-EL-1001 Rev 5 is attached which shall supersede the previous revision.
8.	Tender Doc_Part 4	Pg. 1911 of 7166	Doc No. B269-475-17-44-EL-1002, Rev 2	1. ZLD Feed Tank	Equipment List of ZLDP	<u>Modification:</u> The quantity of ZLD Feed tank stands modified as “1 Nos.” AND The Tag No. of ZLD Feed Tanks stands modified as “475-T-201”.
9.	Technical Amendmen t-01	35 of 94	Process datasheet No.: B269-472-17-44-DS-1003, Rev 2.		Lamella Clarifier	<u>Deletion:</u> Note No. 9 ‘THE LAMELLA CLARIFIER AND UF FEED SUMP & PUMP SHALL BE A SINGLE STRUCTURE’ stands DELETED
10.	Tender Doc_Part 4	Pg.1945 of 7166	Process datasheet No.: B269-472-17-44-DS-1014, Rev 1.		HRSCC Backwash	<u>Modification:</u> The Material of Construction for TANK stands replaced as: “RCC Epoxy Coated”

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11.	Tender Doc_Part 4	Pg.2010 of 7166	Process datasheet No.: B269-475-17-44-DS-1015, Rev 2		UF-I Feed Tank (RODMP)	<u>Modification:</u> The "TOTAL HEIGHT: 19m" Stands replaced as: "TOTAL HEIGHT: 20 M"
12.	Tender Doc_Part 4	Pg.2041 of 7166	Process datasheet No.: B269-475-17-44-DS-1042, Rev 0		Flash Mixing Tank-II	<u>Modification:</u> The Material of Construction for TANK stands replaced as: "RCC Epoxy Screed Lining"
13.	Tender Doc_Part 4	Pg.2042 of 7166	Process datasheet No.: B269-475-17-44-DS-1043, Rev 0		Flash Mixer-II	<u>Modification:</u> The Material of Construction for "Impeller" stands replaced as: "SS316 FRP COATED" AND The Material of Construction for "Blade" stands replaced as: "SS316 FRP COATED" AND The Material of Construction for "Shaft" stands replaced as: "SS431 FRP COATED"

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14.	Technical Amendmen t-01	79 of 94	Process datasheet No.: B269-475-17-44-DS-1044, Rev 0		HRSCC-II	<u>Modification:</u> The Material of Construction for TANK stands replaced as: “RCC Epoxy Screed Lining”
15.	Tender Doc_Part 4	Pg.2045 of 7166	Process datasheet No.: B269-475-17-44-DS-1045, Rev 0		HRSCC-II Sludge Sump	<u>Modification:</u> The Material of Construction for “INTERNAL PAINTING/ COATING/ LINING” stands replaced as: “Epoxy Screed Lining”
16.	Tender Doc_Part 4	Pg.2046 of 7166	Process datasheet No.: B269-475-17-44-DS-1046, Rev 0		HRSCC-II Sludge Sump Agitator	<u>Modification:</u> The Material of Construction for “Impeller” stands replaced as: “SS316 FRP COATED” AND The Material of Construction for “Blade” stands replaced as: “SS316 FRP COATED” AND The Material of Construction for “Shaft” stands replaced as: “SS431 FRP COATED”

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17.	Tender Doc_Part 4	Pg.2047 of 7166	Process datasheet No.: B269-475-17-44-DS-1047, Rev 1		HRSCC-II Sludge Transfer Pumps	<u>Modification:</u> The Material Code for “Casing” stands replaced as: “SDSS” AND The Material Code for “Impeller” stands replaced as: “SDSS”
18.	Tender Doc_Part 4	Pg.2048 of 7166	Process datasheet No.: B269-475-17-44-DS-1048, Rev 0		Filter Feed Sump-II	<u>Modification:</u> The Material of Construction for “INTERNAL PAINTING/LINING” stands replaced as: “Epoxy Screed Lining”
19.	Tender Doc_Part 4	Pg.2052 of 7166	Process datasheet No.: B269-475-17-44-DS-1051, Rev 0		Activated Carbon Filters-II	<u>Modification:</u> The “DETAILS OF INTERNAL PROTECTION: EPOXY COATED” Stands replaced as: “DETAILS OF INTERNAL PROTECTION: GLASS FLAKED VINYL ESTER LINING”

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20.	Tender Doc_Part 4	Pg.2055 of 7166	Process datasheet No.: B269-475-17-44-DS-1053, Rev 0		Filter Air Scour Blowers-II	<u>Modification:</u> The "NORMAL FLOW RATE: 565 NM3/H" Stands replaced as: "NORMAL FLOW RATE: 560 NM3/H"
21.	Tender Doc_Part 4	Pg.2059 of 7166	Process datasheet No.: B269-475-17-44-DS-1056, Rev 0		Backwash Waste Holding Sump-II	<u>Modification:</u> The Material of Construction for "INTERNAL PAINTING/ COATING/ LINING" stands replaced as: "Epoxy Screed Lining"
22.	Tender Doc_Part 4	Pg.2110 of 7166	Process datasheet No.: B269-475-17-44-DS-1104, Rev 1		Caustic Storage Tanks (20%)	<u>Addition:</u> The following Note is added to the Process Datasheet: "3. Inter tank transfer facility for caustic shall be provided."
23.	Tender Doc_Part 4	Pg.2124 of 7166	Process datasheet No.: B269-475-17-44-DS-1119, Rev 2		Morpholine Solution Dosing Pumps (RODMP)	<u>Modification:</u> The data for "Liquid Handled" shall be read as: "10% Morpholine solution"

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24.	Tender Doc_Part 5	Pg.2165 of 7166	Process datasheet No.: B269-476-17-44-DS-1004, Rev 0		Activated Carbon Filters (Primary & Secondary) (CPU P25)	<u>Modification:</u> The “DETAILS OF INTERNAL PROTECTION: EPOXY COATED” Stands replaced as: “DETAILS OF INTERNAL PROTECTION: GLASS FLAKED VINYL ESTER LINING”
25.	Tender Doc_Part 5	Pg.2167 of 7166	Process datasheet No.: B269-476-17-44-DS-1005, Rev 0		Mixed Bed Exchanger	<u>Modification:</u> The “HEIGHT OF EXCHANGER (T/T) m: 2.6” stands replaced as: “HEIGHT OF EXCHANGER (T/T) m: 2.8”
26.	Tender Doc_Part 5	Pg.2459 of 7166	Schematic flow diagram: B269-475-17-44-0101 (Sht. 1 of 2), Rev 0		SFD for RODMP	<u>Deletion:</u> The line from “RWTP HRSCC Clarified Water” to “UF-I Feed Collection Tank” stands deleted. AND “CIO2 Dosing” in “CTBD Inlet Line” AND “ETP Treated Effluent Line” stands deleted.

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27.	Tender Doc_Part 5	1. Pg.1955 of 7166 2. Pg 1982 of 7166 3. Pg 1983 of 7166	RWTP Process datasheet No. 1. B269-472-17-44-DS-1022, Rev 1. 2. B269-472-17-44-DS-1049, Rev 1. 3. B269-472-17-44-DS-1050, Rev 1.		1. Fe ₂ (SO ₄) ₃ /PAC solution dosing pumps 2. Treated Water Reservoir 3. Treated Water Sump	<u>Modification:</u> The following Process datasheets are attached which shall supersede the previous revision: 1. B269-472-17-44-DS-1022, Rev 2. 2. B269-472-17-44-DS-1049, Rev 2. 3. B269-472-17-44-DS-1050, Rev 2.
28.	Tender Doc_Part 4	1. Pg.2005 2. Pg 2006 3. Pg 2013 4. Pg 2033 5. Pg 2050 6. Pg 2057 of 7166	RODMP Process datasheet No. 1. B269-475-17-44-DS-1010, Rev 2 2. B269-475-17-44-DS-1011, Rev 0 3. B269-475-17-44-DS-1018, Rev 1 4. B269-475-17-44-DS-1034, Rev 0 5. B269-475-17-44-DS-1050, Rev 0 6. B269-475-17-44-DS-1055, Rev 1		1. Filter Backwash Pumps-I 2. Filter Air Scour Blowers-II 3. UF Skids-I 4. Degassed Water Tank 5. Dual Media Filter-II 6. UF Skids-II	<u>Modification:</u> The following Process datasheets are attached which shall supersede the previous revision: 1. B269-475-17-44-DS-1010, Rev 3 2. B269-475-17-44-DS-1011, Rev 1 3. B269-475-17-44-DS-1018, Rev 2 4. B269-475-17-44-DS-1034, Rev 1 5. B269-475-17-44-DS-1050, Rev 1 6. B269-475-17-44-DS-1055, Rev 2
29.	1. TA-01 2. Tender Part 5 3. TA-01 4. Tender Part 5 5. Tender Part 5 6. Tender Part 5	1. 49 of 94 2. 2444 of 7166 3. 50 of 94 4. 2454 of 7166 5. 2456 of 7166 6. 2457 of 7166	RWTP P&ID No. 1. B269-17-44-472-1111, Rev 2 2. B269-17-44-472-1118, Rev 1 3. B269-17-44-472-1119, Rev 2 4. B269-17-44-472-1128, Rev 1 5. B269-17-44-472-1130, Rev 1 6. B269-17-44-472-1131, Rev 0	-	1. Battery Limit 2. Ultra Filtration Skids 3. Treated Water reservoir 4. Lime Dosing System 5. HCl dosing system 6. CEB-I/II/III dosing system	<u>Modification:</u> The following P&IDs are attached which shall supersede the previous revision: 1. B269-17-44-472-1111, Rev 3 2. B269-17-44-472-1118, Rev 2 3. B269-17-44-472-1119, Rev 3 4. B269-17-44-472-1128, Rev 2 5. B269-17-44-472-1130, Rev 2 6. B269-17-44-472-1131, Rev 1

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30.	Tender Doc_Part 5	1. Pg.2464 2. Pg.2465 3. Pg.2477 4. Pg.2479 5. Pg.2494 6. Pg.2495 7. Pg.2500 8. Pg.2503 9. Pg.2508 of 7166	RODMP P&ID No. 1. B269-17-44-475-1111 (Sht1), Rev 2 2. B269-17-44-475-1111 (Sht 2), Rev 2 3. B269-17-44-475-1122, Rev 0 4. B269-17-44-475-1124, Rev 0 5. B269-17-44-475-1139, Rev 1 6. B269-17-44-475-1140, Rev 1 7. B269-17-44-475-1145, Rev 2 8. B269-17-44-475-1148, Rev 1 9. B269-17-44-475-1153, Rev 1	-	1. Battery Limit Interface 2. Battery Limit Interface 3. UF-I Skids 4. RO-I Cartridge Filters 5. UF-II Skids 6. Backwash Waste Holding Sump & Pump-I/II 7. Zero Liquid Discharge Plant 8. Caustic Storage & Dosing System 9. 20% Caustic Storage and Transfer System	<u>Modification:</u> The following P&IDs are attached which shall supersede the previous revision: 1. B269-17-44-475-1111 (Sht1), Rev 3 2. B269-17-44-475-1111 (Sht 2), Rev 3 3. B269-17-44-475-1122, Rev 1 4. B269-17-44-475-1124, Rev 1 5. B269-17-44-475-1139, Rev 2 6. B269-17-44-475-1140, Rev 2 7. B269-17-44-475-1145, Rev 3 8. B269-17-44-475-1148, Rev 2 9. B269-17-44-475-1153, Rev 2
31.	Tender Doc_Part 5	1. Pg.2511 2. Pg 2512 3. Pg 2514 4. Pg 2517 of 7166	CPU P&ID No. 1. B269-17-44-476-1111, Rev 2 2. B269-17-44-476-1112, Rev 1 3. B269-17-44-476-1114, Rev 0 4. B269-17-44-476-1117, Rev 0	-	1. Condensate Polishing Unit 2. CPU Feed Tank & Pumps 3. MB Exchanger 4. Heat Exchanger and Trim Cooler	<u>Modification:</u> The following P&IDs are attached which shall supersede the previous revision: 1. B269-17-44-476-1111, Rev 3 2. B269-17-44-476-1112, Rev 2 3. B269-17-44-476-1114, Rev 1 4. B269-17-44-476-1117, Rev 1
32.	-	-	B269-02-42-00-1191 & 1192 Rev 1		Legend Sheets	<u>Addition:</u> The following P&IDs are added as part of tender document: “P&ID of Standard symbols and nomenclature.”

List of Attachments:

1. Scope of Works/Supply for RWTP (Doc. No. B269-472-17-44-SS-1001 Rev 2, Total pages 21)
2. Process Design Basis RODMP & ZLDP (Doc. No. B269-475-17-44-DB-1001 Rev 4, Total pages 21)
3. Scope of Works/Supply for RODMP (Doc. No. B269-475-17-44-SS-1001 Rev 5, Total pages 42)
4. Scope of Works/Supply for ZLDP (Doc. No. B269-475-17-44-SS-1002 Rev 3, Total pages 27)
5. Scope of Works/Supply for CPU (P-25) (Doc. No. B269-476-17-44-SS-1001 Rev 2, Total pages 19)
6. Scope of Works/Supply for CPU (PNCP COMPLEX) (Doc. No. B269-81-17-44-SS-1001 Rev 2, Total pages 19)
7. Equipment List of RODMP (Doc No. B269-475-17-44-EL-1001 Rev 5, Total pages 17)
8. Process Datasheets of RWTP (Total pages 3)
9. Process Datasheets of RODMP (Total pages 9)
10. P&I Diagrams RWTP (Total pages 6)
11. P&I Diagrams RODMP (Total pages 9)
12. P&I Diagram of CPU P-25 (Total pages 4)
13. Legend Sheets (Doc No. B269-02-42-00-1191, 1192, Rev 1, Total 5 pages)
14. Technical Amendment- 01 Process (Total No. of pages 35)
15. Technical Amendment-01 Electrical (Total No. of Pages 230)
16. Technical Amendment-01 SME(RED) (Total No. of Pages 100)

SCOPE OF WORKS / SUPPLY (PLOT PLAN AND WATER)

RAW WATER TREATMENT PLANT (RWTP)

PROJECT : PANIPAT REFINERY EXPANSION (P-25) PROJECT

OWNER : IOCL

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B269

2	22.02.2022	ISSUED FOR TECHNICAL AMMENDMENT-01	DD	VS	PKG
1	25.05.2021	REISSUED FOR TENDER	DD	VS	PKG
0	05.05.2020	ISSUED FOR TENDER	DD	VS	PKG
Rev. No	Date	Purpose	Prepared By	Checked by	Approved by

1.0 INTRODUCTION

Indian Oil Corporation Limited (IOCL) operates 15.0 million metric tons per annum (MMTPA) refinery at Panipat in state of Haryana, India. The refinery is currently implementing facilities to manufacture 100% BS-VI fuel mandated by Auto Fuel Policy.

In order to meet the demand growth of petroleum products and also to increase its profitability and competitiveness in the long run, IOCL intends to enhance the refinery capacity from 15 to 25 MMTPA. The Expansion Project consists of a new Crude / Vacuum Distillation unit (CDU/VDU) of capacity of 10 MMTPA followed by a SR LPG Treater (SR LPGT), MS Block comprising of Naphtha Hydrotreater (NHT), Catalytic cracking reformer unit (CCRU) & Isomerization Unit, Alkylation / Sulphuric Acid Regeneration Unit (SARU), Diesel Hydrotreater (DHDT), Vacuum gasoil Hydrotreater (VGO-HDT), Resid Hydrocracker Unit (RHCU), INDMAX including CR LPG Treater (CR LPGT) followed by a Propylene recovery unit (PRU). A new Polypropylene (PP) unit and Catalytic Dewaxing Unit (CDWU) are included as value augmentation unit. Auxiliary facilities i.e., Hydrogen generation unit (HGU), Sour water stripper (SWS)/ Amine regeneration Unit (ARU) and Sulphur recovery unit (SRU) and Utility / Offsite (U&O) facilities for the entire project are included in the facility.

Engineers India Limited has been retained by IOCL as the Engineering and Project Management Consultant (EPCM) for the Upgradation Cum Expansion project and for design of all open art facilities which include AVU, PRU, SWS, ARU and the U&O facilities. Basic Engineering Design Basis (BEDB) for all facilities, containing technical information decided between IOCL and EIL, shall be binding on the process design and engineering of units, utility systems and offsite facilities.

A Raw Water Treatment Plant (RWTP) is envisaged to cater to the treated raw water requirements of the Refinery and Petrochemical Complex. The Raw Water Treatment Plant is part of the Common Water Treatment Block consisting of RWTP, RO based DM Plant, Condensate Polishing Unit and Zero Liquid Discharge Plant.

This document specifies the scope of Works / Supply and Technical Specifications for the Raw Water Treatment Plant (RWTP) which shall be followed by the Contractor as a minimum.

The Design Capacity of the Raw Water Treatment Plant shall be 2400 m³/hr of Net Treated Raw Water production on continuous basis.

2.0 DETAILED SCOPE OF SUPPLY / WORK

The scope of work for the Raw Water Treatment Plant (RWTP) shall be as follows but not limited to as given herein:

The scope of work shall include Project Management; Residual Process Design & Detailed Engineering; Procurement; Fabrication; Inspection; Supply; Manufacture; Transportation of all equipment/materials to the work site & Storage at site; assembly, erection & installation; Construction and Erection of Civil & Structural, Mechanical, Electrical, Instrumentation & Piping works; Acid /Alkali resistant proof tiling; Painting; Testing; Pre-commissioning, trial run for 30 days before commissioning; commissioning; Training of IOCL's personnel; performance guarantee test run for 72 hours continuous operation in presence of IOCL's & EIL's Representatives; Guaranteeing and handing over of Raw Water Treatment Plant (RWTP) to the Client on lump sum turnkey basis as per design basis, equipment list, standards, P&IDs, data sheets, drawings, etc., all complete within Contractor's specified battery limits including supply of spares, chemicals & consumables. The Contractor shall be required to obtain all statutory approvals for completion of his scope of work.

HAZOP for the complete Raw Water Treatment Plant (RWTP) including implementation of HAZOP recommendation shall be under contractor's scope of work. HAZOP chairman shall be engaged by the contractor at his own cost and his CV shall be submitted by the contractor to EIL/IOCL for acceptance. HAZOP requirements shall be as per the HAZOP specifications attached elsewhere in the tender.

3D modeling (in latest software version) for the Raw Water Treatment Plant (RWTP) shall also be included in scope of work of the contractor.

SMART P&IDs shall be prepared for the plant during detailed engineering review and as built. 2

All equipment described in these specifications; datasheets & equipment list; as shown in the P&IDs & PFDs; as mentioned elsewhere in the tender document or as necessary for completeness but not listed above shall also be deemed to have been included in Contractor's scope. All works required to meet requirements given in design/process/operation requirements defined elsewhere in the bid document shall also be deemed to have been included in Contractor's scope.

Contractor's scope of work/supply also include the following:

- Operation and Maintenance of the Raw Water Treatment Plant (RWTP), RO-MB based DM Plant (RO-DMP), Zero Liquid Discharge Plant (ZLDP) & Condensate Polishing Unit (CPU) for a period of TWO (2) YEARS after successful commissioning. Contractor's Scope of

Works / Supply during the Operation & Maintenance Contract shall be as per the O&M Specifications No. B269-472/475/476-17-44-SS-1003.

2

2.1 PROCESS

Process documents enclosed are the basic documents and are to be followed for execution of job leading to successful commissioning and performance guarantee test run of the Plant. During the course of execution, updating/modification to the process documents that would become necessary is to be carried out with the approval of EIL/IOCL. The resultant work arising out of this will also form the part of scope from detailed engineering to handing over of the plant with no cost implication to IOCL.

The tender specifies the scheme (refer to the PFDs and P&IDs attached in relevant sections in tender documents) & Contractor's scope of supply in subsequent sections of this document as minimum requirements. Bidder may include in his scope any additional requirements, if so warranted to meet process guarantees and for smooth, safe and trouble free operation of the plants.

2.2 ENGINEERING

The design basis, data sheets, drawings, standards, specification, codes to be followed for different types of works are brought out in the various engineering sections forming part of the tender document. Contractor shall carry out residual process design & detail engineering works for the plant and submit various drawings and documents for approval of EIL/IOCL before these are released for construction.

2.3 CONSTRUCTION AND INSTALLATION

These activities shall be carried out by the contractor as specified elsewhere in the tender document.

2.4 QUALITY ASSURANCE

These activities shall be carried out by the contractor as specified elsewhere in the tender document.

2.5 STATUTORY CLEARANCES

All the applicable safety codes, national laws and local regulations shall be followed by the successful bidder for the design, engineering, fabrication, erection, commissioning & handing over of the Plant / Equipment and necessary approvals shall be obtained from the concerned statutory authorities by the contractor. Statutory bodies from which approvals may have to be

taken include State Pollution Control Board, Chief Inspector of Boilers / IBR, Factory Inspectorate, Labour Authorities, Electrical Inspectorate and Chief Controller of Explosive, Directorate General of Mines and Safety requirements, etc. The contractor shall ascertain requirement of approvals as applicable in such plants and initiation of action as required shall be in contractor's scope.

2.6 SAFETY

These activities shall be carried out by contractor as specified elsewhere in the tender document. All safety procedures for different types of work as per the safety rules from time to time by EIL/IOCL shall be binding and adhered to by the contractor. Safety report generation for different situations as per the rules and required by EIL/IOCL are to be adhered to. HSE policy of IOCL shall be binding upon the contractor.

2.7 VENDOR LIST

For most of the systems/equipment, the approved vendor list of EIL is enclosed in the bid document, which shall be adhered to. While for other items, not listed in the approved vendor list, the suppliers who would be involved for design, engineering and supply of equipments and materials are to be proposed by the contractor (for EIL/IOCL approval) during detailed engineering with the documentary evidence of having supplied similar equipment, systems and/or materials for similar applications with proven track record. Any change for new contractor/supplier after award of contract for supply will not be permitted. It will be necessary to purchase certain items as a system and not as individual equipment. These have to be identified and furnished during detailed engineering for approval of the EIL/ IOCL.

2.8 WASTE DISPOSAL

All wastes generated like surplus earth after use/surplus construction materials to be disposed off from time to time by the contractor to the disposal locations as directed by the Engineer-in-Charge.

However, disposal of dewatered 'chemical sludge' generated from operation of RWTP is excluded from contractor's scope of work and the same shall be disposed off outside RWTP by M/s IOCL (including transportation through tractor trolley). However, disposal of sludge during commissioning and PGTR shall be in contractor's scope.

2.9 DESCRIPENCIES / VARIATIONS IN SPECIFICATIONS / STANDARDS

Bidders may bring out variations, deviations, if any, in related data sheets, equipment list, drawings, specifications, standards, codes, scope and any other contractual clauses before submission of bids and seek clarifications. In case of any contradiction on specification brought

out at the post award stage of job, decision of EIL/ IOCL shall be final & binding upon the Contractor without any time & cost implication.

2.10 SUPPLY OF CONSUMABLES & CHEMICALS

Supply of all chemicals (except HCl & NaOH), spares and consumables required for Operation and Maintenance of the Raw Water Treatment Plant (RWTP) during start-up, pre-commissioning, 30 days trial runs and up to successful commissioning shall be in the scope of supply of the LSTK contractor. Special chemicals required, if any, shall be clearly defined by the contractor with respect to quality and quantity and the supply of the same shall also be in Contractor's scope. Minimum two nos. of manufacturers shall be specified by the bidder for these special chemicals. Unloading, handling and storage of all chemicals and consumables (including provision of necessary facilities) shall be done by the contractor.

Also, contractor's scope regarding supply of chemicals, spares, consumables and other requirements during the Two year Comprehensive Operations & Maintenance Contract duration shall be as per Specifications No. B269-472/475/476-17-44-SS-1003.



2.11 SPARES

2.11.1 MANDATORY SPARES

Contractor's scope regarding supply of mandatory spares shall be as per the specifications attached in the tender.

2.11.2 ERECTION & COMMISSIONING SPARES

Contractor shall ensure adequate supply of all spares as required by him for successful erection & commission of the plants till handing over to the client. The lump sum price quoted shall be deemed to be inclusive of cost of such spares.

2.11.3 SPECIAL TOOLS AND TACKLES

Contractor shall ensure supply of all special tools and tackles for commissioning of the entire plants till handing over. The lump sum price quoted shall be deemed to be inclusive of cost of such tools and tackles.

2.11.4 TWO YEARS RECOMMENDED SPARES

Two years normal operation spares required are to be identified by the bidder and shall be in the bidder's scope during the Two Years Operation and Maintenance Contract. These Spares

as identified by the Bidder shall be over and above the minimum spares list as indicated in the Annexure-1 of the O&M Specifications document No. B269-472/475/476-17-44-SS-1003.

2.11.5 STORAGE OF SPARES

All spare parts supplied by the bidder shall be properly wrapped, packaged and stored by the contractor so that they will be preserved in original and new condition under the normal conditions of storage to be anticipated in India and shall be properly tagged and coded so that later identification as to intended equipment usage will be facilitated. They shall be packed separately clearly marked as 'spare parts'. Packing lists shall be furnished so that the parts can be handled without uncrating if desired.

2.12 MECHANICAL COMPLETION / PRE-COMMISSIONING / COMMISSIONING / GUARANTEE & TOLERANCES

Mechanical Completion

Mechanical completion of the Plant shall mean that all installations works of the Plant have been completed and hydrotested in accordance with approved construction drawings, approved specifications, applicable codes, accepted International good engineering practices and all the activities have been completed in a comprehensive manner by the Contractor.

Pre-Commissioning

Pre-commissioning activities are defined as those activities which are required to be performed after completion / installation, inspection, hydrotesting, etc. of the Plant to make it ready for commissioning.

Commissioning

The Plant shall be considered "Ready for Commissioning" when 30 days trial runs are over and all the facilities have been completed along with their auxiliaries and support facilities in every respect including charging of lubes, chemicals, consumables, preparation of solution, etc. as recommended by IOCL / EIL in standard format with all exceptions, if any, resolved.

Commissioning of the Plant shall mean taking the feed in the system, passing it through normal route and establishing the process control parameters. The Plant shall be considered to be commissioned successfully with instrumentation / control system, process, utilities & support system have been on uninterrupted stable operation for not less than 72 hours while producing treated raw water of desired quality. Whether the 72 hours operation has been successful or not shall be decided by IOCL/EIL based on observations recorded during 72 hours. The countdown for 72 hours operation shall start on after the system has been on stable operation with all controls and safety systems in normal operation for a period of not less than 48 hours.

GUARANTEE

Contractor shall guarantee the following parameters (details as specified in clause no. 2.13 below):

- Hydraulic capacity of the plant (including recoveries)
- Treated Raw Water quality
- Life of membranes (warranty shall be offered to IOCL directly from the membrane supplier)

TOLERANCES

The guaranteed figures are subject to the following tolerances for acceptance of the plant.

- Capacity measurement $\pm 2\%$.
- Quality measurement as per accuracies guaranteed by the instrument supplier.

In case of any variation over the tolerances given above, contractor shall rectify the plant at his own cost within a time mutually agreed upon by the contractor and IOCL/EIL to bring the plant performance in line with the guaranteed figures.

2.13 PERFORMANCE AND GUARANTEES

- After the system has been stabilized by the contractor during 30 days trial runs and plant is successfully commissioned, the contractor shall conduct a performance guarantee test run for the Raw Water Treatment Plant (RWTP). The procedure for performance testing shall be submitted by the contractor to the EIL / IOCL for review & approval. The duration for the performance guarantee test run shall be 72 hours continuous operation of the plant.

The performance guarantee test run for Raw Water Treatment Plant (RWTP) shall be carried out at the design conditions (including design capacities & design feed raw water quality) at RWTP inlet as specified in the Process Design Basis (Doc. No. B269-472-17-44-DB-1001).

During the performance guarantee test runs, the following guarantee parameters shall be fulfilled (within the tolerances as specified) at design conditions as specified above.

Guaranteed Hydraulic Capacity of the Plant

System/Parameter	Value
Hydraulic Capacity of RWTP (Treated Raw Water)	2400 m ³ /hr
Hydraulic Capacity of each UF Skid (Net Permeate)	400 m ³ /hr @ 90% Recovery

☞ **Guaranteed Quality Parameters (at Outlet of UF Skid)**

S. No.	Parameter	Unit	Value
1.	Turbidity	NTU	< 1
2.	Silt Density Index (SDI)	-	< 3
3.	Total Suspended Solids (TSS)	mg/l	< 0.5
4.	Iron	mg/l	≤ 0.1

- In case the designed feed quantity & quality is not available as specified in the tender document, the PGTR may be carried out (if so desired by M/s IOCL) for the actual conditions within the design conditions for the plant, while performing to the desired treated outlet quality as per the requirement of the tender.
- Any loss of consumable/material during pre-commissioning, trial runs, commissioning, etc. prior to handing over of plant to IOCL shall be made up by the contractor to the quantities specified in the design calculations as initial charge without any extra time & cost to IOCL.
- If on testing, any material or equipment or the unit does not meet the design, rated or guaranteed performance related there to, the contractor shall forthwith, within the scope of work of contractor and at no additional cost to IOCL, undertake such additional tests and / or operations as are necessary to identify the cause of such failure. Such tests and / or operations shall be conducted in conjunction with IOCL, if the plant as a whole fails to meet the guarantees.
- If as a result of such tests and / or operations it is determined that the design, rated and / or guaranteed outputs or capacities have not been met because of defect in any material(s) (including machines and equipment) supplied by the Contractor, the Contractor shall forthwith in consultation with the Engineer-in charge take steps necessary to cause the defect to be identified and rectified, either by replacement of the defected material, machine or equipment or part thereof or by repair or replacement thereof at sole cost and expenses of Contractor.
- In the event that certain of the guaranteed performance have not been met, the Contractor shall make suitable additions, deletions or modifications, if required after obtaining approval of IOCL /EIL to the process and the Plant to ensure the guaranteed results.

2.14 GUARANTEED LIFE OF MEMBRANES

Guaranteed membrane life for UF membranes in the RWTP shall be for a period of 5 years from the date of successful commissioning. During this period of guarantee, guarantees for membranes for first year shall be absolute (full replacement without any cost to the IOCL) and

for subsequent years the guarantees for UF membranes shall be on pro-rata basis as offered by the membrane suppliers in line with internationally acceptable norms.

2.15 PROJECT MANAGEMENT

Effective project management within time frame is also a part of the contractor's scope. The system of organization & control; feedback & corrective measures; communication & project execution scheme to be submitted.

Planning, scheduling and monitoring is essential for timely completion of the project and effective project management system to be adopted as enumerated.

3.0 BATTERY LIMIT CONDITIONS

Raw Water line, treated raw water lines and various other incoming and outgoing lines to and from Raw Water Treatment Plant (RWTP) shall be as indicated in the Process Design Basis and other tender document drawings.

INCOMING AND OUTGOING LINES Service	Parameter	Unit	Min	Nor	Max	Mech. Design
INCOMING LINES						
Raw Water	Press	Kg/cm2g	2.0	2.0	3.0	10.5
	Temp	°C		Amb		65
OUTGOING LINES						
Cooling Water / DM Plant Make-up	Press	Kg/cm2g	As per Process Datasheet No. B269-472-02-42-DS-1901			
	Temp	°C				
Service Water	Press	Kg/cm2g	As per Process Datasheet No. B269-472-02-42-DS-1602			
	Temp	°C				
Drinking Water	Press	Kg/cm2g	As per Process Datasheet No. B269-999-81-41-DS-44801			
	Temp	°C				
Treated Backwash Water to Reservoir	Press	Kg/cm2g	3.0	3.5	4.0	10.5
	Temp	°C		Amb		65

The following utilities will be supplied at the common battery limit of the RWTP/RODM/ZLDP / CPU battery limit:

- Plant Air
- Instrument Air
- Power
- Fire Water
- LP Steam
- Cooling Water

4.0 SCOPE OF CONTRACTOR'S WORK/ SUPPLY (ISBL)

The Contractor's scope of supply of equipments as minimum shall be as given in the Process Design Basis, Equipment List, Process Datasheets, PFD, P&IDs, and as specified elsewhere in the Tender Document.

All works required inside the battery limit of Raw Water Treatment Plant (RWTP) for treatment including all other associated facilities as per tender requirements shall be in contractor's scope of supply.

For all the equipments listed in tender or as required to make the plant complete in all respects to deliver the required quantity & quality of treated products, the contractor has to supply piping, valves and fittings, instruments, electrical items, consumables, etc. and all other items as indicated in the equipment list, datasheets, P&IDs, PFDs etc., or as required to make the plant complete with respect to safe trouble free operation of the plant.

The proposed Raw Water Treatment Plant (RWTP) shall be designed for the conditions as specified in the Process Design Basis documents and as described in the subsequent sections of this specification and as described elsewhere in the Tender Document.

Equipment list for the Raw Water Treatment Plant (RWTP) shall be as per the Equipment List, Document No. B269-472-17-44-EL-1001 attached with the tender. Bidder may include in his scope any additional requirements / equipments, if so warranted by him, in order to meet the guarantees as specified in Clause No. 2.13 of this specification.

Also, all other works (including Mechanical, Electrical, Instrumentation, Civil & Structural works) mentioned elsewhere in the tender document or as shown in the drawings but not listed herein shall also be deemed to have been included in contractor's scope of work.

The RWTP shall be controlled from a Dedicated PLC based Control System located in the Control Building which shall house the Substation and Control room along with associated facilities for the RWTP.

All signals of the RWTP shall be routed to the RWTP PLC in the Control Room for Monitoring and Control of the RWTP. Separate Operator consoles shall be provided for the RWTP in the Common Control Room. All Signals of the RWTP shall be repeated in the MCR of the Refinery for Monitoring.

The detailed Instrumentation Scope of Works / Supply shall be as detailed in the Instrumentation Specifications provided in the Tender.

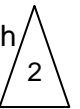
Power for the RWTP shall be supplied from the Substation housed in the Control Building for the RWTP Plant. All Motor Controls shall be located in the Substation.

The Detailed Electrical Scope of Works and Supply shall be as detailed in the Electrical Specifications provided in the Tender Document.

The contractor shall provide one Double Storied CHEMICAL HOUSE BUILDING within the battery limit of RWTP to house chemicals required for twenty days requirement based on chemical solution strengths & dose rates specified in the datasheets, otherwise as per process requirements & shelf life.

The proposed chemical house building shall have provision to store chemicals on ground floor of the chemical house building & chemical dosing facilities (tanks/pumps/agitators/etc.,) on first floor (except lime) of the chemical house building. Other facilities to be provided in the chemical house building shall be as per the process datasheet of chemical house. Each dosing tank in solution preparation area shall have working platform guarded by handrails and its floor shall be made of nonskid galvanized plate/ chequered plates. Width of platform shall be 1.5 m minimum and access steel stairs (both sides of the platform) shall be of minimum 1000 mm width. All fixing arrangements on platform shall be by bolting and not by welding.

Acid shall be made available from RWTP by RWTP contractor at ETP battery limit on south side interface road between RWTP & ETP.



The sewage generated from the buildings of raw water treatment plant shall be routed to OSBL and connected to nearest hook up point of the plant sewer network at the OSBL.

Since the RWTP shall be commissioned before commissioning of Compressed air system (Plant Air & Instrument Air), Supply of Instrument Air for the RWTP till commissioning and for further 3 Months operation after commissioning of RWTP shall be in scope of Contractor. The quantity and quality of the instrument air required for the operation of the RWTP shall be ensured by the Contractor during commissioning and 3 months Operation of the Plant.

Utilities required for the supply of Instrument Air for the RWTP till commissioning and 3 months operations after commissioning shall be in scope of RWTP contractor.

A UF Skids and following associated Items / Equipments of the RWTP shall be provided by the Contractor in the UF Shed.

- Auto backwash filters of the RWTP
- UF Skids of the RWTP

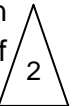
- CEB/CIP Tanks and CEP/CIP Pumps for the RWTP UF Skids System
- Common Analyzer Room (with Air conditioner)

The UF permeate water from the UF skids shall be routed to the Treated Water Reservoir with a parallel connection to the drinking water sump.

Treated Water Reservoir including Treated Water Sump & Drinking Water Storage Sump as per the Equipment List are also to be provided as part of the Raw Water Treatment Plant and shall be in the scope of the Contractor.

Chemical Sludge handling & dewatering facilities (including sludge sump, sludge transfer pumps, centrifuge, etc.) shall be provided by Contractor.

A Centrifuge Building which shall be provided for housing the Dewatering facilities of RWTP Plant shall also be provided by the Contractor. Centrifuges shall be located on first floor of the building, with dewatered sludge collected directly in tractor trolleys parked underneath on ground floor of the building. The trolley shall be in contractor's scope. However, disposal of sludge from trolley will be in IOCL's scope.



The Contractor shall also supply & install a **CHLORINE DIOXIDE Generation & Dosing System** for Pre-Chlorination of raw water in the RWTP and the scope for the same shall be as indicated but not limited to the following:

- 2 Nos. (1 working + 1 standby) of Automatic Chlorine Dioxide generators having minimum capacity of 5 kg/hr each.
- 1 (One) Nos. of on-line free residual ClO_2 analyzer with recorder in the Treated raw water line at the inlet of the Treated Water Reservoir shall be provided.
- Bulk Storage Tank and unloading Pumps for HCl & NaClO_2 shall be provided as per process datasheet of the respective equipment.
- Dosing pumps for HCl and NaClO_2 shall be provided as per process datasheet of the respective equipment.
- Booster (Dilution) Water Pumps shall be provided for supplying water to the ClO_2 generators. The Pumps shall draw water from the UF backwash tank.
- Generators must be equipped with systems of dosing and/ or measurement for reagents and diluting water. These systems must be able to shut down the operation of the generator in case any of the supplies is cut off.
- ClO_2 leak sensor with detector shall be installed at ClO_2 generator room. The least count of sensor shall be 0.1 ppm and generator shall stop automatically.

- All other instruments like pressure gauges, pressure relief valves, level indicators, compound gauges, etc. as required for safe & trouble free operation of the system. All level transmitters shall be non contact radar type.
- Complete piping (with diffusers) from Chlorine Dioxide generator to respective dosing location/point with flow control valves, drain valves, Y-strainers, vents, ejector, etc. The diffuser shall be of HDPE (A1Z).
- Complete piping (including interconnecting), all fittings, bends, tees, reducers, valves, flanges, bolts, gaskets, specials, isolation valves, permanent strainers, etc., including pipe racks/sleepers and supports, jointing, etc., and any other work as required for the system as per EIL piping specifications, P&ID, process flow diagram etc.
- ClO₂ generator equipment room and control room shall be provided in a separate room in the Ground Floor of the Chemical House building.
- 1 (One) No. Safety shower and eye wash facility (located inside the Chlorine-dioxide generator room).
- Pressure indicator and flow meter with controller shall be provided on water inlet pipe to generator.
- In case of water supply to the generator stops, the chemical dosing pumps shall also stop automatically.
- Any other item(s) if required for completeness of the system, safety requirements and to make the system operational.
- Painting of exposed pipelines, steel structures, equipments operating platforms, ladders, stairs, hand railing, etc., as required and as per specification.
- Complete Civil & structural, mechanical, electrical and instrumentation works for the system.
- Approvals, as applicable, from any regulatory/statutory body shall be in the scope of contractor.
- Safety equipments – Chlorine institute approved shall have 2 (Two) nos. respiratory equipment (pressure demand type air masks-full face for working in leak area), 2 (Two) nos. canister type gas mask, 2 (Two) nos. of ammonia torches, 2 (Two) Nos. of emergency repair kit, One No. Weather sock provided at a suitable location on the building, 2 (Two) each of Safety helmets, goggles, rubber boots, gloves and colored vests

(aprons), Display charts of PFD, Safety checks, maintenance procedure, Emergency Action Plan, etc.

Datasheet for ClO₂ generator system shall be prepared and submitted by the system supplier during detail engineering for EIL's review & approval. Capacity indicated is minimum requirement. In case higher capacity is envisaged by the bidder, the same to be considered & provided by the bidder.

The ClO₂ Generator System shall be of Approved make as per the EIL Approved Supplier List provided in the Tender Document

5.0 GENERAL DESIGN & ENGINEERING REQUIREMENTS

➤ Line Size Criteria to be based on following pipe/line velocities:

☞ Pump Discharge	:	2.0 m/sec (maximum)
☞ Pump Suction	:	1.2 m/sec (maximum)
☞ Gravity Lines	:	0.8 m/sec (maximum)

➤ Piping class shall be as given below for the indicated services. Corresponding material shall be as per EIL Piping Specifications.

Service	Piping Class
Raw Water & Treated Raw Water	A93A
Sludge Lines	A9A
Lime	A91S (CPVC)
Fe ₂ (SO ₄) ₃ /PAC Solution	A1K
PE	A1K
DWPE	A1K
Acid Solution	A91S (CPVC)
Caustic Solution	A19A
NaClO ₂	A91S (CPVC)
ClO ₂	A91S (CPVC)
Service Water	A93A
Plant Air	A3A
Instrument Air	A93M (upto 4" size)
Drinking water (AG/UG)	J92A
Fire Water	A91Y
LP Steam	A2A-IH

2

Service	Piping Class
Cooling Water Supply & Cooling Water Return	A93A (AG) (0.5"-16") A92A (U/G) (burial depth upto 3.0 m)
<p>For all incoming lines, same class of piping, as available at the Plant battery limit, shall be used up to their respective first unit.</p> <p>Material, for services not listed here, shall be subject to EIL's review and approval during engineering.</p> <p><u>In case, different material & line size is specified in the tender drawings (Schematic Flow Diagram, PFDs/SFDs, P&IDs, etc.), the material & line size specified in the drawings shall be provided as a minimum.</u></p>	

- Following types of valves shall be used for the Indicated Services.

Service	Valve Type
Raw Water Lines/Treated Raw Water Lines	Gate, Globe Valve & Butterfly Valves
Sludge Lines	Gate Valve / On/Off Valves shall be ball valves
Conc. Hydrochloric Acid	Ball Valve
Caustic Solution Lines	Plug Valve (Lubricated)
Chemical Solution Lines	Ball Valves / Diaphragm Valves
Sampling Lines	Gate followed by Globe Valve
<p>Other type of valves such as Check Valve (NRV), Control Valve etc. shall be provided, wherever required. Isolation valves shall be provided in each unit as per the valve specs. MOC of the valves shall be compatible with MOC of the pipe.</p> <p>Spectacle blinds shall be provided downstream of all tank drain lines as well as at other main isolation places, wherever required.</p> <p>Piping components and its type shall be provided, as appropriate, which shall be subject to EIL's review and approval during Detailed Engineering.</p>	
<p>All Butterfly Valves shall be double offset tight shut-off valves.</p>	
<p>Valves shall be provided as per the P&IDs.</p>	

- For a full liquid system at the discharge of centrifugal pumps/blowers, the design pressure shall be as under.

$$P(\text{des}) = P(\text{max}) \text{ suction} + \Delta P(\text{max})$$

where,

$P(\text{max}) \text{ suction}$ = Maximum pressure at suction vessel bottom during suction system relieving conditions.

$\Delta P(\text{max})$ = Pump differential pressure at pump shutoff head with maximum operating density. If not known:

$\Delta P(\max) = 1.2 \times \Delta H \times \text{Density}(\max)$: constant speed pump

$\Delta P(\max) = 1.1 \times 1.2 \times \Delta H \times \text{Density}(\max)$: variable speed pump

$\Delta P(\max) = 1.3 \times \Delta H \times \text{Density}(\max)$: high head multistage pump

$\Delta P(\max) = 1.3 \times 1.1 \times \Delta H \times \text{Density}(\max)$: variable speed high-head multistage Pump

Where, ΔH is the pump head at rated condition

Minimum Design Pressure shall be 2 kg/cm²g more than the operating pressure.

- For a full liquid system at the discharge of positive displacement pumps, the design pressure shall be the higher of:

$$P(\text{des}) = P(\text{rated}) \text{ discharge} + 2 \text{ kg/cm}^2$$

$$P(\text{des}) = 1.1 \times P(\text{rated}) \text{ discharge}$$

- All the pumps which are to be located below FGL shall have a suitable pump house building having RCC construction below FGL and RCC lintel and brick masonry work above FGL. All pump pedestals shall have arrangement for collection of leakage and connection to the nearest drain. Edges of pump pedestals in pump house shall be kept in one line on pump motor side so as to render clear walkway. The clear distance between adjacent pump/blower pedestals shall be minimum 900 mm. Minimum clearance of 500 mm shall be provided around pumps / blowers / equipment pedestal for paving, etc. applicable guidelines shall be followed for the minimum clearances between the adjacent equipments/pumps/blowers etc.
- **The complete battery limit area of Raw Water Treatment Plant (RWTP) shall be RCC paved as per the specifications given in the tender.**
- Cathodic protection shall be considered for all metal tanks which are not provided on RCC / Pile foundation.
- Common delivery header and suction header of pumps (and blowers) shall be provided with a blind flange on one end. Recirculation lines for the pumps shall be provided by the vendor as indicated in the tender PFDs / P&IDs and also if envisaged as per process / turndown requirements.
- All working & standby pumps (including warehouse/store standby) shall also be provided with the respective motors. All motor shall have running indication in control room. Motors of all pumps and blowers, if not housed under shed/room, shall be covered with canopy. Suction line/filter of blowers shall also be provided with canopy.
- Rated capacity of all the blowers shall be minimum 10% more than the normal process requirements. Also, head of all the pumps shall be minimum 10% more than the total calculated

head (including static head and losses in pipes, fittings, instruments, etc.) based on normal process requirements. All sets of rotating equipments viz. pumps, blowers, compressors, etc. shall be provided with at least one standby of same capacity as the operating equipment.

- All Chemical Dosing Diaphragm Pumps shall be provided with pressure transmitters for Diaphragm Failure alarm.
- Chemical dosing pumps shall be designed to cater for minimum to maximum hydraulic requirements.
- All chemical dosing pumps shall be provided with pressure safety valves and pulsation dampeners on individual pump discharge.
- All chemical handling pumps shall have permanent flushing connection (inlet and outlet).
- All pumps shall be flooded suction type, unless otherwise specified, fully primed under Low Liquid Level in the suction sump/ tank. Also, for all pumps with flooded suction, LWL in the tank/sump shall be above the top of pump casing.
- Effective liquid depth (side water depth) of tank/ sump shall be considered between Low Water Level (LWL) & Top Water Level (TWL) and shall exclude free board & dead volume depth (liquid depth below LWL). The tank/sump floor shall slope towards suction pit/channel. All RCC sumps shall be made water tight and designed as water retaining structure as per engineering specifications. All above ground holdup tanks/ sumps shall be provided with overflow lines, drain etc., and provision shall be made to route the overflows from all the sumps, tanks and pump leakages to Backwash water holding sump.
- All Acid and NaClO₂ Bulk chemical storage tanks shall be located inside dyked areas (separate dykes for different chemicals), suitably lined (floor, inside dyke wall and all structures inside the dyked area) with acid/alkali proof tiling. Chemical drain lines shall also have Acid/alkali proof tiles. Dyke height shall be sufficient to hold total volume of chemical of the largest tank. Proper floor slope shall be provided for area drainage. Internal drainage of the dyked area shall be routed to neutralization pit with a provision to route to OWS/storm water sewer (with isolation valves). Minimum distance of dyke wall inside from tank shell shall be half the tank's total height. Also, minimum distance between the two tanks (shell to shell distance) inside the same dyke shall be one fourth the sum of diameters of the two tanks.
- All chemical dosing pumps & dosing tanks shall be located inside a kerbed area, suitably lined (floor, inside kerb wall and all structures inside the kerb area) with acid/alkali proof tiling. The pumps & tanks shall be located on elevated platform, with platform elevation higher than kerb height (minimum 150 mm). Proper floor slope shall be provided for area drainage. Internal drainage of the kerb area should be routed to neutralization pit. All drains from chemical

handling areas to be routed to Neutralization pit. Drains of all chemicals storage tanks shall be provided with spectacle blind in addition to valves.

- Flushing connections shall be provided in all chemical & sludge handling units & lines. Flow measurement shall be provided at all chemical dosing lines. Safety measures for hazardous chemical handling shall be strictly followed as per industry norms and manufacturers recommendation.
- Sufficient tanker parking space along with an unloading bay shall be provided near all chemical unloading pumps and entrance to chemical storage area in Chemical House.
- Plant air & Service water hose connection with flexible hose pipe with suitable length at pump houses, sludge handling area, chemical storage and handling area and others wherever applicable shall be provided. Safety Shower and eyewash facility, service water and plant air hose connection shall be provided near bulk storage & other chemical handling areas. FRP grating, hand rail and members shall be used in chemical and highly corrosive area.
- All piping at battery limit shall be left with flange connection. The ISBL piping shall be through pipe racks, pipe sleepers and trenches / underground lines as per the Engineering Specifications. U/G piping shall have a minimum cushion of 1.2 m below FGL. Wherever such cushion is not feasible, pipe shall be encased in R.C.C. pipe.
- All valves shall be located at operable height from the ground/permanent platform. Platform for operation of valves shall have a minimum width of 900 mm with galvanized grating / chequered plate. All below grade valves shall be operable from grade by providing extended spindle and hand wheel arrangement.
- All motorized valves and all auto ON/OFF valves shall have provision for manual override.
- All instrument indication facility shall be readable from grade.
- Access to the platform shall be by ladders. Access shall be by staircase if unit requires frequent attention of operating personnel. Approach & platform shall be provided wherever adjustable weir, instruments, measuring scale, etc. are kept. Adjoining units shall be connected with operating platform (with Hand-railing).
- **Monorail and Section pulley block (Manually operated) shall be provided for all pump houses, blower sheds, centrifuge building, etc.,** of adequate capacity (minimum 1.5 times the weight of heaviest equipment). Drop-out platform (minimum 1.5 m wide) shall be provided. Monorail shall be extended outside the Pump houses/sheds/ buildings to facilitate loading / unloading equipments directly on vehicle, for which ramp approach shall be given. Vehicular approaches shall be provided to units wherever required from maintenance / operation point of view.

- A monorail hoist (electrically operated) of adequate capacity (minimum 1.5 times the weight of heaviest equipment) along with cradle shall be provided in UF shed.
- Vehicular approaches shall be provided to units wherever required from maintenance / operation point of view.
- Contractor shall ensure adequate maintenance, operation and access space within the layout.
- The Equipment Layout shall be prepared such that all units are accessible for routine maintenance/repair. It shall also facilitate convenience for regular monitoring of units by operating staff. Road approach shall be provided for crane movement for all major and critical equipment. Rerouting or shifting of any under/above ground lines or facilities respectively, as may be required during the execution, shall be under the scope of contractor only.
- Draining arrangement and Neutralization Facility shall be provided for all units/equipment, as necessary.
- **Sampling points shall be provided for each treatment section including adequate sampling points for measuring water quality at intermediate points and chemical solution concentration.**
- All piping, instrumentation, electrical and other mechanical works as necessary are in Contractor's scope.
- Sizes/specifications as given in various datasheets of the tender are minimum requirements, which are to be followed by the bidders as a minimum. Higher sizes, if process design demands, shall be provided by the bidders at no extra cost to IOCL. These are part of the detail engineering review/approval by EIL.
- Type and minimum size of manholes (for pressure vessels, tanks, covered sumps, underground sewer etc.) shall be as per EIL standards. All vessels with a bottom manhole shall have a clear height of 1.2 m below the manhole elevation.
- The specifications/requirements are bare minimum only. The vendor shall follow good engineering practices and incorporate maximum operational flexibility in the system.

6.0 FORMAT FOR CHEMICAL AND UTILITY CONSUMPTION FIGURES FOR RWTP

6.1 Maximum Consumption Figures for Utilities

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/day (1 Day = 24 Hours)
Power	KW		
Service Water	m ³ /hr		
Drinking Water	m ³ /hr		

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/day (1 Day = 24 Hours)
Plant Air	Nm ³ /hr		
Instrument Air	Nm ³ /hr		
Fire water	m ³ /hr		
Any Other			

6.2 Maximum Consumption Figures For Chemicals

Description of Chemical	Dosing Rate in ppm (Nor. / Design)	Consumption in kg/d at Design Flow	Purity of Chemical	Solution Strength
Ferric Sulphate / PAC				
Hydrochloric acid (HCl)				
Caustic (NaOH)				
Poly electrolyte (PE)				
De-watering poly electrolyte				
Lime				
Sodium Chlorite				
NaOCl				
Any Other				

Note: MSDS for all the chemicals are to be provided by the contractor. Chlorine gas should not be used in RWTP.

All Utilities & Chemicals Consumption shall be listed which are envisaged to be used in Raw Water Treatment Plant (RWTP) for Normal Operation as well as for start-up / shutdown requirements.

7.0 LIST OF ENCLOSURES

All works as per following enclosures are part of contractor's scope of work/supply:

S. No.	Document No.	Document Title
1.	B269-472-17-44-DB-1001	Process Design Basis for RWTP
2.	B269-472-17-44-1001 (2 Sheets)	Schematic Flow Diagram for RWTP
3.	B269-17-44-472-1111 to 1132	P&IDs for RWTP
4.	B269- 472-17-44-DS-1001 to 1052	Datasheets for RWTP
5.	B269-472-17-44-1040	Equipment Layout for RWTP
6.	B269-472-17-44-EL-1001	Equipment List
7.	B269-472/475/476-17-44-VDR-1001	Vendor data requirement (Plot Plan & Water) for RWTP, RO-DMP, CPU & ZLD Plants
8.	B269-472/475/476-17-44-TC-1001	Technical compliance (Plot Plan & Water) for RWTP, RO-DMP, CPU & ZLD Plants
9.	B269-472/475/476-17-44-SP-1001	Pre-Commissioning, Commissioning and P.G. Test Guidelines
10.	B269-472/475/476-17-44-SS-1002	Operation and Maintenance Specifications for RWTP, RODM, CPU and ZLD Plants

**PROCESS DESIGN BASIS
(PLOT PLAN AND WATER)
FOR
REVERSE OSMOSIS – MIXED BED BASED
DEMINERALIZATION PLANT (RO-DMP)
AND
ZERO LIQUID DISCHARGE PLANT (ZLDP)

PANIPAT REFINERY EXPANSION PROJECT (P-25)
IOCL- PANIPAT REFINERY, HARYANA, INDIA**

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List of Acronyms

AVU	Atmospheric and Vacuum Distillation Unit
ARU	Amine Regeneration Unit
CCRU	Catalytic cracking reformer unit
CDWU	Catalytic Dewaxing Unit
CDU	Crude Distillation Unit
CR LPGT	CR LPG Treater
CPU	Condensate Polishing Unit
DHDT	Diesel Hydrotreater
EIL	Engineers India Limited
ETP	Effluent Treatment Plant
HCl	Hydrogen Chloride
HGO	Heavy Gas Oil
HRSCC	High Rate Solid contact Clarifier
HVGO	Heavy Vacuum Gas Oil
HGU	Hydrogen Generation Unit
IOCL	Indian Oil Corporation Limited
NHT	Naphtha Hydrotreater
PP	Polypropylene
PRU	Propylene recovery unit
RHCU	Resid Hydrocracker Unit
RO	Reverse osmosis
SARU	Sulphuric Acid Regeneration Unit
SR LPGT	SR LPG Treater
SRU	Sulphur recovery unit
SWS	Sour water stripper
TBP	True Boiling Point
U&O	Utility / Offsite
VDU	Vacuum Distillation Unit
VGO-HDT	Vacuum gasoil Hydrotreater
ZLD	Zero Liquid Discharge

1. INTRODUCTION

Indian Oil Corporation Limited (IOCL) operates 15.0 million metric tons per annum (MMTPA) refinery at Panipat in state of Haryana, India. The refinery is currently implementing facilities to manufacture 100% BS-VI fuel mandated by Auto Fuel Policy.

In order to meet the demand growth of petroleum products and also to increase its profitability and competitiveness in the long run, IOCL intends to enhance the refinery capacity from 15 to 25 MMTPA. The Expansion Project consists of a new Crude / Vacuum Distillation unit (CDU/VDU) of capacity of 10 MMTPA followed by a SR LPG Treater (SR LPGT), MS Block comprising of NHT, CCRU & Isomerization Unit, Alkylation/ SARU, DHDT, VGO-HDT, RHCU, INDMAX including CR LPG Treater, and PRU. A new PP unit and Catalytic De-waxing Unit are included as value augmentation unit. Auxiliary facilities i.e., HGU, SWS/ARU and SRU and Utility / Offsite (U&O) facilities for the entire project are included in the facility.

Engineers India Limited has been retained by IOCL as the Engineering Consultant for the Upgradation Cum Expansion project and for design of all open art facilities which include AVU, PRU, SWS, ARU and the U&O facilities. Basic Engineering Design Basis (BEDB) for all facilities, containing technical information decided between IOCL and EIL, shall be binding on the process design and engineering of units, utility systems and offsite facilities.

A New RO based DM water plant is envisaged in the project which shall process the Cooling tower blow down, Treated Effluent from the ETP, blow down from the boiler and treated Raw water make-up to generate the DM water of required Quantity and Quality.

The reject water from the DM plant shall be routed to the Zero Liquid Discharge Plant which shall process the Waste stream from the RODM Plant to generate Condensate and Distillate equivalent to Treated Raw Water quality which shall be recycled and Dried Solids that shall be sent for Disposal.

This document constitutes the Design Basis for the New RO based Demineralised Water Plant and the Zero Liquid Discharge Plant for the Panipat Refinery Expansion (P-25) Project and shall be a part of the Water Block Package in the Complex.

2. DESIGN OF RO-DM AND ZLD PLANT

The Design Basis of the RO-DM Plant and the ZLD Plant for P-25 project are indicated in the subsequent sections.

2.1. DESIGN CAPACITY OF RO-DM PLANT

The Design Capacity of the RO-DM Plant shall be 850 m³/h of Net treated Demineralised Water production.

The DM water produced in the RO-DM plant shall be transferred to the boiler and Process units through pumping.

2.1.1. FEED STREAMS TO THE RODM PLANT

The RO-DM plant shall treat the following feed streams to generate DM quality water.

S. No.	Description	Quantity (m3/h) (Normal)	Quantity (m3/h) (Design)
1.	Cooling Tower Blow down from CT-1 & CT – 2	301	434
2.	Blow Down from Process Units	14	35
3.	Blow down from Utility Boiler	13	32
4.	ETP Treated Water	360	450
5.	Treated Raw Water	149 (Note-1)	20 (Note-1)

Note-1: Treated Raw water (380M3/HR) from Raw Water Treatment Plant shall be kept as backup feed for the RO-DM Plant in case of non-availability of one largest feed to RO-DM plant) and during start-up if required.

2.1.2. DESIGN INLET STREAMS FOR THE RO-DM PLANT

Feed influent design quality for various effluent streams to RO-DM Plant shall be as follows:

2.1.2.1. COOLING TOWER BLOW DOWNS FROM CT-1&CT-2.

Feed flow to the RO-DM Plant : 301 m3/h (Nor)
Design Feed flow to the RO-DM Plant : 434 m3/h (Max)

Cooling tower blow-down quality shall be as indicated in Table-1 below.

Table -1: Cooling Towers Blow-down Quality

S. No.	Parameter	Normal	Maximum
1.	pH	7.5-8.0	8.0
2.	Turbidity, NTU (5 Min settled)	10-15	30
3.	Total Hardness as CaCO ₃	360-500	650
4.	Ca Hardness as ppm CaCO ₃	260-340	450
5.	Total Silica as SiO ₂ , mg/l	35-40	100
6.	TDS, mg/l	400-650	800
7.	MO-Total alkalinity as CaCO ₃ , mg/l	90-100	125
8.	Chlorides as ppm Cl ⁻	55-65	75
9.	Free Chlorine, mg/l	0.5-0.3	1.0
10.	Fe as ppm, Fe	1.0	1.0
11.	Sulphate as SO ₄ ,mg/l	300-450	600

12.	Organo-phosphate as PO ₄ , mg/l	8-10	10
13.	Inorganic phosphate as PO ₄ , mg/l	4-6	6
14.	Polymeric Dispersant, mg/l	20-30	10
15.	Zinc Sulphate as Zn, mg/l	1-2	3
16.	Azole (BZT), ppm	0.2-0.5	0.5
17.	KMnO ₄ consumption at 100°C, ppm	30-40	50
18.	Oil Content, ppm	-	-/10

2.1.2.2. BOILER BLOW DOWN

A. BLOW DOWN FROM UTILITY BOILER

Feed flow to the RO-DM Plant : 13.0 m³/h (Nor)

Design Feed flow to the RO-DM Plant : 32.0 m³/h (Max)

Boiler Blow Down quality shall be as indicated in Table-2 below.

B. BLOW DOWN FROM PROCESS UNITS

Feed flow to the RO-DM Plant : 14.0 m³/h (Nor)

Design Feed flow to the RO-DM Plant : 35.0 m³/h (Max)

Boiler Blow Down quality shall be as indicated in Table-2 below.

Table - 2 Blow down Quality

S. No.	Parameter	Unit	Value (Design)
1.	TDS	mg/l	50

2.1.2.3. TREATED ETP EFFLUENT

Design Feed flow to the RO-DM Plant : 360 m³/h

Maximum Feed flow to the RO-DM Plant : 450 m³/h

Treated ETP effluent quality shall be as indicated in Table-3 below.

Table - 3: Treated ETP Effluent Quality

S. No.	Parameter	Unit	Value (Design)
1.	pH	-	6.0 - 8.5
2.	Oil & Grease	mg/l	≤ 5
3.	BOD _{3 days, 27°C}	mg/l	≤ 10
4.	COD	mg/l	≤ 90
5.	Phenols	mg/l	≤ 0.35
6.	Total Suspended Solids	mg/l	<10
7.	Alkalinity	mg/l	<120
8.	Total Dissolved Solids	mg/l	3000
9.	Sulphides as S	mg/l	≤ 0.5
10.	Ammonia as N	mg/l	≤ 11

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S. No.	Parameter	Unit	Value (Design)
11.	Ammonia as NH ₄	mg/l	≤ 20
12.	TKN	mg/l	≤ 40
13.	Phosphorous as P	mg/l	≤ 1.5
14.	Cyanide as CN	mg/l	≤ 0.2
15.	Nitrate as NO ₃	mg/l	Traces
16.	Hexavalent Chromium	mg/l	Traces
17.	Total Chromium as Cr	mg/l	Traces
18.	Lead as Pb	mg/l	Traces
19.	Mercury as Hg	mg/l	Traces
20.	Zinc as Zn	mg/l	Traces
21.	Nickel as Ni	mg/l	Traces
22.	Copper as Cu	mg/l	Traces
23.	Vanadium as V	mg/l	Traces
24.	Benzene	mg/l	≤ 0.1
25.	Benzo Pyrene	mg/l	Traces
26.	Reactive Silica	mg/l	Traces
27.	Colloidal Silica	mg/l	Traces

2.1.2.4. TREATED RAW WATER

In case the normal feed streams to the RO-DM plant are not available, backup of Treated Raw Water equivalent to one largest feed to RO-DM plant shall be considered from the Treated Water Reservoir to produce required quantity of DM water.



The treated raw water as backup feed to the RO-DM plant shall be routed directly to the RO treatment section bypassing the Ultra Filtration sections of the RO-DM Plant.

Treated Raw Water quality shall be as indicated in Table-4 below.

Table – 4: Treated Raw Water Quality

S. No.	Parameters	Unit	Treated Raw Water Quality (Design)
1.	pH	--	7.5-8.0
2.	Turbidity	NTU	<1
3.	Silt Density Index (SDI)	-	<3
4.	Total Suspended Solids (TSS)	mg/l	<0.5
5.	Total Dissolved Solids (TDS)	mg/l	100-160
6.	MO Alkalinity as CaCO ₃	Mg/l	60-90
7.	Calcium Hardness as Ca	mg/l	65-85
8.	Total Hardness as CaCO ₃	mg/l	90-125

S. No.	Parameters	Unit	Treated Raw Water Quality (Design)
9.	Chlorides (as Cl ⁻)	mg/l	13-15
10.	Sulphates (as SO ₄ ²⁻)	mg/l	15-55
11.	Iron (as Fe)	mg/l	<0.1
12.	Reactive Silica as SiO ₂	mg/l	8-10
13.	Ammonia	mg/l	-
14.	Sulphides as S	mg/l	-
15.	ORP Value	mV	-

2.1.2.5 BATTERY LIMIT CONDITIONS



	Pressure, Kg/cm ² g				Temperature, °C			
RO DM Plant	Min.	Nor.	Max.	Mech. Design	Min.	Nor.	Max.	Mech. Design
Incoming Lines								
Cooling Tower Blow downs, Boiler Blow downs, Process Unit Blow downs	-	2.5	-	15	-	33	-	75
Treated Effluent from ETP	-	3.0	-	10	-	Amb	-	65
Outgoing Lines								
DM Water	As per Process Datasheet No.: B269-475-02-42-DS-1601				-	Amb	-	65

2.2. DESIGN CAPACITY OF ZERO LIQUID DISCHARGE PLANT

The Design Capacity of the Zero Liquid Discharge (ZLD) Plant shall be **50m³/hr**. The Zero Liquid Discharge Plant shall comprise of a multi-effect Evaporator Unit followed by a Dryer Unit. Three (2 working and 1 standby) Multi-Effect Evaporator Units, each with processing capacity of **25 m³/hr** Feed Water for and Two Units (1 working and 1 standby) Dryer Unit, each with processing capacity of **5 m³/hr** for processing the Concentrated Brine from the Evaporator Outlet envisaged.

The Condensate and Distillate water generated from the evaporator and dryer units shall be sent to the UF Feed Collection Tank of RODMP.

2.2.1. DESIGN FEED QUALITY TO THE ZERO LIQUID DISCHARGE PLANT

Feed influent design quality for Zero Liquid Discharge Plant shall be as follows

2.2.1.1. REJECT WATER FROM RO-DM PLANT

The Reject Water from the RO-IV in the Reject Recovery Section of the RO-DM plant shall be feed to the ZLD plant. The Design feed Quality to the ZLD plant from the RO-DM shall be as indicated in the Table-5.

Table-5: RO-DM plant Reject Water Quality

S.No.	Parameters	Unit	Specifications
1	pH		7.0-9.0
2	Conductivity	μmho/cm	60000
3	Total Hardness as CaCO ₃	mg/l	2000
4	TSS	mg/l	<1
5	Total (reactive) Silica as SiO ₂	mg/l	200
6	Total Iron	mg/l	5
7	Total Copper	mg/l	1
8	Turbidity	NTU	<1
9	KMnO ₄ at 100 deg C	mg/l	10
10	Sodium as Na ⁺	mg/l	15000
11	Chloride	mg/l	24000
12	Oil	mg/l	Nil
13	TDS	mg/l	40000
14	Colloidal Silica as SiO ₂	mg/l	BDL

Note:

1. The RO-DM reject water quality is calculated by RO projection software and is based on quality of RO-DM feed streams. The ionic balance of water shall vary based on feed water quality.

2.3. TREATED WATER QUALITY

The Treated Water specifications from the RODM and ZLD Plant are indicated in the following Section.

2.3.1. DEMINERALIZED WATER QUALITY

The DM Water Quality from the RO-DM Plant at the Outlet of the Mixed Bed (MB) exchanger unit shall be indicated in the Table-7.

Table-7: DM Water Quality (at the outlet of MB Exchanger)

S. No.	Parameter	Unit	Specification
1.	pH		6.7 - 7.3 #
2.	Conductivity at 20 °C	μmho/cm	<0.2 #

S. No.	Parameter	Unit	Specification
3.	Total Dissolved Solids	mg/l	< 0.1
4.	Total Hardness as CaCO ₃	mg/l	NIL #
5.	Total Suspended Solids	mg/l	NIL #
6.	Total (reactive) Silica as SiO ₂	mg/l	<0.02 #
7.	Turbidity	NTU	BDL #
8.	Total Chlorides	mg/l	NIL #
9.	Total Iron as Fe	mg/l	<0.01 #
10.	KMnO ₄ value at 100°C	mg/l	<1 #
11.	Total Copper as Cu	mg/l	<0.003 #
12.	Sodium + K	mg/l	<0.01 #
13.	Oil	mg/l	NIL #
BDL : Below Detectable Limit			
# Parameters to be considered for Process Guarantee (at MB Exchanger outlet).			

2.3.2. DESIGN TREATED WATER QUALITY AT DIFFERENT STAGES IN RO-DM PLANT

The treated permeate water quality as required from different treatment sections of the RO-DM plant is indicated in Table-8 below. The same shall be considered for design of the RO-DM plant.

Table – 8: Design Treated Water Quality for RO-DM Plant

Parameters	Unit	Specification – DM Water				Specification – RO Reject Recovery Section		
		UF-I Outlet	RO-I Permeate	RO-II Permeate	MB Outlet	RO-III Permeate	UF –II Outlet	RO-IV Permeate
pH					6.5-7.0			
Conductivity	µmho/cm				< 0.2			
Total Hardness as CaCO ₃	mg/l				Nil			
TSS	mg/l	<1	Nil	Nil	Nil	Nil	<1	Nil
Total (reactive) Silica as SiO ₂	mg/l				≤0.02			
Total Iron	mg/l				≤0.01			
Total Copper	mg/l				≤ 0.003			
Turbidity	NTU	<1	Nil	Nil	Nil	Nil	<1	Nil
SDI	-	< 3					< 3	
KMnO ₄ at 100°C	mg/l				1 Max			
Sodium as Na+	mg/l				≤ 0.01			
Oil	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil
TDS	mg/l		≤100	≤10	< 0.1	≤250		≤350

Parameters	Unit	Specification – DM Water				Specification – RO Reject Recovery Section		
		UF-I Outlet	RO-I Permeate	RO-II Permeate	MB Outlet	RO-III Permeate	UF –II Outlet	RO-IV Permeate
Colloidal Silica	mg/l	BDL	Nil	Nil	Nil	Nil	BDL	Nil

Notes

- Other parameters in UF-I, RO-I, RO-II, RO-III, UF-II and RO-IV permeate shall be as per UF/RO projections

2.3.3. TREATED WATER QUALITY AT ZERO LIQUID DISCHARGE PLANT OUTLET

The Quality of the recovered Condensate / Distillate at the Outlet of the Zero Liquid Discharge Plant shall be as indicated in the Table-9.

Table-9: Recovered Condensate Quality at ZLDP Outlet

S. No.	Parameter	Unit	Specification
1.	Temperature	Deg C	40 (Max)
2.	pH	-	6.5 - 7.5
3.	Total Dissolved Solids (TDS)	ppm	300(Max)
4.	Total Suspended Solids (TSS)	ppm	<1.0

The distillate/condensate from the plant shall be condensed, stored and pumped for reuse as treated water in the UF Feed Collection Tank. The plant shall be provided with a collection tank & transfer pumps to collect and discharge the distillate/condensate from the ZLD Plant. Any additional treatment system envisaged to treat the Condensate / Distillate to the above quality shall be provided and considered in the scope of the contractor.

3. TREATMENT PHILOSOPHY

The Treatment Philosophy and Scheme for the treatment of different feed streams in the RO-DM plant and the Zero Liquid Discharge Plant are described in this Section.

The Treatment systems provided in the Plants are to ensure maximum recovery of Water for production of DM quality water and Treated water for Recycle and Reuse in the Refinery Complex.

3.1. TREATMENT PHILOSOPHY OF THE RO-DM PLANT

The treatment process in the RO-DM plant consists of four stages of treatment as below:

- Pre-Treatment Section
- Ultra filtration Section
- Reverse Osmosis (DM Water)
- Degasification and Mixed Bed Stage

- RO Reject Recovery Section

Pre-Treatment Section

CTBD, Boiler blow down streams from Utility boiler & blowdowns from process units (received at RO-DMP B/L at pressure) shall be stored in storage tanks before pumping to HRSCC-I. Clarified water from HRSCC-I shall be further treated in Dual Media Filter (DMF-I) for filtration followed by Activated Carbon Filter (ACF-I) for removal of any oil /organics.

Sludge from HRSCC-I shall be routed to sludge sump-I and then pumped to sludge dewatering unit. Centrate from dewatering unit shall be collected and then pumped back to HRSCC-I for further treatment, whereas dewatered Sludge shall be sent outside RO-DMP for disposal.

ACF-I treated water shall be stored in UF-I Feed tank. Treated effluent from ETP (received at RO-DMP B/L at pressure) and ZLD Distillate shall also be received in UF-I Feed tank.

The UF feed Tank shall be utilized to homogenise and equalize the blow down streams treated in the pre-Treatment section with the ETP Treated Effluent. The combined feed shall be routed to the Ultra-Filtration Treatment Section for removal of fines and particulates.

Ultra Filtration (UF) Section

The Combined treated Effluent from the UF feed Tank shall be further processed in Auto Backwash Filter (ABF-I) followed by Ultra Filtration-I system for removal of the residual micro impurities, which are still slipping through the previous filtration stages.

UF-I permeate along treated Raw water shall be stored before feeding to RO-I System. The backwash & chemical cleaning waste from the UF-I, DMF-I, ACF-I& ABF-I shall be collected in Backwash Sump-I and then pumped to HRSCC-I as recycle water for further treatment.

Reverse Osmosis (RO) – DM Water Section

DM water section consists of Two Pass RO system. The UF Permeate from the RO-I Feed tank shall be pumped to the RO-I skid for processing. The RO-I permeate is then sent to an intermittent hold-up tank for RO-II. The RO-II shall process the RO-I permeate along with the provision of processing Permeate Water from RO-III and RO-IV to produce MB Feed Quality water.

Reject from RO-I shall be sent to the RO Reject Recovery Section for further processing and production of recycle water. RO-II reject is sent back to RO-I inlet for reprocessing.

Degasification and Mixed Bed (MB) Section.

RO-II permeate shall be routed to degasser towers for removal of dissolved CO₂. Air is fed to the Degasser Tower by Degasser Air Blower. Degassed water is collected in Degassed

Water Tank, which is further treated in the Mixed Bed Exchanger units. Final polishing of reactive silica and TDS shall be carried out through resin based MB unit to achieve the desired DM quality water. The DM water from the outlet of MB units shall be routed to the DM water Storage Tanks. The DM water from the storage tanks shall be pumped outside the RO-DMP to Process units and Boiler by DM Water Transfer Pumps.

RO Reject Recovery Section

RO-I Reject effluent is further processed in RO-III to generate low TDS water which is recycled as feed to RO-II system.

RO-III Reject Effluent and MB (DMP & CPU) regeneration waste shall be sent to the HRSCC-II for chemical precipitation of salts and removal of hardness and Silica.

The clarified water from HRSCC-II shall be further treated in Dual Media Filter (DMF-II) for filtration followed by Activated Carbon Filters (ACF-II) for organics removal followed by Auto Backwash Filter (ABF-II) and Ultra Filtration-II for removal of micro impurities.

The filtered water shall be further processed in RO-IV stage for additional water recovery and permeate recycled as RO-II Feed along with RO-III permeate.

The reject of RO-IV shall be routed to the ZLD Feed for processing in the Plant to generate Distillate water and condensate that shall be recycled and reused as UF Feed in RODMP.

The backwash & chemical cleaning waste from the UF-II, DMF-II, ACF-II and ABF-II shall be collected in Backwash Sump-II and then pumped to HRSCC-II for reprocessing. Sludge from HRSCC-II shall be routed to Sludge Sump-II and then pumped to sludge dewatering unit. Centrate from dewatering unit shall be collected and pumped back to HRSCC-II. Sludge from dewatering unit shall be sent outside RO-DM Plant for disposal.

3.1.1. RO-DM PLANT CONFIGURATION

RO-DM Plant Treatment Scheme shall have the following Major System/Units (Unit Capacities shall be Finalised as per the Design DM water requirements:

Unit	No. of Units	Design Capacity per Unit/Chain
UF-I Skids (RO-DM Section)	3 Working + 1 Standby	352m ³ /hr Feed Capacity (Minimum 88% recovery as Permeate)
RO-I Skids (RO-DM Section)	4 Working + 1 Standby	250m ³ /hr Feed Capacity (Minimum 75% recovery as Permeate)
RO-II Skids (RO-DM Section)	4 Working + 1 Standby	241m ³ /hr Feed Capacity (Minimum 90% recovery as Permeate)
MB Units (RO-DM Section)	5 Working + 2 Standby	3400m ³ /day Net DM water per Unit.

Unit	No. of Units	Design Capacity per Unit/Chain
RO-III Skids (Reject recovery Section)	2 Working + 1 Standby	125m ³ /hr Feed Capacity (Minimum 65% recovery as Permeate)
UF-II Skids (Reject recovery Section)	1 Working + 1 Standby	130 m ³ /hr Feed Capacity (Minimum 88% recovery as Permeate)
RO-IV Skids (Reject recovery Section)	1 Working + 1 Standby	108 m ³ /hr Feed Capacity (Minimum 55% recovery as Permeate)
Chemical Dosing & Sludge Handling facilities	As per design requirements	

3.2. TREATMENT PHILOSOPHY OF THE ZERO LIQUID DISCHARGE PLANT

The Zero Liquid discharge Plant shall consist of the following sections

- Pre-treatment Section
- Evaporator Section
- Dryer Section
- Products (distillate/condensate, concentrated liquor and reject vapors/emissions) handling, treatment & disposal facilities
- Cleaning & Dosing Chemicals handling & dosing facilities

The reject stream from the RO-IV system in the RODM plant shall be routed to the ZLD feed storage tank. The ZLD Feed tank, with storage capacity equivalent to ~ 24 hours of design feed flow shall homogenize the feed and then the same shall be pumped at a controlled rate for further Processing. The ZLD feed storage tank shall also act as a buffer storage tank to provide for the storage of the feed during the Cleaning Cycle of the Evaporator and Dryer units of the ZLDP.

Pre-treatment of the feed stream as required prior to the Evaporator Unit shall be provided in the pre-treatment section. Pre-treatment section is to be proposed by the bidders and may include the following facilities in general (as required):

- Treatment Facilities for Hardness and Silica reduction from the Feed water and making it acceptable for processing in the Evaporator and Dryer units of the ZLDP shall be provided. Lime-Soda Ash Softening process or any other process as recommended by the Evaporator / Dryer Suppliers shall be provided and all associated facilities as required shall be considered in the scope of the water block package contractor. Any effluent generated from the pre-treatment section of the ZLDP shall be suitably treated within the ZLDP or the Water Block Package and it must be ensured that **NO Liquid Effluent** is discharged outside the water block package.
- Acid dosing for converting bicarbonates to carbonates before feeding to the evaporators.

- Additive/Anti-scalant dosing to prevent calcium salts depositing on the wall of the evaporator or Dryer / crystallizer units.
- Neutralization for pH correction shall be done if required with Caustic.

The feed to the evaporator unit from the ZLD feed tank shall be through the ZLD feed pumps. Intermittent Tank and pumping facilities if envisaged in the ZLDP pre-treatment section shall be considered in the Package and Feed Control to the Evaporator Unit shall be adequately controlled.

Evaporation Section

Feed at controlled rate (controlled by a flow control valve) shall pass through pre-heaters, calandrias and vapour separators of various effects. The evaporation takes place under vacuum, which shall be maintained mainly by vacuum system. Steam shall be supplied as a heating medium through thermal vapour recompression (TVR) to the 1st effect jacket. The concentrated product at the desired concentration shall continuously be taken out from the system.

Multiple effects (minimum FOUR EFFECTS for good steam economy and maximum condensate recovery) falling film cum forced circulation evaporators with thermal vapour recompression (TVR) system are envisaged.

The feed shall be preheated in pre-heaters before going into the 1st effect. The circulating brine in the 1st effect heating element shall be heated with steam from the discharge of the TVR, and which condenses on the shell side. The heated and concentrated brine slurry which is circulating in the tube side of the heating element shall be discharged from each heating element into its respective vapour separator. The vapours separate from the brine/slurry in the vapour separators. Mesh-pad droplet separators shall be provided to virtually eliminate droplet carry over with vapours leaving the vapour separators. Vapours from the 1st effect vapour separator shall be discharged into the shell side of the 2nd effect heating element (where they condense) whereas a part of the vapours (depending upon the bidder's design) may be discharged into the suction of the TVR (The choice of the effect from where vapours for TVR are to be taken shall be made by the bidder on the basis of his optimized design). The vapours from the 2nd effect vapour separator shall be discharged into the 3rd effect heating element and so on. The type (falling film or forced circulation) for each effect shall be as per bidder's design.

The type of evaporator shall be based on bidder's experience. The unit shall be designed for operation under vacuum. The necessary flash vessels, as require, shall be provided so as to recover maximum heat from the feed purge and condensates and at the same time meet the temperature requirements of these streams at the battery limit of the plant. The vapours shall be condensed in a surface condenser or any other suitable system.

Dryer Section

The concentrated feed shall then be passed through a Dryer Unit with forced circulation type or falling film type (ATFD) or as per bidder's own proven system so as to recover maximum quantity of distillate / condensate from the feed and salts as a dry product shall be provided. The condensate/ Distillate shall be recycled back as treated Water and the solids/salts shall be disposed of as solids or crystals (having moisture content less than 8%) from the plant. The solids shall be discharged to a dumpster. At least two Dumpster units of adequate size/volume shall be provided.

Steam Station

MP Steam / LP steam shall be made available at the Water Block Battery Limit at the Indicated conditions. The Pressure reduction and De-superheating facilities as required for the ZLD Plant shall be considered in the Water Block Package. MP BFW shall also be made available at the Water Block Battery Limit. The Consumption of steam shall be optimized to achieve the maximum steam economy from the Evaporator Package and Dryer Unit.

Cleaning Facilities for Vessels/Equipment

During normal operation of the plant, gradual deposition of carbonates, sulphates, silicates etc. due to super saturation may take place. To maintain and operate the system at desired efficiency, provisions (as required) for hot water washing, chemical/acid (HNO_3) cleaning & high-pressure water jet cleaning shall be provided. Sufficient stand by equipment/arrangements shall be provided so that down time for the plant for maintenance is minimized. The necessary tanks & pumps shall be provided for dosing of cleaning chemicals as per the Unit Supplier recommendations.

Material of Construction

The minimum MOC requirements of the Zero Liquid Discharge Plant shall be as per the following table:

Unit	MOC
Multi-Effect Evaporator	
Calendria	Tubes : Titanium Grade II Shell: SS 304
Preheaters	Tubes : Titanium Grade II Shell: SS 304
Tanks & Vessels	SDSS
Dryer	
ATFD	SDSS (CS Jacketed)
Condensers	SS 304

3.2.1. ZERO LIQUID DISCHARGE PLANT CONFIGURATION

The Zero Liquid Discharge Plant Treatment Scheme shall have the following Major System/Units (Unit Capacities shall be Finalised as per the Design Requirements:

Unit	No. of Units	Design Capacity per Unit/Chain
Pre-Treatment Section	1 Working	50 m ³ /hr Feed
Multi – Effect Evaporator	2 Working + 1 Standby	25 m ³ /hr Feed Capacity each
Dryer Unit (ATFD or Equivalent)	1 Working + 1 Standby (for each chain of MEE)	05 m ³ /hr Brine Feed Capacity each

4. CHEMICALS HANDLING

Tentative list of chemicals proposed to be used in RO-DM/CPU Plant are as follows:

Caustic (NaOH)	Morpholine	Ferric Chloride (FeCl ₃)
Acid (HCl)	Lime	Polyelectrolyte (PE)
Antiscalant	RO Cleaning Chemicals	Sodium Meta Bisulphite (SMBS)
Soda Ash	Sodium Hypochlorite (NaOCl)	De-Oiling Polyelectrolyte (DOPE)

The chemical dosing system in the RO-DM Plant and ZLD plant shall be provided with proper dilution & dosing facilities.

5. CONTROL PHILOSOPHY

The RO-DMP/ZLD shall be controlled from the Common Control Building which shall house the Substation and Control room along with associated facilities for the RWTP, RODMP, ZLDP and CPU Plants. The Control system for RWTP, RODMP, ZLDP and CPU shall be PLC based. Separate PLC based control systems are envisaged for RWTP, RO-DMP+CPU and ZLD.

The control system shall be provided in line with the engineering specifications/ standards/ drawings. The Operation of the UF-I & UF-II system shall be automatic and Backwash sequence for the UF-I & UF-II skids, DMF-I, ACF-I, ABF-I, DMF-II, ACF-II, ABF-II and regeneration sequence of MB shall be incorporated in the PLC based control system, apart from other requirements to be specified in the P&ID's. The plant shall also have a provision for manual operation. The Instrumentation and Control Philosophy for the Plant shall be as applicable for smooth, safe & trouble free operation of the plant.

PLC shall be serially interfaced with centralized DCS at Refinery Main Control Room (RMCR) for monitoring purposes and mapped to DCS with dedicated graphics.

6. EQUIPMENT DESIGN PHILOSOPHY

The Design of the RO-DM plant shall be Modular and the RO skid capacities shall be considered to ensure optimum turndown in the plant.

Hydraulic turndown : 50%
On-stream factor : Plants shall be able to operate all-round the Year

The Zero Liquid Discharge Plant shall be designed to operate continuously for a minimum of 120hours between every cleaning cycle.

The duration of the cleaning cycle for the individual Evaporator and Dryer Units in the ZLD plant shall not be more than 16 hours (and maximum 24 hours between Stabilized Operation of the Individual Unit)

7. REJECT/WASTE WATER IN RO-DM AND ZLD PLANT

Reject/waste water in the RO-DM Plant and the Zero Liquid Discharge Plant shall be handled as per philosophy specified in Table-10 below

Table-10: Effluent Generation and Handling

S. No.	Effluent	Handling and Treatment
1.	DMF-I, ACF-I, ABF-I, UF-I and Chemical Cleaning Waste from UF system	Recycled within the RO-DM Plant
2.	RO Reject Recovery Section Backwash Waste (ABF-II, UF-II, DMF-II & ACF-II)	Recycled within the RO-DM Plant
3.	RO-IV Reject	Routed to Zero Liquid Discharge Plant
4.	Regeneration Waste from MB exchanger units of DM and CPU	Recycled within RO-DM Plant
5.	ACF – CPU Backwash	Sent to ETP
6.	Chemical Sludge from HRSCC-I & HRSCC-II	Temporary storage facility (Approx. 7 days) shall be provided for disposal.
7.	Dry Solids from Zero Liquid discharge Plant	Temporary storage facility (Approx. 7 days) shall be provided for disposal.

8. GUARANTEED PARAMETERS

The treated water quality to be guaranteed by the contractor shall be as specified in Section 2.3 (indicated by “#”) Apart from this, the following parameters shall also be guaranteed by the contractor.

8.1. GUARANTEE PARAMETERS FOR RO-DM PLANT (Including Reject Recovery Section)

The following Parameters shall be guaranteed by the contractor for the RO-DM Section including the Reject Recovery Section in the RO-DM Plant.

System/Parameter	Guaranteed Value
Hydraulic Capacity of the Plant	850 m ³ /hr of Net DM Water Production
UF-I skid	333m ³ /hr Average Feed Capacity(Minimum 88% recovery as Filtrate)
UF-II skid	123 m ³ /hr Average Feed Capacity (Minimum 88% recovery as Filtrate)
RO-I skid	250m ³ /hr Feed Capacity (Minimum 75% recovery as Permeate)
RO-II skid	241m ³ /hr Feed Capacity (Minimum 90% recovery as Permeate)
RO-III skid	125m ³ /hr Feed Capacity (Minimum 65% recovery as Permeate)
RO-IV skid	108m ³ /hr Feed Capacity (Minimum 55% recovery as Permeate)
Mixed Bed Exchanger	3400 m ³ /day Net DM water per Unit.

Intermediate Treated Water Quality

System/Parameter	Value
SDI at each UF Outlet	≤ 3 #
Total Dissolved Solids in RO-I permeate	≤ 100 mg/l #
Total Dissolved Solids in RO-II permeate	≤ 10 mg/l #
Total Dissolved Solids in RO-III permeate	≤ 250 mg/l #
Total Dissolved Solids in RO-IV permeate	≤ 350 mg/l #

8.2. GUARANTEE PARAMETERS FOR ZLD PLANT

Apart from the guaranteed distillate and condensate Quality from the Zero Liquid Discharge Plant, the following Parameters shall also be guaranteed by the contractor for the ZLD plant.

Solids Content at the Multi Effect Evaporator Outlet : 30.0 % (Min)

Moisture Content in Solids (Salts) at the Dryer Outlet : 10 % (Max)
(Suitable for filling and packing in bags/drums for transferring to the landfill site)

9. UTILITIES

The following utilities will be supplied at the RO-DM and ZLD Plant battery limit:

- Plant Air
- Instrument Air
- LP Steam / MP Steam
- MP BFW
- Service Water
- Drinking Water
- Nitrogen
- Power
- Fire Water

Battery limit conditions shall be as per Scope of Works/Supply Document No. B269-475-17-44-SS-1001.

10. UNITS OF MEASUREMENTS

All engineering specifications shall be issued in the MKS system of measurement, with the exception of piping/tubing sizes, which shall be reported in inches

Parameter	Unit
Temperature	°C
Pressure (Gauge)	Kg/cm ² .g
Pressure (absolute)	Kg/cm ² .a
Mass	Kg
Length	Meters
Relative density (Sp. gravity)	-
Density	Kg/m ³ or g/l
Vacuum	MmH ₂ O or mmHg

Parameter	Unit
Flowing mass	Kg/h
Flowing liquid	M3/h
Flowing vapour	Nm3/h or kg/h
Heat rate	K Cal/h
Viscosity	Cp
Kinematic viscosity	Cst
Composition	Vol %
Power	KWHR

11. REFERENCE DOCUMENTS / DRAWINGS

S. No.	Drawing/Document Name	Drawing/Document No.
1	Schematic Flow Diagram for RO-DM & ZLD Plant (2 Sheets)	B269-475-17-44-0101

SCOPE OF WORKS/SUPPLY **(PLOT PLAN AND WATER)**

REVERSE OSMOSIS– MIXED BED BASED **DEMINERALIZATION PLANT (RODMP)**

PROJECT : PANIPAT REFINERY EXPANSION PROJECT (P-25)

OWNER : IOCL

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B269

5	03.03.2021	REVISED & ISSUED WITH TA-02	SC	VS	PKG
4	27.08.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
3	15.07.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
Rev. No	Date	Purpose	Prepared By	Checked by	Approved by

1.0 INTRODUCTION

Indian Oil Corporation Limited (IOCL) operates 15.0 million metric tons per annum (MMTPA) refinery at Panipat in state of Haryana, India. The refinery is currently implementing facilities to manufacture 100% BS-VI fuel mandated by Auto Fuel Policy.

In order to meet the demand growth of petroleum products and also to increase its profitability and competitiveness in the long run, IOCL intends to enhance the refinery capacity from 15 to 25 MMTPA. The Expansion Project consists of a new Crude / Vacuum Distillation unit (CDU/VDU) of capacity of 10 MMTPA followed by a SR LPG Treater (SR LPGT), MS Block comprising of NHT, CCRU& Isomerization Unit, Alkylation/ SARU, DHDT, VGO-HDT, RHCu, INDMAX including CR LPG Treater, and PRU. A new PP unit and Catalytic De-waxing Unit are included as value augmentation unit. Auxiliary facilities i.e., HGU, SWS/ARU and SRU and Utility / Offsite (U&O) facilities for the entire project are included in the facility.

A New RO-MB based DM water plant (RODMP) is envisaged in the project which shall process the Cooling Tower Blow Down, ETP Treated Effluent, Boiler Blow Down and Treated Raw Water as make-up to generate the DM water of required Quantity and Quality.

The Zero Liquid Discharge Plant (ZDP) shall be a part of RODMP and shall process the reject/waste stream from the RODM Plant to generate Condensate and Distillate water equivalent to Treated Raw Water quality which shall be recycled and Dried Solids that shall be sent for Disposal.

A Raw Water Treatment Plant (RWTP) is envisaged to cater to the treated raw water requirements of the Refinery and Petrochemical Complex.

A Condensate Polishing Unit (CPU) is envisaged for treatment of unpolished condensate to produce polished condensate.

2.0 DETAILED SCOPE OF SUPPLY/WORK

The scope of work for the RODMP shall be as follows but not limited to as given herein:

The scope of work shall include Project Management; Residual Process Design & Detailed Engineering; Procurement; Fabrication; Inspection; Supply; Manufacture;

Transportation of all equipment/materials to the work site & Storage at site; assembly, erection & installation; Construction and Erection of Civil & Structural, Mechanical, Electrical, Instrumentation & Piping works; Acid /Alkali proof tiling; Painting; Testing; Pre-commissioning, trial run for 30 days before commissioning; commissioning; Training of IOCL's personnel; performance guarantee test run for 72 hours continuous operation in presence of IOCL's & EIL's Representatives; guaranteeing and handing over of RODMP & to the Client on lump sum turnkey basis as per design basis, equipment list, standards, P&IDs, data sheets, drawings, etc., all complete within Contractor's specified battery limits including supply of spares, chemicals & consumables.

HAZOP for the complete RWTP, RODMP, ZLDP & CPU including implementation of HAZOP recommendation shall be under contractor's scope of work. HAZOP chairman shall be engaged by the contractor at his own cost and his CV shall be submitted by the contractor to EIL/IOCL for acceptance. HAZOP requirements shall be as per the HAZOP specifications attached in the tender.

3D modeling (in PDMS software as defined in the Piping specifications) for the RWTP, RODMP, ZLDP and CPU shall also be included in scope of work of the contractor.

SMART P&IDs shall be prepared for the plant during detailed engineering review and as built.



All equipment described in these specifications; datasheets & equipment list; as shown in the P&IDs & PFDs; as mentioned elsewhere in the tender document or as necessary for completeness but not listed above shall also be deemed to have been included in Contractor's scope. All works required to meet requirements given in design/process/operation requirements defined elsewhere in the bid document shall also be deemed to have been included in Contractor's scope.

Contractor's scope of work/supply shall also include the following:

- Condensate Polishing Unit (CPU) on LSTK basis as per bidding document specifications No. B269-476-17-44-SS-1001.
- Raw Water Treatment Plant (RWTP) on LSTK basis as per bidding document specifications No. B269-472-17-44-SS-1001
- Zero Liquid Discharge Plant (ZLDP) on LSTK basis as per bidding document specifications No. B269-475-17-44-SS-1002

- Operation & Maintenance of Raw Water Treatment Plant (RWTP), RO-MB based DM Plant (RO-DMP), Zero Liquid Discharge Plant (ZLDP) & Condensate Polishing Unit (CPU) for a period of TWO (2) YEARS after successful commissioning. Contractor's scope of work during Operation & Maintenance contract shall be as per Specifications No. B269-472/475/476-17-44-SS-1003.
- Condensate Polishing Unit (CPU- PNCP Area) on LSTK basis as per bidding document specifications No. B269-81-17-44-SS-1001

2.1 PROCESS

Process documents enclosed are the basic documents and are to be followed for execution of job leading to successful commissioning and performance guarantee test run of the Plant. During the course of execution, updating/modification to the process documents that would become necessary is to be carried out with the approval of EIL/IOCL. The resultant work arising out of this will also form the part of scope from detailed engineering to handing over of the plant with no cost implication to IOCL.

The tender specifies the scheme (refer to the PFDs/SFDs and P&IDs attached in relevant sections in tender documents) & Contractor's scope of supply in subsequent sections of this document as minimum requirements. Bidder may include in his scope any additional requirements, if so warranted to meet process guarantees and for smooth, safe and trouble free operation of the plants.

2.2 ENGINEERING

The design basis, data sheets, drawings, standards, specification, codes to be followed for different types of works are brought out in the various engineering sections forming part of the tender document. Contractor shall carry out residual process design & detail engineering works for the plant and submit various drawings and documents for approval of EIL/IOCL before these are released for construction.

2.3 CONSTRUCTION AND INSTALLATION

These activities shall be carried out by the contractor as specified elsewhere in the tender document.

2.4 QUALITY ASSURANCE

These activities shall be carried out by the contractor as specified elsewhere in the tender document.

2.5 STATUTORY CLEARANCES

All the applicable safety codes, national laws and local regulations shall be followed by the successful bidder for the design, engineering, fabrication, erection, commissioning & handing over of the Plant / Equipment and necessary approvals shall be obtained from the concerned statutory authorities by the contractor. Statutory bodies from which approvals may have to be taken include State Pollution Control Board, Chief Inspector of Boilers / IBR, Factory Inspectorate, Labour Authorities, Electrical Inspectorate and Chief Controller of Explosive, Directorate General of Mines and Safety requirements, etc. The contractor shall ascertain requirement of approvals as applicable in such plants and initiation of action as required shall be in contractor's scope.

2.6 SAFETY

These activities shall be carried out by contractor as specified elsewhere in the tender document. All safety procedures for different types of work as per the safety rules from time to time by EIL/IOCL shall be binding and adhered to by the contractor. Safety report generation for different situations as per the rules and required by EIL/IOCL are to be adhered to. HSE policy of IOCL shall be binding upon the contractor.

2.7 VENDOR LIST

For most of the systems/equipment, the approved vendor list of EIL is enclosed in the bid document, which shall be adhered to. While for other items, not listed in the approved vendor list, the suppliers who would be involved for design, engineering and supply of equipment and materials are to be proposed by the contractor (for EIL/IOCL approval) during detailed engineering with the documentary evidence of having supplied similar equipment, systems and/or materials for similar applications with proven track record. Any change for new contractor/supplier after award of contract for supply will not be permitted. It will be necessary to purchase certain items as a system and not as individual equipment. These have to be identified and furnished during detailed engineering for approval of the EIL/ IOCL.

2.8 WASTE DISPOSAL

All wastes generated like surplus earth after use/surplus construction materials to be disposed-off from time to time by the contractor to the disposal locations as directed by the Engineer-in-Charge.

Disposal of dewatered 'chemical sludge' and dried salts generated from operation of RODMP & ZLDP is excluded from contractor's scope of work and the same shall be disposed off outside RODMP battery limit by M/s IOCL (including transportation through tractor trolley). The trolleys for dewatered sludge from centrifuges and bagging of ZLD salts shall be in contractor's scope.

However, disposal of sludge and dried salts during trial run, commissioning and PGTR shall be in contractor's scope.

2.9 DESCRIPENCIES / VARIATIONS IN SPECIFICATIONS / STANDARDS

Bidders may bring out variations, deviations, if any, in related data sheets, equipment list, drawings, specifications, standards, codes, scope and any other contractual clauses before submission of bids and seek clarifications. In case of any contradiction on specification brought out at the post award stage of job, decision of EIL/ IOCL shall be final & binding upon the Contractor without any time & cost implication.

2.10 SUPPLY OF CONSUMABLES & CHEMICALS

Supply of all chemicals (**except HCl & NaOH**), spares and consumables required for the Operation and Maintenance of the plant during start-up, pre-commissioning, 30 days trial runs and up to successful commissioning shall be in the scope of supply of the LSTK contractor. HCl and NaOH shall be free issue supply by IOCL. Special chemicals required, if any, shall be clearly defined by the contractor with respect to quality and quantity and the supply of the same shall also be in Contractor's scope. Minimum two nos. of manufacturers shall be specified by the bidder for these special chemicals. Unloading, handling and storage of all chemicals and consumables (including provision of necessary facilities) shall be done by the contractor.

Also, contractor's scope regarding supply of chemicals, spares, consumables and other requirements during two years operation duration shall be as per Specifications No. B269-472/475/476-17-44-SS-1003.

2.11 SPARES

2.11.1 MANDATORY SPARES

Contractor's scope regarding supply of mandatory spares shall be as per the specifications attached in the tender.

2.11.2 ERECTION & COMMISSIONING SPARES

Contractor shall ensure adequate supply of all spares as required by him for successful erection & commission of the plants till handing over to the client. The lump sum price quoted shall be deemed to be inclusive of cost of such spares.

2.11.3 SPECIAL TOOLS AND TACKLES

Contractor shall ensure supply of all special tools and tackles for commissioning of the entire plants till handing over. The lump sum price quoted shall be deemed to be inclusive of cost of such tools and tackles.

2.11.4 TWO YEARS RECOMMENDED SPARES

Two years normal operation spares required are to be identified by the bidder and shall be in the bidder's scope during the Two Years Operation and Maintenance Contract. These Spares as identified by the Bidder shall be over and above the minimum spares list as indicated in the Annexure-1 of the O&M Specifications document No. B269-472/475/476-17-44-SS-1003.

2.11.5 STORAGE OF SPARES

All spare parts supplied by the bidder shall be properly wrapped, packaged and stored by the contractor so that they will be preserved in original and new condition under the normal conditions of storage to be anticipated in India and shall be properly tagged and coded so that later identification as to intended equipment usage will be facilitated. They shall be packed separately clearly marked as 'spare parts'. Packing lists shall be furnished so that the parts can be handled without uncrating if desired.

2.12 MECHANICAL COMPLETION / PRE-COMMISSIONING / COMMISSIONING / GUARANTEE & TOLERANCES

Mechanical Completion

Mechanical completion of the Plant shall mean that all installation works of the Plant have been completed and hydrotested in accordance with approved construction drawings, approved specifications, applicable codes, accepted International good engineering practices and all the activities have been completed in a comprehensive manner by the Contractor.

Pre-Commissioning

Pre-commissioning activities are defined as those activities which are required to be performed after completion / installation, inspection, hydrotesting, etc. of the Plant to make it ready for commissioning.

Commissioning

The Plant shall be considered "Ready for Commissioning" when 30 days trial runs are over and all the facilities have been completed along with their auxiliaries and support facilities in every respect including charging of lubes, chemicals, filters media, preparation of solution, etc. as recommended by IOCL / EIL in standard format with all exceptions, if any, resolved.

Commissioning of the Plant shall mean taking the feed in the system, passing it through normal route and establishing the process control parameters. The Plant shall be considered to be commissioned successfully with instrumentation / control system, process, utilities & support system have been on uninterrupted stable operation for not less than 72 hours while producing treated water of desired quality. Whether the 72 hours operation has been successful or not shall be decided by IOCL/EIL based on observations recorded during 72 hours. The countdown for 72 hours operation shall start on after the system has been on stable operation with all controls and safety systems in normal operation for a period of not less than 48 hours.

GUARANTEE

Contractor shall guarantee the following parameters (details as specified in clause no. 2.13 below):

- Hydraulic capacity of RODMP (including recoveries) & ZLDP

- DM water quality
- Intermediate treated water quality
- Life of membranes (warrantee shall be offered to IOCL directly from the membrane suppliers)

TOLERANCES

The guaranteed figures are subject to the following tolerances for acceptance of the plant.

- Capacity measurement $\pm 2\%$.
- Quality measurement as per accuracies guaranteed by the instrument supplier.

In case of any variation over the tolerances given above, contractor shall rectify the plant at his own cost within a time mutually agreed upon by the contractor and IOCL/EIL to bring the plant performance in line with the guaranteed figures.

2.13 PERFORMANCE AND GUARANTEES

- After the system has been stabilized by the contractor during 30 days trial runs and plant is successfully commissioned, the contractor shall conduct a performance guarantee test run for the RO-DMP. The procedure for performance testing shall be submitted by the contractor to the EIL/ IOCL for review & approval. The duration for the performance guarantee test run shall be 72 hours continuous operation of the plant.

The performance guarantee test run for RO-DMP shall be carried out at the design conditions (including design capacities & design feed water quality) at RO-DMP inlet as specified in the Process Design Basis (Doc. No.B269-475-17-44-DB-1001).

During the performance guarantee test runs, the following guarantee parameters shall be fulfilled (within the tolerances as specified) at design conditions as specified above.

Guaranteed Hydraulic Capacity of the Plant (including recoveries):

System/Parameter	Value
Overall Hydraulic Capacity	850 m3/h of net DM water production
UF-I skid	293 m3/h (net treated water/skid) @ 88% minimum recovery
UF-II skid	108 m3/h (net treated water/skid) @ 88% minimum recovery

System/Parameter	Value
RO-I skid	187.5 m ³ /h (permeate water/skid) @ 75% minimum recovery
RO-II skid	217 m ³ /h (permeate water/skid) @ 90% minimum recovery
RO-III skid	82 m ³ /h (permeate water/skid) @ 65% minimum recovery
RO-IV skid	59.5 m ³ /h (permeate water/skid) @ 55% minimum recovery
Mixed Bed Exchanger	3400 m ³ net output between two successful regeneration (each MB)

☞ **DM water quality (parameters to be guaranteed by the contractor at the outlet of MB Exchanger):**

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S. No.	Parameter	Unit	Specification
1.	pH		6.7 - 7.3
2.	Conductivity at 20 °C	µmho/cm	<0.2
4.	Total Hardness as CaCO ₃	mg/l	NIL
5.	Total Suspended Solids	mg/l	NIL
6.	Total (reactive) Silica as SiO ₂	mg/l	<0.02
7.	Turbidity	NTU	BDL
8.	Total Chlorides	mg/l	NIL
9.	Total Iron as Fe	mg/l	<0.01
10.	KMnO ₄ value at 100°C	mg/l	<1
11.	Total Copper as Cu	mg/l	<0.003
12.	Sodium + K	mg/l	<0.01
13.	Oil	mg/l	NIL

BDL: Below Detectable Limit

☞ **Intermediate Treated water quality (parameters to be guaranteed by the contractor):**

System/Parameter	Value (Hold)
SDI at each UF Outlet	≤ 3
Total Dissolved Solids in RO-I permeate	≤ 100 mg/l
Total Dissolved Solids in RO-II permeate	≤ 10 mg/l
Total Dissolved Solids in RO-III permeate	≤ 250 mg/l
Total Dissolved Solids in RO-IV permeate	≤ 350 mg/l

In case the designed feed quantity & quality is not available as specified in the tender document, the PGTR may be carried out (if so desired by M/s IOCL) for the actual conditions within the design conditions for the plant, while performing to the desired treated outlet quality as per the requirement of the tender.

Power Consumption Guarantee for the following pumps shall be provided as per Document No B269-472/475/476-17-44-LC-8701.

Item No.	Tag No.	Item (Pump Set)
a.	475-P-102 A/B/C	Filter Feed Pumps-I
b.	475-P-108 A/B/C	RO-I Cartridge Filter Feed Pumps
c.	475-P-109 A/B/C/D/E/F	RO-I Feed Pumps (VFD Driven)
d.	475-P-110 A/B/C/D/E/F	RO-II Feed Pumps (VFD Driven)
e.	475-P-111 A/B/C/D	RO-III Feed Pumps (VFD Driven)
f.	475-P-121 A/B/C	RO-IV Feed Pumps (VFD Driven)
g.	475-P-112 A/B/C/D/E/F/G	MB Feed Pumps

- b) Any loss of consumable/material during pre-commissioning, trial runs, commissioning, etc. prior to handing over of plant to IOCL shall be made up by the contractor to the quantities specified in the design calculations as initial charge without any extra time & cost to IOCL.
- c) If on testing, any material or equipment or the unit does not meet the design, rated or guaranteed performance related there to, the contractor shall forthwith, within the scope of work of contractor and at no additional cost to IOCL, undertake such additional tests and / or operations as are necessary to identify the cause of such failure. Such tests and / or operations shall be conducted in conjunction with IOCL, if the plant as a whole fails to meet the guarantees.
- d) If as a result of such tests and / or operations it is determined that the design, rated and / or guaranteed outputs or capacities have not been met because of defect in any material(s) (including machines and equipment) supplied by the Contractor, the Contractor shall forthwith in consultation with the Engineer-in charge take steps necessary to cause the defect to be identified and rectified, either by replacement of the defected material, machine or equipment or part thereof or by repair or replacement thereof at sole cost and expenses of Contractor.
- e) In the event that certain of the guaranteed performance have not been met, the Contractor shall make suitable additions, deletions or modifications, if required after

obtaining approval of IOCL/EIL to the process and the Plant to ensure the guaranteed results.

2.14 GUARANTEED LIFE OF MEMBRANES

Guaranteed membrane life for UF membranes shall be for a period of 5 years and guaranteed membrane life for RO membranes shall be for a period of 3 years from the date of successful commissioning. During this period of guarantee, guarantees for UF & RO membranes for first year shall be absolute (full replacement without any cost to the IOCL) and for subsequent years the guarantees for UF & RO membranes shall be on pro-rata basis as offered by the membrane suppliers in line with internationally acceptable norms. The testing of membranes (Autopsy) for foulants (if required) shall also be carried out by the contractor at his own cost. IOCL shall have no liability on this account.

2.15 PROJECT MANAGEMENT

Effective project management within time frame is also a part of the contractor's scope. The system of organization & control; feedback & corrective measures; communication & project execution scheme to be submitted.

Planning, scheduling and monitoring is essential for timely completion of the project and effective project management system to be adopted as enumerated.

3.0 BATTERY LIMIT CONDITIONS

Feed treated effluent, treated raw water lines and various other incoming and outgoing lines to and from the Plant Battery Limit shall be as indicated in the Process Design Basis, Process Datasheet and other tender document drawings and as indicated below: Plant Battery Limit indicates the combined battery limit for incoming & outgoing lines of RODMP, ZLDP and CPU.

INCOMING LINES

Description	Parameter	Unit	Min.	Nor.	Max.	Design
AT PLANT BATTERY LIMIT (Grade Level)						
CTBD from CT-1,2, Utility Boiler BD, Process Unit BD to RODMP	Pressure	Kg/cm ² g	-	2.5	3.0	15
	Temperature	°C	Ambient			75

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Description	Parameter	Unit	Min.	Nor.	Max.	Design
Suspect condensate to CPU	Pressure	Kg/cm ² g	-	3.5	-	14
	Temperature	°C	-	90	-	150
Pure condensate to CPU	Pressure	Kg/cm ² g	-	3.5	-	14
	Temperature	°C	-	90	-	150
Treated Raw Water from Reservoir to RODMP	Pressure	Kg/cm ² g	-	2.5	-	10.5
	Temperature	°C	-	Amb.	-	65
Cooling Water Supply	Pressure	Kg/cm ² g	-	4.5	-	8.0
	Temperature	°C	-	34	-	65
Treated Effluent from ETP to RODMP	Pressure	Kg/cm ² g	-	3	-	10
	Temperature	°C	Ambient			65

OUTGOING LINE

Description	Parameter	Unit	Min.	Nor.	Max.	Design
AT PLANT BATTERY LIMIT (Grade Level)						
DM Water to OSBL	Pressure	Kg/cm ² g	As per Process Datasheet No.: B269-475-02-42-DS-1601			
	Temperature	°C	Ambient			65
Polished Condensate to OSBL	Pressure	Kg/cm ² g	-	7	-	16
	Temperature	°C	-	65	-	120
NaOH (20%) to OSBL	Pressure	Kg/cm ² g	-	6	-	18
	Temperature	°C	-	45	45	65
ACF backwash from CPU to ETP	Pressure	Kg/cm ² g	-	3.0	-	12.5
	Temperature	°C	Ambient			125
Sanitary Sewage to OSBL	Pressure	Kg/cm ² g	GRAVITY FLOW			
	Temperature	°C	-	45	45	65
RO-I Permeate to Treated Raw Water make-up line	Pressure	Kg/cm ² g	-	6	-	8
	Temperature	°C	-	Amb.	-	-

The following utilities shall be supplied at the Plant Battery Limit:

- Plant Air
- Instrument Air
- MP Steam
- MP BFW
- LP steam
- Service Water
- Drinking Water
- Nitrogen
- Power
- Fire Water
- Cooling Water

4.0 SCOPE OF CONTRACTOR'S WORK/ SUPPLY (ISBL)

The Contractor's scope of supply of equipment as minimum shall be as given in this specification, Process Design Basis, Equipment List, Process Datasheets, PFD, P&IDs, and as specified elsewhere in the Tender Document.

All works required inside the battery limit of RODMP for treatment including all associated facilities as per tender requirements shall be in contractor's scope of supply.

For all the equipment listed in tender or as required to make the plant complete in all respects to deliver the required quantity & quality of treated products, the contractor has to supply piping, valves and fittings, instruments, electrical items, consumables, etc. and all other items as indicated in the equipment list, datasheets, P&IDs, PFDs etc., or as required to make the plant complete with respect to safe & trouble-free operation of the plant.

The proposed RODMP shall be designed for the conditions as specified in the Process Design Basis documents and as described in the subsequent sections of this specification and as described elsewhere in the Tender Document.

Equipment list for RODMP shall be as per the Equipment List (Document No. B269-475-17-44-EL-1001) attached with the tender. Bidder may include in his scope any additional requirements/equipment, if so warranted by him, in order to meet the guarantees as specified in Clause No. 2.13 & 2.14 of this specification.

Also, all other works (including civil & structural works) mentioned elsewhere in the tender document or as shown in the drawings but not listed herein shall also be deemed to have been included in contractor's scope of work.

The contractor shall provide one **Double Storied CHEMICAL HOUSE BUILDING** within the battery limit of RO-DMP to house chemicals required for **twenty days requirement** based on chemical solution strengths & dose rates specified in the datasheets, otherwise as per process requirements & shelf life.

Each dosing tank in solution preparation area shall have working platform guarded by handrails and its floor shall be made of nonskid galvanized plate/ chequered plates. Width of platform shall be 1.5 m minimum and access steel stairs (both sides of the

platform) shall be of minimum 1000 mm width. All fixing arrangements on platform shall be by bolting and not by welding.

Storage, unloading/ transfer and handling facilities for bulk liquid chemicals (acid, alkali, etc.) shall also be provided by the contractor in the RODMP. Unloading bays shall also be provided at the Bulk chemical storage tanks.

The RO-DMP & ZLD shall be controlled from the Common Control Building which shall house the Substation and Control room along with associated facilities for the RODMP, ZLDP and CPU Plants.

The Control system for RODMP+CPU and ZLDP shall be PLC based. All signals of the RODMP+CPU and ZLDP shall be routed to the Common Control Room for Monitoring and Control of the Plants. Separate PLC based control systems are envisaged for RO-DMP+CPU and ZLD. The Operator consoles for the RODM + CPU and ZLDP shall also be separate.

All Signals of the RODMP+ CPU and ZLDP shall be repeated in the MCR of the Refinery for Monitoring. The detailed Instrumentation scope shall be as per the Instrumentation Specifications provided in the Tender.

Power for the RODMP + CPU and ZLDP shall be supplied from the Common Substation housed in the Control Building for the RODM, ZLDP and CPU Plants. All Motor Controls shall be located in the Common Substation. Detailed Electrical scope shall be as per the Electrical Specifications attached in the Tender Document.

Space shall be kept in SS/SRR, control room, junction boxes etc. for electric connections, instrumentation and control signals of one future chain of 140 m³/h of CPU.

An elevated RCC Column structure/ platform shall be provided by the contractor for Degasser system.

DM Storage Tanks & DM Transfer Pumps shall be in scope of the contractor.

ZLD Plant shall be located on a superstructure in the scope of the contractor.

Since the RWTP & RO-DMP shall be commissioned before commissioning of compressed air system (Plant Air & Instrument Air), Supply of Instrument Air till

commissioning of RWTP & RO-DM Plant & during operation of 3 months after commissioning of RWTP & RO-DM Plants shall be in scope of Contractor. The quantity and quality of the instrument air required for the operation of the RWTP & RODMP shall be ensured by the Contractor during commissioning and 3 months Operation of the Plants.

Cooling water supply for the compressed air system shall be in scope of the contractor. After commissioning of compressed air system, Instrument Air & Plant Air in RWTP & RO-DMP shall be taken from Instrument Air and Plant Air Headers available at the battery limit of the RWTP and RODM, ZLD and CPU Plants.

A **UF/RO SHED** shall be provided by the contractor for housing the following items/equipment in RODMP:

- Auto backwash filters (ABF-I & ABF-II)
- UF Skids – I & UF Skids – II
- RO Skids – I, RO Skids – II, RO Skids – III & RO Skids – IV
- Cleaning systems for the RO skids
- Cartridge filters (CF-I & CF-II)
- RO-I feed pumps, RO-II feed pumps, RO-III feed pumps & RO-IV feed pumps
- Pressure Exchangers, Pressure Exchangers Booster Pumps, Turbo Chargers
- MB Exchanger Vessels (RO-DMP and CPU)
- Oil Coalescers & ACF (CPU)
- Analyser Room (with air conditioner)
- Common CEB Tanks and Dedicated CEP/CIP Pumps for the UF Skids System
- ACF cum MB air Blowers (CPU)
- MB Air blowers (RODMP)
- Acid & NaOH dilution/measuring tanks (DMP & CPU)
- NaOCl Storage area

Adequate operational, maintenance and access space shall be provided in the UF/RO shed, which shall be reviewed and approved by EIL during detailed engineering. The sizes indicated for the UF/RO shed are minimum. Any increase in the size during detailed engineering review shall have no implications of time and cost to the IOCL on this account.

All blowers for RWTP, RO-DMP and CPU shall be provided under shed.

VFD of all RO-I, RO-II, RO-III & RO-IV Feed pumps shall be without bypass facility & other VFD driven pumps shall be as per Electrical specifications.

Provision for continuous online monitoring and recording of power consumption for the following pumps shall be provided:

- RO-I Feed Pumps
- RO-II Feed Pumps
- RO-III Feed Pumps
- RO-IV Feed Pumps

Sewerage generated from RODM/CPU/ZLDP buildings shall be hooked up with plant sewer network at South of RODM battery limit.

Two H₂S gas detectors shall be installed on the South Boundary of the RODMP/CPU/ZLDP Plot.

5.0 GENERAL DESIGN & ENGINEERING REQUIREMENTS

➤ Line Size Criteria to be based on following pipe/line velocities:

- ☞ Pump Discharge : 2.0 m/sec (maximum)
- ☞ Pump Suction : 1.2 m/sec (maximum)
- ☞ Gravity Lines : 0.8 m/sec (maximum)

➤ Piping class shall be as given below for the indicated services. Corresponding material shall be as per EIL Piping Specifications.

5

Service	Piping Class
Water main line up to RO-I Cartridge Filter Feed Pump Outlet header	A93A
RO-I Cartridge Filter Feed Pump Outlet header to MB Outlet/ Battery Limit	A1K
MB Common Header to DM Tank	A1K
RO - I Reject to RO-III inlet	A1N/B1N
RO - III Reject to RO-IV inlet	SDSS
RO-IV Reject to ZLD Package outlet	SDSS
ZLD Package outlet to UF Feed Tank	A1K

Service	Piping Class
Chemical Sludge	A9A
Caustic Lye	A19A
Hydrochloric Acid Solution	CPVC
Caustic Solution	A19A
PAC Solution	CPVC
Sodium Hypochlorite	CPVC
Antiscalant	CPVC
Sodium Bisulphite	A1K
Dewatering Polyelectrolyte (DWPE)	A1K
Lime	CPVC
Coagulant	CPVC
Polymer	CPVC
Morpholine	A1K
Cleaning Chemicals	CPVC
Service Water	A93A
Plant Air	A3A
Instrument Air	A93M (SS 316 up to 1" size)
Drinking water (AG/UG)	J92A (0.5" to 6" size) (burial depth up to 1.5M)
LP Steam	A2A-IH
MP Steam	B2A-IH
MP BFW	D2A-IH
Cooling Water Supply & Cooling Water Return	A93A (AG) (0.5"-16") A92A (UG) (burial depth up to 3.0 m)
Fire Water	A91Y
Nitrogen	A3A
From inlet isolation valve (manual) of MB up to outlet isolation valve (manual) of MB including all frontal piping for MB and piping on MB. Caustic (up to 5% concentration), HCl (up to 5% concentration), DM water for Regeneration.	A1K
For all incoming lines, same class of piping, as available at the Plant battery limit, shall be used up to their respective first unit. Material, for services not listed here, shall be subject to EIL's review and approval during engineering.	

Service	Piping Class
<u>In case, different material & line size is specified in the tender drawings (Schematic Flow Diagram, PFDs, P&IDs, etc.), the material & line size specified in the drawings shall be provided as a minimum.</u>	

- Following types of valves shall be used for the Indicated Services.

Service	Valve Type
Effluent Lines/Treated water lines	Gate & Globe Valve/ Butterfly Valves
Conc. Hydrochloric Acid	Ball Valve
Caustic Solution Lines	Plug Valve (Lubricated)
Chemical Solution Lines	Ball Valves / Diaphragm Valves
Sampling Lines	Gate followed by Globe Valve
Other type of valves such as Check Valve (NRV), Control Valve etc. shall be provided, wherever required. Isolation valves shall be provided in each unit as per the valve specs. MOC of the valves shall be compatible with MOC of the pipe.	
Spectacle blinds shall be provided downstream of all tank drain lines as well as at other main isolation places, wherever required.	
Piping components and its type shall be provided, as appropriate, which shall be subject to EIL's review and approval during Detailed Engineering.	
All Butterfly Valves shall be double offset tight shut-off valves.	
Valves shall be provided as per the P&IDs.	

- For a full liquid system at the discharge of centrifugal pumps/blowers, the design pressure shall be as under.

$$P(\text{des}) = P(\text{max}) \text{ suction} + \text{DELTA } P(\text{max})$$

where,

$P(\text{max}) \text{ suction}$ = Maximum pressure at suction vessel bottom during suction system relieving conditions.

$\text{DELTA } P(\text{max})$ = Pump differential pressure at pump shutoff head with maximum operating density. If not known:

$\text{DELTA } P(\text{max}) = 1.2 \times \text{DELTA } H \times \text{Density}(\text{max})$: constant speed pump

$\text{DELTA } P(\text{max}) = 1.1 \times 1.2 \times \text{DELTA } H \times \text{Density}(\text{max})$: variable speed pump

$\Delta P(\max) = 1.3 \times \Delta H \times \text{Density}(\max)$: high head multistage pump

$\Delta P(\max) = 1.3 \times 1.1 \times \Delta H \times \text{Density}(\max)$: variable speed high head multistage Pump

Where, ΔH is the pump head at rated condition

- For a full liquid system at the discharge of positive displacement pumps, the design pressure shall be the higher of:

$$P(\text{des}) = P(\text{rated}) \text{ discharge} + 2 \text{ kg/cm}^2$$

$$P(\text{des}) = 1.1 \times P(\text{rated}) \text{ discharge}$$

- Vessels operating under vacuum shall be, in general, designed for an external pressure of $1.033 \text{ kg/cm}^2 \text{ abs}$ and full internal vacuum, unless otherwise specified.
- All the pumps which are to be located below FGL shall have a suitable pump house building having RCC construction below FGL and RCC lintel and brick masonry work above FGL. All pump pedestals shall have arrangement for collection of leakage and connection to the nearest drain. Edges of pump pedestals in pump house shall be kept in one line on pump motor side so as to render clear walkway. The clear distance between adjacent pump/blower pedestals shall be minimum 900 mm. Minimum clearance of 500 mm shall be provided around pumps / blowers / equipment pedestal for paving, etc. applicable guidelines shall be followed for the minimum clearances between the adjacent equipment/pumps/blowers etc.
- The complete battery limit area of RO-DMP, ZLDP & CPU shall be RCC paved as per the specifications given elsewhere in the tender
- Common delivery header and suction header of pumps (and blowers) shall be provided with a blind flange on one end. Recirculation lines for the pumps shall be provided by the vendor as indicated in the tender PFDs / P&IDs and also shall be provided as per process requirements/ turndown requirements.
- All working & standby pumps (including warehouse/store standby) shall also be provided with the respective motors. All motor shall have running indication in control room. Motors of all pumps and blowers, if not housed under shed/room, shall be covered with canopy. Suction line/filter of blowers shall also be provided with canopy.

- Rated capacity of all the blowers shall be minimum 10% more than the normal process requirements. Also, head of all the pumps (except RO high pressure pumps) shall be minimum 10% more than the total calculated head (including static head and losses in pipes, fittings, instruments, etc.) based on normal process requirements. All sets of rotating equipment viz. pumps, blowers, compressors, etc. shall be provided with at least one standby of same capacity as the operating equipment.
- Chemical dosing pumps shall be designed to cater for minimum to maximum hydraulic requirements. All chemical dosing pumps shall be provided with pressure safety valves and pulsation dampeners on individual pump discharge. All chemical handling pumps shall have permanent flushing connection (inlet and outlet).
- All pumps shall be flooded suction type, unless otherwise specified, fully primed under Low Liquid Level in the suction sump/ tank. Also, for all pumps with flooded suction, LWL in the tank/sump shall be above the top of pump casing.
- Effective liquid depth (side water depth) of tank/ sump shall be considered between Low Water Level (LWL) & Top Water Level (TWL) and shall exclude free board & dead volume depth (liquid depth below LWL). The tank/sump floor shall slope towards suction pit/channel. All RCC sumps shall be made water tight and designed as water retaining structure as per engineering specifications. All above ground holdup tanks/ sumps shall be provided with overflow lines, drain etc. and provision shall be made to route the overflows from all the sumps, tanks and pump leakages to OWS sump.
- All bulk Acid, caustic and other hazardous Bulk chemical storage tanks shall be located inside dyked areas (separate dykes for different chemicals), suitably lined (floor, inside dyke wall and all structures inside the dyked area) with acid/alkali proof tiling. Chemical drain lines shall also have Acid/alkali proof tile. Dyke height (minimum 1000 mm) shall be sufficient to hold total volume of chemical of the largest tank. Proper floor slope shall be provided for area drainage. Internal drainage of the dyked area shall be routed to OWS sump with a provision to route to storm water sewer (with isolation valves). Minimum distance of dyke wall inside from tank shell shall be half the tank's total height. Also, minimum distance between the two tanks (shell to shell distance) inside the same dyke shall be one fourth the sum of diameters of the two tanks.
- All Acid, Alkali and other hazardous chemical dosing pumps & dosing tanks shall be located inside a kerbed area, suitably lined (floor, inside kerb wall and all structures inside the kerb area) with acid/alkali proof tiling. The pumps & tanks shall be located on elevated platform, with platform elevation higher than kerb height (minimum 150 mm).

Proper floor slope shall be provided for area drainage. Internal drainage of the kerb area should be routed to a neutralization pit and after neutralization shall be routed to the backwash waste sump in RODM section. Drains of all chemical storage tanks shall be provided with spectacle blind in addition to valves.

- Flushing connections shall be provided in all chemical & sludge handling units & lines. Flow measurement shall be provided at all chemical dosing lines. Safety measures for hazardous chemical handling shall be strictly followed as per industry norms and manufacturers recommendation.
- Sufficient tanker parking space shall be provided near all chemical unloading pumps and entrance to chemical storage area in Chemical House.
- RO membrane windings are an integral part of membranes and are supplied along with the membrane by the membrane supplier. The guarantee/warranty for RO membranes shall extend to their respective winding also. Pressure tube is a protective cover, wherein membrane elements re-housed. RO pressure tubes shall be as per ASME.
- Head of RO feed pumps & RO booster pumps should be designed such that it is suitable for at least two approved makes of membranes at design condition.
- Block & bleed valve arrangements shall be provided at backwash inlet and regeneration (acid & alkali) inlet of individual MB.
- Cathodic protection shall be considered for all tanks which are not provided on RCC/pile foundation.
- Plant air, Service water & LP steam hose connection with flexible hose pipe with suitable length at pump houses, sludge handling area, chemical storage and handling area and others wherever applicable shall be provided. Safety Shower and eyewash facility, service water and plant air hose connection shall be provided near bulk storage & other chemical handling areas. FRP grating, hand rail and members shall be used in chemical and highly corrosive area.
- All piping at battery limit shall be left with flange connection. The ISBL piping shall be through pipe racks, pipe sleepers and trenches /underground lines as per the Engineering Specifications. U/G piping shall have a minimum cushion of 1.2 m below FGL. Wherever such cushion is not feasible, pipe shall be encased in R.C.C. pipe.
- Dewatering systems shall be provided for trenches if considered in the UF/RO-shed.

- All valves shall be located at operable height from the ground/permanent platform. Platform for operation of valves shall have a minimum width of 900 mm with galvanized grating / chequered plate. All below grade valves shall be operable from grade by providing extended spindle and hand wheel arrangement.
- All motorized valves and all auto ON/OFF valves shall have provision for manual override.
- All instrument indication facility shall be readable from grade.
- Access to the platform shall be by ladders. Access shall be by staircase if unit requires frequent attention of operating personnel. Approach & platform shall be provided wherever adjustable weir, instruments, measuring scale, etc. are kept. Adjoining units shall be connected with operating platform (with Hand-railing).
- **Monorail and Section pulley block (Manually operated) shall be provided for all pump houses, blower sheds, etc.,** of adequate capacity (minimum 1.1 times the weight of heaviest equipment). Drop-out platform (minimum 1.5 m wide) shall be provided. Monorail shall be extended outside the Pump houses/sheds/ buildings to facilitate loading / unloading equipment directly on vehicle, for which ramp approach shall be given. Vehicular approaches shall be provided to units wherever required from maintenance / operation point of view.
- A monorail hoist (electrically operated) with a capacity of 1.5 tonne along with cradle shall be provided in the first floor of chemical house.
- A monorail hoist (electrically operated) or EOT of adequate capacity (minimum 1.1 times the weight of heaviest equipment) along with cradle shall be provided in UF/RO shed.
- Vehicular approaches shall be provided to units wherever required from maintenance / operation point of view.
- The Equipment Layout shall be prepared such that all units are accessible for routine maintenance/repair. It shall also facilitate convenience for regular monitoring of units by operating staff.

- Road approach shall be provided for crane movement for all major and critical equipment. Rerouting or shifting of any under/above ground lines or facilities respectively, as may be required during the execution, shall be under the scope of contractor only.
- Draining arrangement shall be provided for all units/equipment, as necessary.
- Sampling points shall be provided for each treatment section including adequate sampling points for measuring water quality at intermediate points and chemical solution concentration.
- All piping, instrumentation, electrical and other mechanical works as necessary are in Contractor's scope.
- Sizes/specifications as given in various datasheets of the tender are minimum requirements, which are to be followed by the bidders as a minimum. Higher sizes, if process design demands, shall be provided by the bidders at no extra cost to IOCL. These are part of the detail engineering review/approval by EIL.
- Type and minimum size of manholes (for pressure vessels, tanks, covered sumps, underground sewer etc.) shall be as per EIL standards. All vessels with a bottom manhole shall have a clear height of 1.2 m below the manhole elevation.
- The specifications/requirements are bare minimum only. The vendor shall follow good engineering practices and incorporate maximum operational flexibility in the system.

6.0 FORMAT FOR CHEMICAL AND UTILITY CONSUMPTION FIGURES

All Utilities & Chemicals Consumption which are envisaged to be used in RO-DMP for Normal Operation as well as for start-up / shutdown requirements shall be listed by the contractor.

6.1 Maximum Consumption Figures for Utilities

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/day (1 Day = 24 Hours)
Power	kW		
Service Water	m ³ /hr		
Drinking Water	m ³ /hr		
Plant Air	Nm ³ /hr		
Instrument Air	Nm ³ /hr		

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/day (1 Day = 24 Hours)
Nitrogen	Nm ³ /hr		
LP Steam	Kg/hr		
Cooling Water	m ³ /hr		
Fire water	m ³ /hr		
Any Other			

6.2 Maximum Consumption Figures for Chemicals

Description of Chemical	Dosing Rate in ppm (Normal / Design)	Consumption in kg/d at Design Flow	Purity of Chemical	Solution Strength
Ferric Chloride				
Hydrochloric acid (HCl)				
Caustic (NaOH)				
Sodium Hypochlorite (NaOCl)				
Antiscalant				
Sodium Meta Bisulphite (SMBS)				
Lime				
Morpholine				
Poly electrolyte (DOPE)				
Cleaning Chemicals				
Any Other				

Note: MSDS for all the chemicals are to be provided by the contractor. Chlorine gas and H₂SO₄ should not be used in the plant.

All Utilities & Chemicals Consumption which are envisaged to be used in RWTP, RO-DMP, ZLDP, CPU and CPU-PNCP for Normal Operation as well as for start-up / shutdown requirements shall be listed by the contractor.

7.0 LIST OF ENCLOSURES

All works as per following enclosures are part of contractor's scope of work/supply:

S. No.	Document No.	Document Title
1.	B269-475-17-44-DB-1001	Process Design Basis
2.	B269-475-17-44-0101	Schematic Flow Diagram (2 Sheets)
3.	B269-475-17-44-1001	Equipment Layout
4.	B269-475-17-44-EL-1001	Equipment List
5.	B269-475-17-44-1111 to 1153	P&IDs

S. No.	Document No.	Document Title
6.	B269-475-17-44-DS-1001 to 1127	Datasheets
7.	B269-472/475/476-17-44-VDR-1001	Vendor data requirement (Plot Plan & Water) for RWTP, RO-DMP, ZLDP& CPU
8.	B269-472/475/476-17-44-TC-1001	Technical compliance (Plot Plan & Water) RWTP, RO-DMP, ZLDP& CPU
9.	B269-472/475/476-17-44-SP-1001	Pre-Commissioning, Commissioning and P.G. Test Guidelines
10.	B269-472/475/476-17-44-SS-1003	Operation & Maintenance of RWTP, RO-DMP, ZLDP & CPU
11.	Annexure 1	Basic Engineering Design Basis

ANNEXURE-1

BASIC ENGINEERING DESIGN BASIS

JOB NO: B269

PROJECT: PANIPAT REFINERY EXPANSION (P-25) PROJECT

CLIENT: INDIAN OIL CORPORATION LIMITED(IOCL)

1.0 PLANT LOCATION

1. Site locations
 - a. State/Country: Haryana/India
 - b. Nearest railway station: Panipat
 - c. Nearest town/city: Panipat
 - d. Nearest Airport: Delhi at 100 km approx.
 - e. Nearest national highway: NH-1
2. Rainy season: June to September
3. Sources of Water: Munak Headworks and Recycled treated effluent water
4. Annual Rainfall Max/min/Av. : 750/ 307 / 709.36mm

2.0 METEOROLOGICAL DESIGN DATA

2.1 METEOROLOGICAL DATA

This section presents relevant data towards preparing process engineering specifications.

S. No.	Parameter	Unit	Min.	Nor.	Max.	Design
1	Barometric pressure	mbar	967.3	978.675	988.4	
2	Ambient temperature□	C	tmin=(-) 0.7	tnor =	tmax=46.6	
3	Relative humidity at ambient temperature	%	@ tmin	88@ tnor	95@ tmax	
5	Rainfall data for 1-hour period	mm			72	
5.1	Rainfall data for 24-hours period	mm			218	
6	Wind data					
6.1	Wind velocity @30 m ht.	Km/h			168	
6.2	Wind velocity @10 m ht.	Km/h			152	
6.3	Wind direction Morning				SE to NW	
6.4	Wind Direction Evening				NW to SE	
7	Elevation above mean sea level	m				238

2.2 DATA FOR EQUIPMENT DESIGN

S.No.	Parameter	UOM	Design Value
1	Dry bulb temp. (for air cooler design)	Deg C	43
2	Wet Bulb Temp.	Deg C	27.5
3	Ambient Temp. for MDMT	Deg C	(-) 0.7

S.No.	Parameter	UOM	Design Value
4	Air temp. for air cooled exchangers where followed by water cooling	Deg C	43
5	Air temp. for air cooled exchangers where not followed by water cooling	Deg C	45
6	Coincident temperature for corresponding relative humidity for Air Blower / Air Compressor	Deg C	94 % @ 42 Deg C
	Corresponding Relative humidity for Air Blower / Air Compressor	%	
7	Earthquake criteria		As per IS: 1893, latest revision the site falls under seismic zone IV.

3.0 UTILITY SPECIFICATIONS

UTILITY CONDITIONS AT UNIT BATTERY LIMITS

Utility pressure and temperature levels, as made available at battery limits of a process unit, as indicated below:

Utility conditions at unit B/L [All B/L pressures are as measured at grade] for PANIPAT REFINERY

S.No.	Describe	Parameter	Min.	Nor.	Max.	Design	Remarks
1	HIGH PRESSURE STEAM(HP)	Pressure, KG/CM ² G	38	40	42	47 /FV	
		Temp., DEG C	380	390	400	425	
2	MEDIUM PRESSURE (MP) STEAM	Pressure, KG/CM ² G	12	14	15	18 / FV	
		Temp., DEG C	210	260	305	350	
3	LOW PRESSURE (LP) STEAM	Pressure, KG/CM ² G	3	4	5	7 / FV	
		Temp., DEG C	143	160	190	240	
4	CONDENSATE RETURN (PURE & SUSPECT/ SURFACE) AT PROCESS UNIT B/L	Pressure, KG/CM ² G		5		14	
		Temp., DEG C	40	90	100	150	
5	SERVICE WATER (SW)	Pressure, KG/CM ² G	3	5	6	10.55	
		Temp., DEG C		Amb		65	
6	COOLING WATER	Supply Pressure, KG/CMG	3.8	4	4.5	8	

		Return Pressure, KG/CM ² G	2.2	2.4	2.8	8	
		Supply temp. DEGC	28	33		65	
		Return temp. DEGC			45	65	
7	DEMINERALISED WATER	Pressure, KG/CM ² G	4	7.5	8	16	
		Temp., DEG C	30	40	50	65	
8	BOILER FEED WATER (HP/MP)	Pressure (MP BFW), KG/CM ² G	25	28	35	40	
		Pressure (HP BFW), KG/CM ² G	47	50	58	76	
		Temp. (MP BFW), DEG C	100	100-105	110	150	
		Temp. (HP BFW), DEGC	100	100-105	110	150	
9	PLANT AIR	Pressure, KG/CM ² G	4	6	8	10	
		Temp., DEG C		AMB		65	
10	INSTRUMENT AIR	Pressure, KG/CM ² G	5	6	7	10	
		Temp., DEG C		AMB		65	
11	NITROGEN	Pressure, KG/CM ² G	4	5	7	10.5	
		Temp., DEG C		AMB		65	

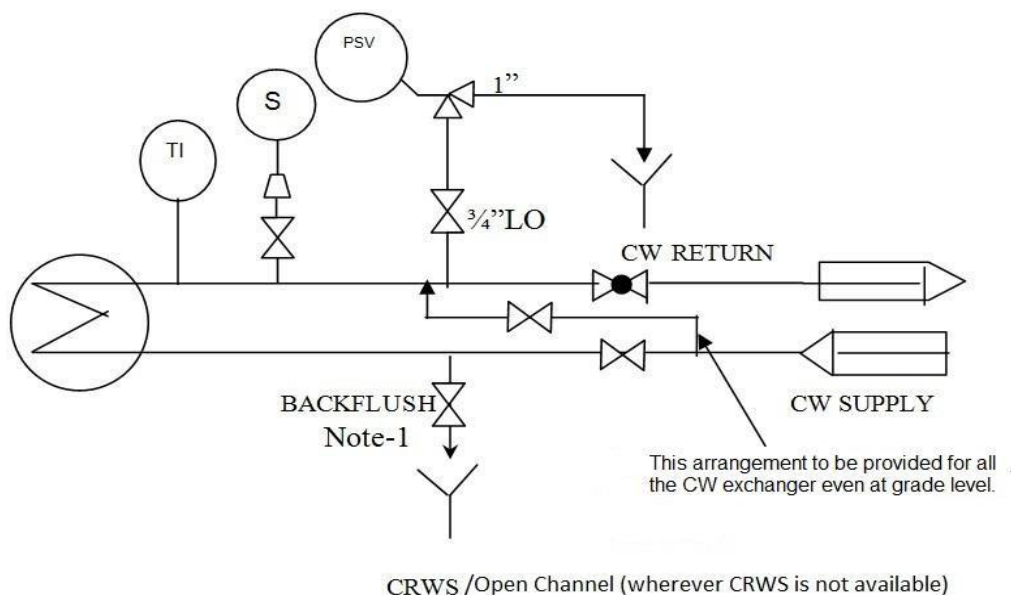
Operating and design parameters shall be updated based on final utility design basis.

4.0 BACK FLUSHING

Owner can choose to provide back flush arrangement for cooling water consumers connected to a recirculating / cooling water system. When provided, EIL recommends the connection as in 4.1 Backflush to be from supply header in case of exchangers located on 15 m and above while it shall be from the return header in case of exchanger at lower elevation. Backflush arrangement shall be provided for:

- | | | |
|---|--|-------|
| 1 | All cooling water consumers | YES |
| 2 | Only overhead condensers | NO |
| 3 | Cooling water consumers with water line sizes greater than | NB NO |

4.1 TYPICAL COOLING WATER PIPING AND INSTRUMENTATION AT HEAT EXCHANGERS



Note:

1. Backflush line size shall be of same size as cooling water line upto 6". For cooling water line > 6", Back flush shall be 6" only.

All pump bridle cooling water lines (for bearing cooling, gland cooling, seal cooling) shall be minimum 2" NB Sch. 80. Tapping for bearing cooling water should be taken from top of the CW supply header.

The return line routing, as preferred by owner, will be:

- | | | |
|---|--|-----|
| 1 | Return line to be connected to cooling water return header. | NO |
| 2 | Return lines to be connected to separate header routed back to cooling tower sump | YES |
| 3 | Return lines shall connect to a dedicated above ground sub-header for collection of bridle cooling water only and this sub-header shall be connected to cooling water return header within ISBL near battery limit. Individual connections from pump bridle cooling water return shall be connected with sight glass. In addition, the local draining provision for pump bridle cooling water return line from individual pumps shall also be provided for checking/ensuring bearing cooling water flow. Additionally, provision of dedicated bearing cooling water return header to the respective cooling tower sump shall also be provided. | YES |
| 4 | Return lines to be connected to separate buried header leading to a sump within unit. Sump to be provided with overflow provision to CRWS. The water from sump can be processed by Pump out return water to CWR header within ISBL | NO |

5.0 HEAT EXCHANGERS AND COOLERS

5.1 FOULING FACTOR

FOULING FACTORS FOR PROCESS STREAMS

Fouling factors for process streams shall be decided by Licensor / designer based on past experience and good design practices. However, owner's overriding considerations towards fouling factors for specific units or process streams shall be the basis of specifications.

FOULING FACTOR FOR UTILITY STREAMS

The following default fouling factors for utility streams shall be used

Utility Stream	EIL Default
Cooling Water	0.0004 hr-m ² -DEG C/kcal For Shell & tube Type
Tempered Water	0.0002 hr-m ² -DEG C/kcal
Steam	0.0001 hr-m ² -DEG C/kcal
Nitrogen	0.0001 hr-m ² -DEG C/kcal
Air	0.0001 hr-m ² -DEG C/kcal
DM water	
Condensate	

5.2 VELOCITY CONSTRAINTS

EIL recommends that constraints be specified for tube side velocities for better on-stream factors of heat exchangers / air coolers, as applicable in fouling services.

Cooling water flow rates are normally not expected to be turned down during operation and can be designed for a velocity constraint applied only for normal flow.

Residue and heavy oil services would have flow rates turned up or turned down during operation and need to be designed for a velocity range that will ensure low fouling regime.

For slurry oils such as catalytic cracker bottoms, such a velocity range has to ensure that solids do not settle out in the tubes while ensuring that this will not result in erosion of tubes.

Respective unit Licensor's / designers shall be required to specify velocity ranges as part of heat exchanger specifications.

EIL default values are as follows:

For critical coolers and condensers, tube inserts may be considered.

Service	Minimum (m/sec)	Maximum (m/sec)
Cooling water	1.0(min)@ normal flow	Admiralty brass, Aluminium or copper - 1.5; Aluminium brass - 2.4; Aluminium bronze - 3.0; Cupro- Nickel 70/30 - 3.0; Cupro-Nickel 90/10 - 2.4; Titanium - 4.5; Monel - 3.7; Austenitic stainless steel & Ni-Fe-Cr alloys - 4.6; Carbon steel with organic protective lining - 2.1; Carbon steel - 2.1

5.3 GENERAL SELECTION OF HEAT EXCHANGER TYPES

5.3.1

All exchangers to be designed as per ASME Code / TEMA-R/ Any other relevant international standard. All shell and tube heat exchangers shall follow TEMA-R unless specified otherwise. The following general criteria for selection of type of heat exchanger will be followed:

- a) Floating head heat exchangers-
In general, floating head exchangers will be preferred with the following features:
- Horizontal
 - Single shell pass
 - Floating head tube bundle (TEMA type "S")
 - Two or more tube passes per shell
- b) U-tube exchangers-
U-tube exchanger will be considered in case of services with:
- Steam condensing/ generating in the tube side.
 - Hydrogen service or other clean service in the tube side requiring no cleaning.
- U-tube exchangers shall not be used for cooling water service
- c) Fixed tube sheet heat exchangers-
The use of fixed tube sheet heat exchangers shall be minimized to the extent possible. These can be used in limited services such as Vertical thermosyphon reboilers where clean fluid is on shell side.
For fixed tube sheet heat exchangers
- Steam-out conditions shall be specified for fixed tube sheet heat exchangers, considering shell-side or tube-side or both sides simultaneously being steamed out at one time.
 - Start-up and upset condition for fixed tube sheet exchangers shall be specified as well.
 - Expansion bellows are not preferred on fixed tube sheet heat exchangers.
- d) Double pipe or multi-tube heat exchanger-
Double pipe or multi-tube heat exchanger should not be used except in the event of infeasible shell-and-tube heat exchanger design.
- e) Stubbed-in reboiler type-
Stubbed-in reboilers be avoided as far as possible in order to facilitate equipment maintenance.

If owner has any known constraints or any other preference, specify below:

- For Fractionator and Stabilizer columns overhead condenser: Two shells in parallel may be considered with each 50% of design duty.
- Two number of chemical cleaning nozzle, each of minimum 2" shall be considered for steam service in shell side of exchanger.

5.3.2 GENERAL CRITERIA OF SELECTION OF TEMA TYPE OF EXCHANGERS AND DESIGN OF TUBE PITCH

Shell side fouling resistance(Hr-m ² - DEG C/ Kcal)	Tube side fouling resistance(Hr-m ² - DEG C/ Kcal)	TEMA type(preferred)	Tube Pitch
>0.0002	>0.0002	Floating head	Square/rotated square
<=0.0002	-	Fixed tube sheet	Triangular pitch
-	<=0.0002	U tube bundle	-Triangular pitch in case shell side fluid is clean. -Square/rotated square in case shell side fluid is fouling.

5.3.3

Vertical thermo siphon, horizontal thermo siphon, or, kettle type reboilers can be specified by unit designers, as found appropriate. Considerations shall be given to:

- Process fluid degradation
- Fouling tendency of process fluid
- Process hold-up volumes within exchangers and constraints, if any
- Film boiling possibilities and temperature difference between hot and cold fluids.
- Width of boiling range.
- Vaporization rates and variations anticipated.
- Equipment investment.
- Equipment space and installation constraints, if any.

For design of coolers and condenser, consider normal cooling water temperature for supply & return.

5.3.4 SELECTION OF HEAD FOR EXCHANGER DESIGN

The following criteria will be followed as default:

- a) TEMA type B stationary head: hydrogen services or when steam or other clean fluid is on tube side, not requiring cleaning.
- b) TEMA type A stationary head: when tube side fluid is cooling water or similar process fluids, requiring cleaning.
- c) TEMA type B or C stationary heads:
 - i. Shall not be used when design pressure is higher than 140 atm.
 - ii. Tube-sheet shall not be full diameter extended type when TEMA type B stationary head is used.
- d) Consideration shall be given for Hydro testing of tubes for IBR / normal testing after preventive maintenance. If necessary dummy shell shall be designed for testing.

5.4 SIZES FOR SHELL AND TUBE EXCHANGERS WITH REMOVABLE BUNDLES

5.4.1 SELECTION OF TUBE DIAMETER AND THICKNESS

Tube dimensions:

Type	Category-A	Category-B
Tube Diameter	25.0mm / 20.0 mm	25.0mm / 20.0 mm
Tube thickness	2.5mm / 2.0mm	2.0mm / 1.6mm
Tube thickness (IBR Service)	2.5mm / 2.1mm	2.1mm / 2.1mm

Note:- Higher tube OD to be used in case of pressure constraints.

Legend:

Category A; CS/Low Alloy

Category B: High Alloy/SS/Admiralty Brass

Any change in the above dimensions, specific approval is needed.

For Titanium type:

Tube diameter is 25mm/20mm Tube thickness is 1.2mm/0.9mm

5.4.2 SELECTION OF TUBE LENGTH

Tube length:

Shell and tube floating head type: 6/9 meters (General) U-tube type : 6 meters max. (straight

portion)

Fixed tube sheet exchangers: 12 m (maximum)

Note: In case of design constraints, lower tube lengths & intermediate length between 6 to 9 meters may be used for removable tube bundle exchanger.

5.4 3 SELECTION OF REMOVABLE TUBE BUNDLE

FOR LP EXCHANGERS:

Maximum bundle diameter will be

1.9 m for 9 m tube length and

2.0 m for 6.0m tube length.

Exchangers at grade level can be up to 60 tons bundle weight. Exchangers that are installed in structure shall be 40 tons (maximum). Vertical exchangers that require a crane to pull bundles are an exception to 40 ton limit.

In case removable tube bundle weight for any exchanger exceeds the stipulated value client specific approval to be obtained before finalization of design.

FOR HP EXCHANGERS:

Maximum bundle diameter will be 1.6 m and Maximum tube length will be 7.5 m. (For Grade mounted exchangers weight is not a constraint).

Note 1: Tube extractors are recommended for maintenance of exchangers at elevation.

Note 2: In case of design constraints, lower tube lengths may be used for removable tube bundle exchanger.

Note 3: The exchanger diameter to be fixed and the length of tube to be varied between 6m and 9m.

6.0 STANDARD SIZE OF STEAM-OUT, VENT, DRAIN, & ACCESS NOZZLES (MANHOLE & HANDHOLES)

Standard size of Steam-out, vent, drain, and access Nozzles (Manhole & Handholes) as per EIL's default shall be as follows.

All vertical vessels not having any nozzle on top shall be provided with 2" NB nozzle for hydrotesting in vertical position,

Vessel volume m3	Vessel/tower diameter(mm)	Steam-out size(clad/unclad)	Vent size (clad/ unclad)	Drain size (clad/unclad)	Manhole size
V < 6.0		3"/2" NB	3"/2" NB	3"/2" NB	
6.0 < V < 15		3"/2" NB	3"/2" NB	3"/2" NB	
more than 15		3"/2" NB	3"/2" NB	3"/2" NB	
	≤ 900				18" NB
	900 - 1200				20" NB
	> 1200				24" NB

7.0 BATTERY LIMIT INSTRUMENTATION

UTILITY LINES

As a minimum, the following shall be provided in utility headers of the Unit: Owner to indicate the requirement.

S.No.	Utility	local PI	DCS PI	PAL/PAH	local TI	DCS TI	TAL/TAH	DCS FI	FAL/ FAH	DCS FQ
0.1	HP steam	y	y	y	y	y	y	y	y	y
1	MP STEAM	y	y	y	y	y	y	y	y	y
2	LP STEAM	y	y	y	y	y	y	y	y	y
3	Condensate	y	y		y	y		y		y
4	CW supply	y	y	y	y	y	y	y	y	y
5	CW return	y	y	y	y	y	y			
6	Instrument Air	y	y	y	y			y	y (FAL)	y
7	Plant Air	y	y	y	y	y	y	y		y
8	Inert Gas	y	y	y	y	y		y	y	y
9	Fuel Gas	y	y	y	y	y	y	y	y	y
10	Fuel Oil Supply	y	y	y	y	y	y	y	y	y
11	Fuel Oil Return	y	y	y	y	y	y	y	y	y
12	DM Water	y	y	y	y	y		y		y
13	Service Water	y	y	y	y	y		y		y
14	Flare	y	y	y	y	y		y	y (FAH)	y
15	Fire Water	y	y	y (PAL)						

For vapor Lines, Temperature / Pressure compensation is to be provided for Flow measure.

8.0 INSULATION THICKNESS

8.1 FOR HEAT CONSERVATION (IH &IT)

8.1.1 FOR HEAT CONSERVATION (IH & IT) -A

Rock Wool (IS 8183-1993 Gr4)

Nominal Dia inches (NB)	upto 125	126-150	151-200	201-250	251-300	301-350	351-400	401-450	451-500	501-550
.5	25	25	40	40	50	65	65	75	90	100
.75	25	25	40	40	50	65	65	75	90	100
1	25	25	40	40	50	65	75	90	90	115
1.5	25	25	40	50	50	65	75	90	100	115
2	25	25	40	50	65	65	90	90	115	125
3	25	25	40	50	65	75	90	100	115	140
4	25	25	40	65	65	75	90	115	140	150
6	25	40	40	65	65	90	100	115	140	150
8	25	40	50	65	75	90	100	125	140	165
10	25	40	50	65	75	90	115	125	140	165
12	25	40	50	65	75	90	115	125	150	175
14	25	40	50	65	75	90	115	140	150	175
16	25	40	50	65	75	90	115	140	150	175
18	25	40	50	65	75	90	115	140	165	190
20	25	40	50	65	75	100	115	140	165	190

8.1.2 FOR HEAT CONSERVATION (IH & IT) -B

Calcium Silicate (IS 9428-1993) (This table is applicable is applicable For fluid having temperature above 550 degC and HP steam service)

Nominal Dia inches (NB)	upto 125	126- 150	151- 200	201- 250	251- 300	301- 350	351- 400	401- 450	451- 500	501- 550	551- 600	601- 650	651- 700	701- 760
.5	50	50	50	50	50	65	75	90	90	115	115	125	140	150
.75	50	50	50	50	65	65	75	90	100	115	115	125	140	150
1	50	50	50	50	65	65	75	90	100	115	115	140	150	165
1.5	50	50	50	65	65	75	90	100	115	125	125	140	165	175
2	50	50	50	65	65	75	90	100	115	140	140	150	165	190
3	50	50	50	65	75	90	100	115	125	140	150	165	190	200
4	50	50	50	65	75	90	100	115	140	150	165	175	190	215
6	50	50	65	75	75	90	115	125	150	165	165	190	215	240
8	50	50	65	75	90	100	115	140	150	175	175	200	225	250
10	50	50	65	75	90	100	115	140	165	190	190	215	240	265
12	50	50	65	75	90	100	125	140	165	190	190	215	240	265
14	50	50	65	75	90	115	125	150	165	190	200	215	240	275
16	50	50	65	75	90	115	125	150	175	200	200	225	250	275
18	50	50	65	75	90	115	125	150	175	200	215	225	250	290
20	50	50	65	90	90	115	140	150	175	200	215	240	265	290

8.2 FOR PERSONNEL PROTECTION(IS)

8.2.1 FOR PERSONNEL PROTECTION (IS) -A

Rock Wool (IS 8183-1993 Gr4) for process temperatures upto 550C

Nominal Dia inches (NB)	upto 125	126-150	151-200	201-250	251-300	301-350	351-400	401-450	451-500	501-550
.5	25	25	25	25	40	40	40	50	65	65
.75	25	25	25	25	40	40	50	50	65	75
1	25	25	25	25	40	40	50	65	65	75
1.5	25	25	25	25	40	50	50	65	75	90
2	25	25	25	40	40	50	65	65	75	90
3	25	25	25	40	40	50	65	75	90	100
4	25	25	25	40	50	65	65	75	90	115
6	25	25	25	40	50	65	75	90	100	115
8	25	25	25	40	50	65	75	90	115	125
10	25	25	40	40	50	65	90	100	115	140
12	25	25	40	40	65	75	90	100	115	140
14	25	25	40	40	65	75	90	100	125	140
16	25	25	40	50	65	75	90	115	125	140
18	25	25	40	50	65	75	90	115	125	150
20	25	25	40	50	65	75	90	115	125	150

8.2.2 FOR PERSONNEL PROTECTION (IS) -B

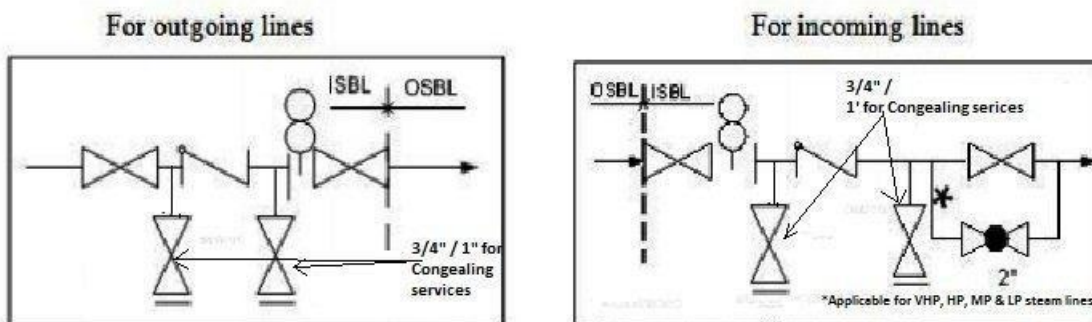
Calcium Silicate (IS 9428-1993)/Rock Wool (IS 8183-1993 Gr 4)

Nominal Dia inches (NB)	551-600	601-650	651-700	701-760
.5	50/40	50/40	50/50	50/65
.75	50/40	50/50	50/65	50/75
1	50/40	50/50	50/65	50/75
1.5	50/50	50/65	50/75	50/90
2	50/65	50/65	50/90	50/100
3	50/65	50/90	50/100	50/115
4	50/75	50/90	50/115	65/125
6	50/90	50/115	50/125	65/140
8	50/100	50/115	50/140	75/140
10	50/115	50/125	65/140	75/140
12	50/115	50/140	65/140	90/150
14	50/115	50/140	65/140	90/150
16	50/115	50/140	65/150	90/150
18	50/125	50/140	65/150	90/150
20	50/125	50/140	65/150	100/150

9.0 BATTERY LIMIT ISOLATION

9.1

The Battery limit isolation for all the incoming and outgoing Process and Utility lines from / to the Process units shall be configured



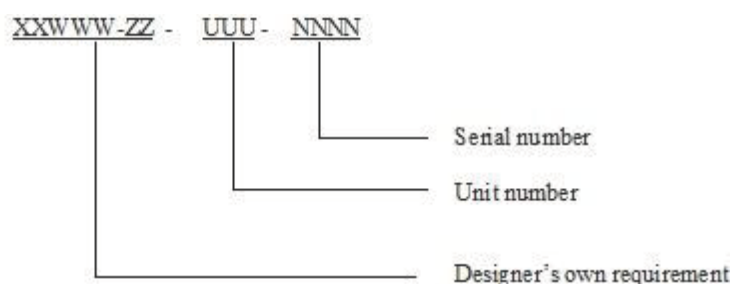
9.2 BATTERY LIMIT ISOLATION REQUIREMENT

Incoming / Outgoing streams	Double Block Isolation valves	Single Block Isolation valve	Non Return Valve (unit side)	Spectacle Blind (unit side)	Bleeder
VHP/ HP steam	YES		YES	YES	YES
MP/ LP steam	YES		YES	YES	YES
Condensate	YES		YES	YES	YES
Instrument Air / Plant Air	YES		YES	YES	YES
Nitrogen	YES		YES	YES	YES
CW supply/ Return	YES			YES	YES
VHP/HP/MP Boiler	YES		YES	YES	YES
Feed Water					
DM Water	YES		YES	YES	YES
Service water		YES	YES	YES	YES
Caustic	YES		YES	YES	YES
Sulphuric acid	YES		YES	YES	YES
Flare	YES			YES	YES

10.0 Tagging & Numbering Philosophy

10.1 Equipment Tagging Philosophy: Equipment tags shall be as per the Equipment List.

10.2 P&ID Numbering Philosophy

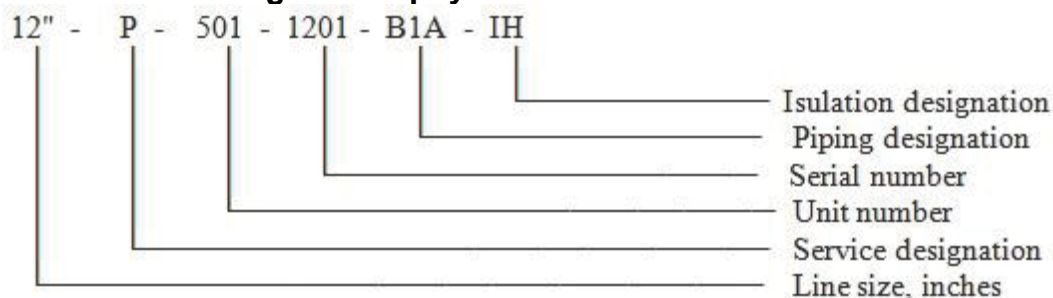


In the four-digit drawing serial number, the digits shall be used as follows:
First digit: '0' for PFDs and '1' for P&IDs, '2' for PCDs, '3' for MFD, '4' for CFD.

Second digit: '0' for iso size A0, '1' for iso size A1, so forth.

Last 2 digits: Serial number starting from '11' for P&IDs, from '01' for PFDs.

10.3 Line Numbering Philosophy

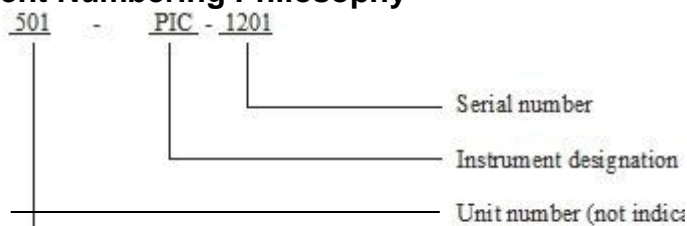


In the four-digit line serial number, the digits shall be used as follows:

First 2 digits: Same as last 2 digits of P&ID serial number.

Last 2 digits: Serial number starting from '01'

10.4 Instrument Numbering Philosophy



In the four-digit instrument serial number, the digits shall be used as follows:

First 2 digits: Same as last 2 digits of P&ID serial number.

Last 2 digits: Serial number starting from "01".

SCOPE OF WORKS/SUPPLY **(PLOT PLAN AND WATER)**

ZERO LIQUID DISCHARGE PLANT

PROJECT : PANIPAT REFINERY EXPANSION PROJECT (P-25)

OWNER : IOCL

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B269

3	07.03.2022	REVISED & ISSUED WITH TA-02	SC/DB	VS	PKG
2	15.07.2021	REVISED & REISSUED FOR TENDER	SC/DB	VS	PKG
1	25.05.2021	REVISED & REISSUED FOR TENDER	SC/DB	VS	PKG
0	27.05.2020	ISSUED FOR TENDER	SC/DB	VS	PKG
Rev. No	Date	Purpose	Prepared By	Checked by	Approved by

1.0 INTRODUCTION

Indian Oil Corporation Limited (IOCL) operates 15.0 million metric tons per annum (MMTPA) refinery at Panipat in state of Haryana, India. The refinery is currently implementing facilities to manufacture 100% BS-VI fuel mandated by Auto Fuel Policy.

In order to meet the demand growth of petroleum products and also to increase its profitability and competitiveness in the long run, IOCL intends to enhance the refinery capacity from 15 to 25 MMTPA. The Expansion Project consists of a new Crude / Vacuum Distillation unit (CDU/VDU) of capacity of 10 MMTPA followed by a SR LPG Treater (SR LPGT), MS Block comprising of NHT, CCRU& Isomerization Unit, Alkylation/ SARU, DHDT, VGO-HDT, RHCu, INDMAX including CR LPG Treater, and PRU. A new PP unit and Catalytic De-waxing Unit are included as value augmentation unit. Auxiliary facilities i.e., HGU, SWS/ARU and SRU and Utility / Offsite (U&O) facilities for the entire project are included in the facility.

A New RO-MB based DM water plant (RODMP) is envisaged in the project which shall process the Cooling Tower Blow Down, ETP Treated Effluent, Boiler Blow Down and Treated Raw Water as make-up to generate the DM water of required Quantity and Quality.

The Zero Liquid Discharge Plant (ZDP) shall be a part of RODMP and shall process the reject/waste stream from the RODM Plant to generate Condensate water that shall be reused as feed to the RODM plant. Dried Solids that are generated after concentration and Drying section in the ZLDP shall be sent for Disposal to secured Landfill.

2.0 DETAILED SCOPE OF SUPPLY/WORK

The scope of work for the Zero Liquid Discharge Plant (ZLDP) as part of the RODMP shall be as follows but not limited to as given herein:

The scope of work shall include Project Management; Residual Process Design& Detailed Engineering; Procurement; Fabrication; Inspection; Supply; Manufacture; Transportation of all equipment/materials to the work site& Storage at site; assembly, erection & installation; Construction and Erection of Civil & Structural, Mechanical, Electrical, Instrumentation & Piping works; Acid /Alkali proof tiling; Painting; Testing; Pre-commissioning, trial run for 30 days before commissioning; commissioning; Training of IOCL's personnel; performance guarantee test run for 72 hours continuous

operation in presence of IOCL's & EIL's Representatives; guaranteeing and handing over of the Zero Liquid Discharge Plant in the RODMP to the Client on lump sum turnkey basis as per design basis, equipment list, standards, P&IDs, data sheets, drawings, etc., all complete within Contractor's specified battery limits including supply of spares, chemicals & consumables.

HAZOP for the complete RWTP, RODMP including the ZLDP& CPU and the implementation of HAZOP recommendation shall be under contractor's scope of work. HAZOP chairman shall be engaged by the contractor at his own cost and his CV shall be submitted by the contractor to EIL/IOCL for acceptance. HAZOP requirements shall be as per the HAZOP specifications attached in the tender.

3D modeling (in PDMS software as defined in the Piping specifications) for the RWTP, RO-DMP including ZLDP and the CPU shall also be included in scope of work of the contractor.

SMART P&IDs shall be prepared for the plant during detailed engineering review and as built.

3

All equipment described in these specifications; datasheets& equipment list; as shown in the P&IDs& PFDs; as mentioned elsewhere in the tender document or as necessary for completeness but not listed above shall also be deemed to have been included in Contractor's scope. All works required to meet requirements given in design/process/operation requirements defined elsewhere in the bid document shall also be deemed to have been included in Contractor's scope.

Contractor's scope of work/supply also includes the following:

- Condensate Polishing Unit (CPU) on LSTK basis as per bidding document specifications No. B269-476-17-44-SS-1001.
- Raw Water Treatment Plant (RWTP) on LSTK basis as per bidding document specifications No. B269-472-17-44-SS-1001
- RO-MB based Demineralization Plant (RO-DMP) on LSTK basis as per bidding document specifications No. B269-475-17-44-SS-1001
- Operation and Maintenance of Raw Water Treatment Plant (RWTP), RO-MB based DM Plant (RO-DMP and ZLDP) & Condensate Polishing Unit (CPU) for a period of TWO (2) YEARS after successful commissioning. Contractor's scope of work during

Operation contract shall be as per Specifications No. B269-472/476/476-17-44-SS-1003.

2.1 PROCESS

Process documents enclosed are the basic documents and are to be followed for execution of job leading to successful commissioning and performance guarantee test run of the Plant. During the course of execution, updating/modification to the process documents that would become necessary is to be carried out with the approval of EIL/IOCL. The resultant work arising out of this will also form the part of scope from detailed engineering to handing over of the plant with no cost implication to IOCL.

The tender specifies the scheme (refer to the PFDs/SFDs and P&IDs attached in relevant sections in tender documents) & Contractor's scope of supply in subsequent sections of this document as minimum requirements. Bidder may include in his scope any additional requirements, if so warranted to meet process guarantees and for smooth safe and trouble-free operation of the plants.

2.2 ENGINEERING

The design basis, data sheets, drawings, standards, specification, codes to be followed for different types of works are brought out in the various engineering sections forming part of the tender document. Contractor shall carry out residual process design & detail engineering works for the plant and submit various drawings and documents for approval of EIL/IOCL before these are released for construction.

2.3 CONSTRUCTION AND INSTALLATION

These activities shall be carried out by the contractor as specified elsewhere in the tender document.

2.4 QUALITY ASSURANCE

These activities shall be carried out by the contractor as specified elsewhere in the tender document.

2.5 STATUTORY CLEARANCES

All the applicable safety codes, national laws and local regulations shall be followed by the successful bidder for the design, engineering, fabrication, erection, commissioning & handing over of the Plant / Equipment and necessary approvals shall be obtained from the concerned statutory authorities by the contractor. Statutory bodies from which approvals may have to be taken include State Pollution Control Board, Chief Inspector of Boilers / IBR, Factory Inspectorate, Labour Authorities, Electrical Inspectorate and Chief Controller of Explosive, Directorate General of Mines and Safety requirements, etc. The contractor shall ascertain requirement of approvals as applicable in such plants and initiation of action as required shall be in contractor's scope.

2.6 SAFETY

These activities shall be carried out by contractor as specified elsewhere in the tender document. All safety procedures for different types of work as per the safety rules from time to time by EIL/IOCL shall be binding and adhered to by the contractor. Safety report generation for different situations as per the rules and required by EIL/IOCL are to be adhered to. HSE policy of IOCL shall be binding upon the contractor.

2.7 VENDOR LIST

For most of the systems/equipment, the approved vendor list of EIL is enclosed in the bid document, which shall be adhered to. While for other items, not listed in the approved vendor list, the suppliers who would be involved for design, engineering and supply of equipment and materials are to be proposed by the contractor (for EIL/IOCL approval) during detailed engineering with the documentary evidence of having supplied similar equipment, systems and/or materials for similar applications with proven track record. Any change for new contractor/supplier after award of contract for supply will not be permitted. It will be necessary to purchase certain items as a system and not as individual equipment. These have to be identified and furnished during detailed engineering for approval of the EIL/ IOCL.

2.8 WASTE DISPOSAL

All wastes generated like surplus earth after use/surplus construction materials to be disposed-off from time to time by the contractor to the disposal locations as directed by the Engineer-in-Charge.

However, disposal of dewatered 'chemical sludge' and dried salts generated from operation of RODMP & ZLDP is excluded from contractor's scope of work and the same shall be disposed off outside RODMP battery limit by M/s IOCL (including transportation through tractor trolley). The trolley and bagging of ZLD salts shall be in contractor's scope.

However, disposal of sludge and dried salts during commissioning and PGTR shall be in contractor's scope.

2.9 DESCRIPENCIES / VARIATIONS IN SPECIFICATIONS / STANDARDS

Bidders may bring out variations, deviations, if any, in related data sheets, equipment list, drawings, specifications, standards, codes, scope and any other contractual clauses before submission of bids and seek clarifications. In case of any contradiction on specification brought out at the post award stage of job, decision of EIL/ IOCL shall be final & binding upon the Contractor without any time & cost implication.

2.10 SUPPLY OF CONSUMABLES & CHEMICALS

Supply of all chemicals (**except HCl & NaOH**), spares and consumables required for the Operation and Maintenance of the plant during start-up, pre-commissioning, 30 days trial runs and up to successful commissioning shall be in the scope of supply of the LSTK contractor. HCl and NaOH shall be free issue supply by IOCL. Special chemicals required, if any, shall be clearly defined by the contractor with respect to quality and quantity and the supply of the same shall also be in Contractor's scope. Minimum two nos. of manufacturers shall be specified by the bidder for these special chemicals. Unloading, handling and storage of all chemicals and consumables (including provision of necessary facilities) shall be done by the contractor.

Also, contractor's scope regarding supply of chemicals, spares, consumables and other requirements during the Two years operation duration shall be as per Specifications No. B269-472/475/476-17-44-SS-1003.

2.11 SPARES

2.11.1 MANDATORY SPARES

Contractor's scope regarding supply of mandatory spares shall be as per the specifications attached in the tender.

2.11.2 ERECTION & COMMISSIONING SPARES

Contractor shall ensure adequate supply of all spares as required by him for successful erection & commission of the plants till handing over to the client. The lump sum price quoted shall be deemed to be inclusive of cost of such spares.

2.11.3 SPECIAL TOOLS AND TACKLES

Contractor shall ensure supply of all special tools and tackles for commissioning of the entire plants till handing over. The lump sum price quoted shall be deemed to be inclusive of cost of such tools and tackles.

2.11.4 TWO YEARS RECOMMENDED SPARES

Two years normal operation spares required are to be identified by the bidder and shall be in the bidder's scope during the Two Years Operation and Maintenance Contract. These Spares as identified by the Bidder shall be over and above the minimum spares list as indicated in the Annexure-1 of the O&M Specifications document No. B269-472/475/476-17-44-SS-1003.

2.11.5 STORAGE OF SPARES

All spare parts supplied by the bidder shall be properly wrapped, packaged and stored by the contractor so that they will be preserved in original and new condition under the normal conditions of storage to be anticipated in India and shall be properly tagged and coded so that later identification as to intended equipment usage will be facilitated. They shall be packed separately clearly marked as 'spare parts'. Packing lists shall be furnished so that the parts can be handled without uncrating if desired.

2.12 MECHANICAL COMPLETION / PRE-COMMISSIONING / COMMISSIONING / GUARANTEE & TOLERANCES

Mechanical Completion

Mechanical completion of the Plant shall mean that all installations works of the Plant have been completed and hydrotested in accordance with approved construction drawings, approved specifications, applicable codes, accepted International good engineering practices and all the activities have been completed in a comprehensive manner by the Contractor.

Pre-Commissioning

Pre-commissioning activities are defined as those activities which are required to be performed after completion / installation, inspection, hydrotesting, etc. of the Plant to make it ready for commissioning.

Commissioning

The Plant shall be considered "Ready for Commissioning" when 30 days trial runs are over and all the facilities have been completed along with their auxiliaries and support facilities in every respect including charging of lubes, chemicals, filters media, preparation of solution, etc. as recommended by IOCL / EIL in standard format with all exceptions, if any, resolved.

Commissioning of the Plant shall mean taking the feed in the system, passing it through normal route and establishing the process control parameters. The Plant shall be considered to be commissioned successfully with instrumentation / control system, process, utilities & support system have been on uninterrupted stable operation for not less than 72 hours while producing treated water of desired quality. Whether the 72 hours operation has been successful or not shall be decided by IOCL/EIL based on observations recorded during 72 hours. The countdown for 72 hours operation shall start on after the system has been on stable operation with all controls and safety systems in normal operation for a period of not less than 48 hours.

GUARANTEE

Contractor shall guarantee the following parameters (details as specified in clause no. 2.13 below):

- Hydraulic capacity of the Zero Liquid Discharge Plant

- Quality at the Multi Effect Evaporator Outlet
- Condensate Quality at the Outlet of the ZLDP
- Solids Quality at the ZLDP Outlet

TOLERANCES

The guaranteed figures are subject to the following tolerances for acceptance of the plant.

- Capacity measurement $\pm 2\%$.
- Quality measurement as per accuracies guaranteed by the instrument supplier.

In case of any variation over the tolerances given above, contractor shall rectify the plant at his own cost within a time mutually agreed upon by the contractor and IOCL/EIL to bring the plant performance in line with the guaranteed figures.

2.13 PERFORMANCE AND GUARANTEES

- After the system has been stabilized by the contractor during 30 days trial runs and plant is successfully commissioned, the contractor shall conduct a performance guarantee test run for the ZLDP. The procedure for performance testing shall be submitted by the contractor to the EIL/ IOCL for review & approval. The duration for the performance guarantee test run shall be 72 hours continuous operation of the plant.

The performance guarantee test run for ZLDP as part of the RO-DMP shall be carried out at the design conditions (including design capacities & design feed water quality) as specified in the Process Design Basis (Doc. No.B269-475-17-44-DB-1001).

During the performance guarantee test runs, the following guarantee parameters shall be fulfilled (within the tolerances as specified) at design conditions as specified above.

- ***Hydraulic Capacity of the ZLD Plant:***

☞ Zero Liquid Discharge Plant Capacity : 25 m³/hr per chain

- ***Quality Parameters to be guaranteed under ZLD as specified below:***

☞ Water Quality at Evaporator Unit Outlet in ZLD Plant

Component	Unit	Evaporator Outlet Water Quality
Total Dissolved Solids Content	%	30.0 (minimum)

☞ Condensate Quality at ZLD Plant Outlet

Component	Unit	Condensate Water Quality
Total Dissolved Solids	ppm	< 300
Total Suspended Solids	ppm	< 1.0

☞ Dry Solids at ZLD Plant Outlet

Component	Unit	Discharge Limit
Moisture Content in Dry Solids	%	10.0 (maximum)

In case the designed feed quantity & quality is not available as specified in the tender document, the PGTR may be carried out (if so desired by M/s IOCL) for the actual conditions within the design conditions for the plant, while performing to the desired treated outlet quality as per the requirement of the tender.

- b) Any loss of consumable/material during pre-commissioning, trial runs, commissioning, etc. prior to handing over of plant to IOCL shall be made up by the contractor to the quantities specified in the design calculations as initial charge without any extra time & cost to IOCL.
- c) If on testing, any material or equipment or the unit does not meet the design, rated or guaranteed performance related there to, the contractor shall forthwith, within the scope of work of contractor and at no additional cost to IOCL, undertake such additional tests and / or operations as are necessary to identify the cause of such failure. Such tests and / or operations shall be conducted in conjunction with IOCL, if the plant as a whole fails to meet the guarantees.
- d) If as a result of such tests and / or operations it is determined that the design, rated and / or guaranteed outputs or capacities have not been met because of defect in any material(s) (including machines and equipment) supplied by the Contractor, the Contractor shall forthwith in consultation with the Engineer-in charge take steps necessary to cause the defect to be identified and rectified, either by replacement of

the defected material, machine or equipment or part thereof or by repair or replacement thereof at sole cost and expenses of Contractor.

- e) In the event that certain of the guaranteed performance have not been met, the Contractor shall make suitable additions, deletions or modifications, if required after obtaining approval of IOCL/EIL to the process and the Plant to ensure the guaranteed results.

2.14 PROJECT MANAGEMENT

Effective project management within time frame is also a part of the contractor's scope. The system of organization & control; feedback & corrective measures; communication & project execution scheme to be submitted.

Planning, scheduling and monitoring is essential for timely completion of the project and effective project management system to be adopted as enumerated.

3.0 BATTERY LIMIT CONDITIONS

Feed to the Zero Liquid Discharge Plant shall be from the RO Reject recovery Section of the RODM plant and shall be considered by the contractor as per ZLD Process requirements.

The outgoing condensate stream shall be sent to the feed collection tank in the RODM Plant as per the process requirements.

The following utilities shall be supplied at the Common RO-DMP/ZLD and CPU Battery Limit:

- Plant Air
- Instrument Air
- MP Steam
- MP BFW
- LP Steam
- Service Water
- Cooling Water
- Drinking Water
- Nitrogen
- Power

➤ Fire Water

4.0 SCOPE OF CONTRACTOR'S WORK/ SUPPLY (ISBL)

The Contractor's scope of supply of equipment as a minimum shall be as given in this specification, Process Design Basis, Equipment List, Process Datasheets, PFD, P&IDs, and as specified elsewhere in the Tender Document.

All works required inside the battery limit of the RO-DMP (including ZLDP) and CPU for treatment including all associated facilities as per tender requirements shall be in contractor's scope of supply.

For all the equipment listed in tender or as required to make the plant complete in all respects to deliver the required quantity & quality of treated products, the contractor has to supply piping, valves and fittings, instruments, electrical items, consumables, etc. and all other items as indicated in the equipment list, datasheets, P&IDs, PFDs etc., or as required to make the plant complete with respect to safe trouble free operation of the plant.

The proposed Zero Liquid Discharge Plant shall be designed for the conditions as specified in the Process Design Basis documents and as described in the subsequent sections of this specification and as described elsewhere in the Tender Document.

Equipment for the plant shall be as per the Equipment List (Document No. B269-475-17-44-EL-1002) attached with the tender. Bidder may include in his scope any additional requirements/equipment, if so warranted by him, in order to meet the guarantees as specified in Clause No. 2.13 of this specification.

Also, all other works (including Mechanical, Electrical, Instrumentation, Civil & Structural works) mentioned elsewhere in the tender document or as shown in the drawings but not listed herein shall also be deemed to have been included in contractor's scope of work.

A deaerator shall be provided before the Multi-effect Evaporator system.

The Multi-effect Evaporator and Dryer Units as part of the ZLD Plant shall be installed on Technological Structures.

The details of the Tech structures (including No. of Tiers) shall be developed by the contractor based on the Multi-effect Evaporator and Dryer Unit supplier(s) requirements and recommendations. The tech structure shall be provided with adequate space to facilitate smooth operation and maintenance of the Units.

The Dryer (ATFD or Pusher Centrifuge) units located at the elevated Technological Structure shall be able to provide for the bottom withdrawal of dried product (salts) into 3 Nos. Salt Storage Sheds. The discharge from each of the Dryer Units shall be conveyed to all Three Storage sheds through Chutes.

Each of the Storage Shed shall be 6.0 meters in Length, 5.0 meters in Width and 4.0 meters Clear Height equivalent to 7 days storage as minimum requirement.

The Storage shed shall be covered to avoid rain ingress into the Shed. The Shed shall be provided with 3.0 meters high Brick Wall on Three sides with the Front of the Shed open for withdrawal of the dried salts for disposal. Suitable Ramp facilities shall be provided for access to each of the Storage shed.

Bagging of ZLD salts in impervious Jumbo LLDPE/HDPE bags (~1000kg bags) shall be in contractor's scope.

Bidder has to design the units in complete conformance with the Technical Specifications of the Evaporator and Dryer Unit as indicated in the process datasheets and elsewhere in the tender specifications.

The ZLDP shall be controlled from the Common Control Building which shall house the Substation and Control room along with associated facilities for the RODM, ZLDP and CPU Plants.

The Control system for the ZLD shall be a PLC based Control System. All signals from the Zero Liquid Discharge Plant shall be routed to the Common Control Room with separate Operator consoles for Monitoring and Control.

All Signals of the ZLDP shall also be repeated in the MCR of the Refinery for Monitoring. The detailed Instrumentation scope shall be as per the Instrumentation Specifications provided in the Tender.

Power for the ZLDP shall be supplied from the Common Substation housed in the Control Building for the RODM, ZLDP and CPU Plants. All Motor Controls shall be

located in the Common Substation. Detailed Electrical scope shall be as per the Electrical Specifications attached in the Tender Document.

A Common Chemical House building shall be provided for the RODM, ZLD and CPU Plants for Chemical Storage and Chemical Solution Preparation and Dosing of Chemicals in the respective plants.

The proposed chemical house building shall have provisions to store chemicals on ground floor of the chemical house building & chemical dosing facilities (tanks/pumps/agitators/etc.,) on first floor (except lime) of the chemical house building. Other facilities to be provided in the chemical house building shall be as per the process datasheet of chemical house.

Detailed scope for the Common Chemical House shall be as per the RODM plant specifications no. B269-475-17-44-SS-1001 attached with the Tender document.

Treatment Philosophy

The Zero Liquid Discharge Plant shall consist of the following sections:

- ZLD Feed Tank and Feed Transfer Pumps
- ZLD Pretreatment Section
- Deaerator
- Evaporator Section
- Dryer Section
- Products (distillate/ condensate, concentrated liquor and reject vapors/emissions) Storage and Transfer Facilities
- Cleaning & Dosing Chemicals Handling & Dosing facilities
- Dried Salts handling and Storage Facilities.

The reject stream from the RO-IV system in the RODM plant shall be routed to the ZLD feed storage tanks.

Pre-treatment of the feed stream as required prior to the evaporators shall be provided in the pre-treatment section. Pre-treatment section shall include the following facilities:

- Treatment Facilities for Hardness and Silica reduction from the feed water and making it acceptable for processing in the Evaporator and Dryer units of the ZLDP shall be provided. Lime-Soda Ash Softening process as recommended by the Evaporator / Dryer Suppliers shall be provided and all associated facilities as required shall be considered in the scope of the contractor.
- Acid dosing for converting bicarbonates to carbonates before feeding to the Evaporators.
- Any effluent generated from the pre-treatment section of the ZLDP shall be suitably treated within the ZLDP and it must be ensured that **NO Liquid Effluent** is discharged outside the ZLD Package.
- The sludge generated from the clarifier in the ZLD Unit shall be dewatered through a centrifuge and the solids shall be sent for disposal.
- The Centrate from the Centrifuge shall be partly recycled back to lime soda clarifier and partly utilized for Lime solution preparation and shall return back to the Clarifier as Lime solution dosing
- Additive/Antiscalant dosing to prevent calcium salts depositing on the wall of the evaporator or Dryer / crystallizer units.
- Neutralization for pH correction shall be done if required with Caustic

The feed to the evaporator unit from the ZLD feed tank shall be through the Evaporator feed pumps.

Evaporation Section

Feed at controlled rate (controlled by a flow control valve) shall pass through deaerator, pre-heaters, calandrias and vapor separators of various effects. The evaporation takes place under vacuum, which shall be maintained mainly by vacuum system. Steam shall be supplied as a heating medium through thermal vapor recompression (TVR) to the 1st effect jacket. The concentrated product at the desired concentration shall continuously be taken out from the system. **Multiple Effects (Minimum four effects for good steam economy and condensate recovery) falling film cum forced circulation evaporators with thermal vapor recompression (TVR) system are envisaged. The No. of Effects for the Multi-effect Evaporator Unit shall be**

confirmed by the Evaporator Supplier for achieving higher steam economy. The feed shall be preheated in pre-heaters before going into the 1st effect. The circulating brine in the 1st effect heating element shall be heated with steam from the discharge of the TVR, and which condenses on the shell side. The heated and concentrated brine slurry which is circulating in the tube side of the heating element shall be discharged from each heating element into its respective vapor separator. The vapors separate from the brine/slurry in the vapor separators. Mesh-pad droplet separators shall be provided to virtually eliminate droplet carry over with vapors leaving the vapor separators. Vapors from the 1st effect vapor separator shall be discharged into the shell side of the 2nd effect heating element (where they condense) whereas a part of the vapors (depending upon the bidder's design) may be discharged into the suction of the TVR (The choice of the effect from where vapors for TVR are to be taken shall be made by the bidder on the basis of his optimized design). The vapors from the 2nd effect vapor separator shall be discharged in to the 3rd effect heating element and so on. The type (falling film or forced circulation) for each effect shall be as per bidder's design.

The type of evaporator shall be based on bidder's experience. The unit shall be designed for operation under vacuum. The necessary flash vessels, as require, shall be provided to recover maximum heat from the feed purge and condensates and at the same time meet the temperature requirements of these streams at the battery limit of the plant. The vapors shall be condensed in a surface condenser or any other suitable system.

Dryer Section

The concentrated feed shall then be passed through a Dryer Unit (ATFD or Pusher Centrifuge) so as to remove maximum quantity of salts from feed as a dry product discharge and same shall be disposed of as solids or crystals (having moisture content less than 10%) from the plant. The solids shall be discharged to the Salt Storage Sheds through the chute.

Cleaning Facilities for Vessels/Equipment

During normal operation of the plant, gradual deposition of carbonates, sulfates, silicates etc. due to super saturation may take place. To maintain and operate the system at desired efficiency, provisions (as required) for hot water washing, chemical/acid (HNO₃) cleaning & high-pressure water jet cleaning shall be provided. Sufficient stand by equipment/arrangements shall be provided so that down time for the plant for maintenance is minimized. The necessary tanks & pumps shall be provided for dosing of cleaning chemicals.

Cleaning and flushing arrangements of the equipment shall also be provided in case of power failure.

Effluents generated during the Cleaning cycles shall be collected in a drain sump and transferred back to the ZLD Feed tanks by pumping. No cleaning effluent shall be drained outside the ZLD package.

Products (salts/solids, distillate/condensate and reject vapors /emissions) handling, treatment & disposal facilities

- **Salts**

The salts/solids coming out of the plant shall have **moisture content less than 10%** and shall be suitable for its disposal in a secured landfill. The salts generated from the Dryer units shall be conveyed to the Salts storage sheds as detailed in the tender specifications. Necessary Facilities for the same shall be considered and provided by the Contractor as part of the scope. The Salts shall be suitable for packing in impervious Jumbo LLDPE/HDPE bags (~1000kg bags) for transferring to the landfill site.

- **Emissions/Reject Vapor**

Liberation of polluting/hazardous/toxic gases, if any, shall be treated to suitable limits as per the applicable environmental regulations.

- **Condensate/Distillate**

The distillate from the plant shall be condensed, stored and pumped for recycle in the UF Feed Tank in RODM Plant. The ZLD plant shall be provided with condensate collection tank for the Evaporator and Dryer Units. The condensate from the condensate tank shall be pumped to the UF Feed Tank in RODMP.

Adsorption or any other suitable system (if required) shall be provided to treat condensate / distillate to the acceptable limits as specified in the Design Basis document no. B269-475-17-44-DB-1001.

The Zero Liquid Discharge Plant shall be designed to operate continuously for a minimum of 120 hours between every cleaning cycle.

The duration of the cleaning cycle for the individual Evaporator and Dryer Units in the ZLD plant shall not be more than 16 hours (and maximum 24 hours between Stabilized Operation of the Individual Unit).

Bidder has to design the units in complete conformance with the Technical specifications of the Evaporator and Dryer Unit as indicated in the process datasheets and elsewhere in the tender specifications.

**Minimum Instrumentation Requirements for ZLD Plant:
(Evaporator and Dryer Units)**

The ZLD plant will be supplied with the necessary instrumentation and interlocks to ensure that it remains in a stable condition and that corresponding measures are taken if, due to operator error or malfunction, the parameters should exceed a defined operating range. Manual intervention shall be provided as required. The instrument control philosophy for the Evaporation plant shall be as applicable for the smooth & trouble-free operation of different section of the Evaporation plant as recommended by the System Supplier.

All the instruments as required to make the plant complete as per design/operation/control/ instrumentation philosophy or as required for safe, smooth & trouble-free operation of the plant shall be provided by the contractor. The plant shall have optimized number of instruments & controls, which shall include the following as a minimum to facilitate safe operating of the plant:

- Suitable type flow measurement systems with local and control room indication along with recording and totalizing facilities (in Control Room) on feed inlet line, condensate/distillate line and cooling water make-up line.
- Flow Transmitter, Pressure and Temperature Transmitter and PI/TI on incoming MP steam line and BFW line.
- Pressure Reduction and De-superheating System (PRDS) along with the required Flow Transmitter, Pressure and Temperature Transmitters and Control Valves. Pressure and Temperature Transmitters at the outlet line of de-superheated Steam from the PRDS shall also be provided.
- Suitable type of flow measurement systems with local indication on all other incoming utility lines and all other outgoing lines.
- Pressure Gauge on cooling water inlet & outlet line.
- All the tanks shall be provided with two (2) Nos. level measurement instruments. Primary level measurement instrument shall be non-contact Radar type. Secondary Level indication shall be a Level Gauge.
- For Acid service, the level measurement instruments shall be a Non-Contact type SMART Radar type Level Transmitters. Level transmitter shall be used for local & control room level indication and for corresponding interlocks, tripping purposes (auto trip of pumps and agitators), etc. including low & high levels alarms in the control room.
- All the dosing pumps shall have in built pressure safety relief valves at their respective discharge lines.
- Flow control valve for level control in the Vapor separators and condensate collection vessels shall be provided on the feed flow to various effects.
- Pressure and Temperature control valves as required for the smooth operation and Control of the evaporator and Dryer units shall be provided.

- Temperature Transmitters for feed line, all vapor separators, and cooling water inlet & outlet. Temperature Transmitter (with local and Control room indication with high/low alarm) for measuring temperature for shell of 1st effect. Auto steam shut-off at high temperature shall be provided as per process requirements.
- Vacuum Pressure Transmitters (with local and Control room indication with high/low alarm) and vacuum gauge on all vapor separators.
- One Level Transmitter and one Level gauge on each vapor separator.
- Density control loop with density transmitter linked with feed rate and display (local and in control room) of concentrate density.
- Online conductivity and TOC analyzers at common condensate header and online conductivity analyzer at Inlet and Outlet line in the pre-treatment section of the ZLD Package shall be provided. All analyzers shall be provided with local and control room indication with high alarm. Analyzers shall be located in the Analyzer room in the Chemical House / RO Building.
- Additional instrumentation, Controllers and Analyzers as required for smooth, trouble free and safe operation of the plant and as per supplier's system design shall be provided.

Online Analyzer Requirements for ZLD Plant (Evaporator and Dryer Unit)

- Conductivity Analyzer at ZLD Feed Tank outlet.
- pH, Silica, COD and Conductivity Analyzer at the Inlet Feed Line to Evaporator Unit (Downstream of the Pre-treatment section).
- pH and Conductivity analyzer at the Condensate outlet headers from the Evaporator and Dryer Units to UF Feed Tank.

All other analyzers as indicated elsewhere in the tender, P&IDs, Drawings, Document shall also be included in the Contractor's scope of work.

5.0 GENERAL DESIGN & ENGINEERING REQUIREMENTS

➤ Line Size Criteria to be based on following pipe/line velocities:

☞ Pump Discharge	:	2.0 m/sec (maximum)
☞ Pump Suction	:	1.2 m/sec (maximum)
☞ Gravity Lines	:	0.8 m/sec (maximum)

- Piping class shall be as given below for the indicated services. Corresponding material shall be as per EIL Piping Specifications.

Service	Piping Class
RO-IV Reject to ZLD Package	A71V/B71V
ZLD Feed Tank up to Pre-Treatment Section Outlet	A71V
Pre-Treatment Outlet to Evaporator Feed / Concentrated Liquor Lines and up to Dryer Unit Inlet	A71V (IH/IS)
Steam Condensate	A1A-IH
Vapor Lines in Evaporator / Dryer Unit	A1A-(IS/IH)
ZLD Package outlet to UF Feed Tank in RODM plant	A1K
Chemical Sludge	A9A
Dewatering Polyelectrolyte (DWPE)	A1K
Lime	A91S
Coagulant	A91S
Polymer	A91S
Morpholine	A1K
Antiscalant	A91S
Anti-foam	A91S
Cleaning Chemicals	A91S or Superior PMS
Nitrogen	A3A
<p>For all incoming lines, same class of piping, as available at the Plant battery limit, shall be used up to their respective first unit. Material, for services not listed here, shall be subject to EIL's review and approval during engineering.</p> <p><u>In case, different material & line size is specified in the tender drawings (Schematic Flow Diagram, PFDs, P&IDs, etc.), the material & line size specified in the drawings shall be provided as a minimum.</u></p> <p><u>Other PMS for lines shall be as per the RODM specifications document no. B269-475-17-44-SS-1001</u></p>	

- Following types of valves shall be used for the Indicated Services.

Service	Valve Type
Effluent Lines/Treated water lines	Gate & Globe Valve/ Butterfly Valves
Conc. Hydrochloric Acid	Ball Valve
Caustic Solution Lines	Plug Valve (Lubricated)
Chemical Solution Lines	Ball Valves / Diaphragm Valves
Sampling Lines	Gate followed by Globe Valve
Other type of valves such as Check Valve (NRV), Control Valve etc. shall be provided, wherever required. Isolation valves shall be provided in each unit as per the valve specs. MOC of the valves shall be compatible with MOC of the pipe.	
Spectacle blinds shall be provided downstream of all tank drain lines as well as at other main isolation places, wherever required.	
Piping components and its type shall be provided, as appropriate, which shall be subject to EIL's review and approval during Detailed Engineering.	
All Butterfly Valves shall be double offset tight shut-off valves.	
Valves shall be provided as per the P&IDs.	

- For a full liquid system at the discharge of centrifugal pumps/blowers, the design pressure shall be as under.

$$P(\text{des}) = P(\text{max}) \text{ suction} + \text{DELTA } P(\text{max})$$

where,

$P(\text{max}) \text{ suction}$ = Maximum pressure at suction vessel bottom during suction system relieving conditions.

$\text{DELTA } P(\text{max})$ = Pump differential pressure at pump shutoff head with maximum operating density. If not known:

$\text{DELTA } P(\text{max}) = 1.2 \times \text{DELTA } H \times \text{Density}(\text{max})$: constant speed pump

$\text{DELTA } P(\text{max}) = 1.1 \times 1.2 \times \text{DELTA } H \times \text{Density}(\text{max})$: variable speed pump

$\text{DELTA } P(\text{max}) = 1.3 \times \text{DELTA } H \times \text{Density}(\text{max})$: high head multistage pump

$\text{DELTA } P(\text{max}) = 1.3 \times 1.1 \times \text{Del } H \times \text{Density}(\text{max})$: variable speed high head multistage Pump

Where, $\text{DELTA } H$ is the pump head at rated condition

- For a full liquid system at the discharge of positive displacement pumps, the design pressure shall be the higher of:

$$P(\text{des}) = P(\text{rated}) \text{ discharge} + 2 \text{ kg/cm}^2$$

$$P(\text{des}) = 1.1 \times P(\text{rated}) \text{ discharge}$$

- Vessels operating under vacuum shall be, in general, designed for an external pressure of 1.033 kg/cm^2 abs and full internal vacuum, unless otherwise specified.
- All the pumps which are to be located below FGL shall have a suitable pump house building having RCC construction below FGL and RCC lintel and brick masonry work above FGL. All pump pedestals shall have arrangement for collection of leakage and connection to the nearest drain. Edges of pump pedestals in pump house shall be kept in one line on pump motor side so as to render clear walkway. The clear distance between adjacent pump/blower pedestals shall be minimum 900 mm. Minimum clearance of 500 mm shall be provided around pumps / blowers / equipment pedestal for paving, etc. applicable guidelines shall be followed for the minimum clearances between the adjacent equipment/pumps/blowers etc.
- The complete battery limit area of Reverse Osmosis Based Demineralization Plant (RO-DMP), Zero Liquid Discharge Plant (ZLDP) & Condensate Polishing Unit (CPU) shall be RCC paved as per the specifications given elsewhere in the tender
- Common delivery header and suction header of pumps (and blowers) shall be provided with a blind flange on one end. Recirculation lines for the pumps shall be provided by the vendor as indicated in the tender PFDs / P&IDs and also shall be provided as per process requirements/ turndown requirements.
- All working & standby pumps (including warehouse/store standby) shall also be provided with the respective motors. All motor shall have running indication in control room. Motors of all pumps and blowers, if not housed under shed/room, shall be covered with canopy. Suction line/filter of blowers shall also be provided with canopy.
- Rated capacity of all the blowers shall be minimum 10% more than the normal process requirements. Also, head of all the pumps (except RO high pressure pumps) shall be minimum 10% more than the total calculated head (including static head and losses in pipes, fittings, instruments, etc.) based on normal process requirements. All sets of

rotating equipment viz. pumps, blowers, compressors, etc. shall be provided with at least one standby of same capacity as the operating equipment.

- Chemical dosing pumps shall be designed to cater for minimum to maximum hydraulic requirements. All chemical dosing pumps shall be provided with pressure safety valves and pulsation dampeners on individual pump discharge. All chemical handling pumps shall have permanent flushing connection (inlet and outlet).
- All pumps shall be flooded suction type, unless otherwise specified, fully primed under Low Liquid Level in the suction sump/ tank. Also, for all pumps with flooded suction, LWL in the tank/sump shall be above the top of pump casing.
- Access to the platform shall be by ladders. Access shall be by staircase if unit requires frequent attention of operating personnel. Approach & platform shall be provided wherever adjustable weir, instruments, measuring scale, etc. are kept. Adjoining units shall be connected with operating platform (with Hand-railing).
- Lifting Arrangement and all Necessary Facilities for Lifting of the Calandrias in the MEE and Other Maintenance in the MEE and ATFD Units shall be provided and considered in the contractor's scope of supply.
- **Monorail and Section pulley block (Manually operated) shall be provided for all pump houses, blower sheds, etc.,** of adequate capacity (minimum 1.1 times the weight of heaviest equipment). Drop-out platform (minimum 1.5 m wide) shall be provided. Monorail shall be extended outside the Pump houses/sheds/ buildings to facilitate loading / unloading equipment directly on vehicle, for which ramp approach shall be given. Vehicular approaches shall be provided to units wherever required from maintenance / operation point of view.
- Vehicular approaches shall be provided to units wherever required from maintenance / operation point of view.
- Vehicular approach for the salts storage sheds with proper ramp / movement spaces.
- The Equipment Layout shall be prepared such that all units are accessible for routine maintenance/repair. It shall also facilitate convenience for regular monitoring of units by operating staff.
- Road approach shall be provided for crane movement for all major and critical equipment. Rerouting or shifting of any under/above ground lines or facilities

respectively, as may be required during the execution, shall be under the scope of contractor only.

- Draining arrangement shall be provided for all units/equipment, as necessary.
- Sampling points shall be provided for each treatment section including adequate sampling points for measuring water quality at intermediate points and chemical solution concentration.
- All piping, instrumentation, electrical and other mechanical works as necessary are in Contractor's scope.
- Sizes/specifications as given in various datasheets of the tender are minimum requirements, which are to be followed by the bidders as a minimum. Higher sizes, if process design demands, shall be provided by the bidders at no extra cost to IOCL. These are part of the detail engineering review/approval by EIL.
- Type and minimum size of manholes (for pressure vessels, tanks, covered sumps, underground sewer etc.) shall be as per EIL standards. All vessels with a bottom manhole shall have a clear height of 1.2 m below the manhole elevation.
- The specifications/requirements are bare minimum only. The vendor shall follow good engineering practices and incorporate maximum operational flexibility in the system.

6.0 FORMAT FOR CHEMICAL AND UTILITY CONSUMPTION FIGURES

All Utilities & Chemicals Consumption shall be listed by contractor which is envisaged to be used in ZLD Plant for Normal Operation as well as for start-up / shutdown requirements.

6.1 Maximum Consumption Figures for Utilities in ZLD Plant

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/ day (1 Day = 24 Hours)
Power	kW		
Service Water	m ³ /hr		
Drinking Water	m ³ /hr		
Plant Air	Nm ³ /hr		
Instrument Air	Nm ³ /hr		
Nitrogen	Nm ³ /hr		
MP BFW	Kg/hr		

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/day (1 Day = 24 Hours)
MP Steam	Kg/hr		
LP Steam	Kg/hr		
Cooling Water	m ³ /hr		
Fire water	m ³ /hr		
Any Other			

6.2 Maximum Consumption Figures for Chemicals in ZLD Plant

Description of Chemical	Dosing Rate in ppm (Normal / Design)	Consumption in kg/d at Design Flow	Purity of Chemical	Solution Strength
Hydrochloric acid (HCl)				
Caustic (NaOH)				
Soda Ash				
Antiscalant				
Lime				
Anti Foam				
Nitric Acid				
Cleaning Chemicals				
Any Other Chemicals				

Note: MSDS for all the chemicals are to be provided by the contractor. Chlorine gas and H₂SO₄ should not be used in the plant.

All Utilities & Chemicals Consumption shall be listed individually and separately for each Plant which are envisaged to be used in RWTP, RO-DMP, ZLDP & CPU for Normal Operation as well as for start-up / shutdown requirements.

7.0 LIST OF ENCLOSURES

All works as per following enclosures are part of contractor's scope of work/supply:

S. No.	Document No.	Document Title
1.	B269-475-17-44-DB-1001	Process Design Basis
2.	B269-475-17-44-0101	Schematic Flow Diagram (2 Sheets)
3.	B269-475-17-44-1001	Equipment Layout
4.	B224-475-17-44-EL-1002	Equipment List
5.	B269-475-17-44-1144 to 1145	P&IDs
6.	B269-475-17-44-DS-2001 to 2022	Datasheets
7.	B269-472/475/476-17-44-VDR-1001	Vendor data requirement (Plot Plan & Water) for RWTP, RO-DMP, ZLDP & CPU
8.	B269-472/475/476-17-44-TC-	Technical compliance (Plot Plan & Water)

S. No.	Document No.	Document Title
	1001	RWTP, RO-DMP, ZLDP & CPU
9.	B269-472/475/476-17-44-SS-1002	Pre-Commissioning, Commissioning and P.G. Test Guidelines
10.	B269-475-17-44-SS-1001	Scope of supply / works for RODMP and ZLD
11.	B269-472/475/476-17-44-SS-1003	Operation & Maintenance of RWTP, RO-DMP, ZLDP & CPU

SCOPE OF WORKS/SUPPLY **(PLOT PLAN AND WATER)** **CONDENSATE POLISHING UNIT (CPU)**

PROJECT : PANIPAT REFINERY EXPANSION PROJECT (P-25)

OWNER : IOCL, PANIPAT

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B269

2	28.02.2022	REVISED & ISSUED WITH TA-02	SC	VS	PKG
1	25.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
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A	23.04.2020	ISSUED FOR INPUTS/COMMENTS	SC	VS	PKG
Rev. No	Date	Purpose	Prepared By	Checked by	Approved by

1.0 INTRODUCTION

Indian Oil Corporation Limited (IOCL) operates 15.0 million metric tons per annum (MMTPA) refinery at Panipat in state of Haryana, India. The refinery is currently implementing facilities to manufacture 100% BS-VI fuel mandated by Auto Fuel Policy.

In order to meet the demand growth of petroleum products and also to increase its profitability and competitiveness in the long run, IOCL intends to enhance the refinery capacity from 15 to 25 MMTPA. The Expansion Project consists of a new Crude / Vacuum Distillation unit (CDU/VDU) of capacity of 10 MMTPA followed by a SR LPG Treater (SR LPGT), MS Block comprising of NHT, CCRU & Isomerization Unit, Alkylation/ SARU, DHDT, VGO-HDT, RHCU, INDMAX including CR LPG Treater, and PRU. A new PP unit and Catalytic De-waxing Unit are included as value augmentation unit. Auxiliary facilities i.e., HGU, SWS/ARU and SRU and Utility / Offsite (U&O) facilities for the entire project are included in the facility.

A Condensate Polishing Unit (CPU) is envisaged for treatment of unpolished condensate to produce polished condensate. Two chains (1 working + 1 standby) each of 140 m³/h capacity along with provision for installation of one more chain of 140 m³/h in future for Alkylation Unit shall be provided for the complex. This document constitutes the scope of work/supply for the Condensate Polishing Unit.

2.0 DETAILED SCOPE OF SUPPLY/WORK

The scope of work for CPU shall be as follows but not limited to as given herein:

The scope of work shall include Project Management; Residual Process Design& Detailed Engineering; Procurement; Fabrication; Inspection; Supply; Manufacture; Transportation of all equipment/materials to the work site& Storage at site; assembly, erection & installation; Construction and Erection of Civil & Structural, Mechanical, Electrical, Instrumentation & Piping works; Acid /Alkali proof tiling; Painting; Testing; Pre-commissioning, trial run for 30 days before commissioning; commissioning; Training of IOCL's personnel; performance guarantee test run for 72 hours continuous operation in presence of IOCL's & EIL's Representatives; guaranteeing and handing over of CPU to the Client on lump sum turnkey basis as per design basis, equipment list, standards, P&IDs, data sheets, drawings, etc., all complete within Contractor's specified battery limits including supply of spares, chemicals & consumables.

HAZOP for the complete RO-DMP and CPU including implementation of HAZOP recommendation shall be under contractor's scope of work. HAZOP chairman shall be engaged by the contractor at his own cost and his CV shall be submitted by the contractor to EIL/IOCL for acceptance. HAZOP requirements shall be as per the HAZOP specifications attached in the tender.

3D modeling (in PDMS software as defined in the Piping specifications) for the RWTP, RO-DMP including ZLD Plant and CPU shall also be included in scope of work of the contractor.

SMART P&IDs shall be prepared for the plant during detailed engineering review and as built.



All equipment described in these specifications; datasheets & equipment list; as shown in the P&IDs & PFDs; as mentioned elsewhere in the tender document or as necessary for completeness but not listed above shall also be deemed to have been included in Contractor's scope. All works required to meet requirements given in design/process/operation requirements defined elsewhere in the bid document shall also be deemed to have been included in Contractor's scope.

Contractor's scope of work/supply shall also include the following:

- RO-MB based Demineralization Plant (RO-DMP) on LSTK basis as per bidding document specifications No. B269-475-17-44-SS-1001.
- Raw Water Treatment Plant (RWTP) on LSTK basis as per bidding document specifications No. B269-472-17-44-SS-1001
- Zero Liquid Discharge Plant (ZLDP) on LSTK basis as per bidding document specifications No. B269-475-17-44-SS-1002
- Operation & Maintenance of Raw Water Treatment Plant (RWTP), RO-MB based DM Plant (RO-DMP), Zero Liquid Discharge Plant (ZLDP) & Condensate Polishing Unit (CPU) for a period of TWO (2) YEARS after successful commissioning. Contractor's scope of work during Operation & Maintenance contract shall be as per Specifications No. B269-472/475/476-17-44-SS-1003.
- Condensate Polishing Unit (CPU - PNCP Area) on LSTK basis as per bidding document specifications No. B269-81-17-44-SS-1001

2.1 PROCESS

Process documents enclosed are the basic documents and are to be followed for execution of job leading to successful commissioning and performance guarantee test run of the Plant. During the course of execution, updating/modification to the process documents that would become necessary is to be carried out with the approval of EIL/IOCL. The resultant work arising out of this will also form the part of scope from detailed engineering to handing over of the plant with no cost implication to IOCL.

The tender specifies the scheme (refer to the PFDs/SFDs and P&IDs attached in relevant sections in tender documents) & Contractor's scope of supply in subsequent sections of this document as minimum requirements. Bidder may include in his scope any additional requirements, if so warranted to meet process guarantees and for smooth, safe and trouble free operation of the plants.

2.2 ENGINEERING

The design basis, data sheets, drawings, standards, specification, codes to be followed for different types of works are brought out in the various engineering sections forming part of the tender document. Contractor shall carry out residual process design & detail engineering works for the plant and submit various drawings and documents for approval of EIL/IOCL before these are released for construction.

2.3 CONSTRUCTION AND INSTALLATION

These activities shall be carried out by the contractor as specified elsewhere in the tender document.

2.4 QUALITY ASSURANCE

These activities shall be carried out by the contractor as specified elsewhere in the tender document.

2.5 STATUTORY CLEARANCES

All the applicable safety codes, national laws and local regulations shall be followed by the successful bidder for the design, engineering, fabrication, erection, commissioning & handing over of the Plant / Equipment and necessary approvals shall be obtained from

the concerned statutory authorities by the contractor. Statutory bodies from which approvals may have to be taken include State Pollution Control Board, Chief Inspector of Boilers / IBR, Factory Inspectorate, Labour Authorities, Electrical Inspectorate and Chief Controller of Explosive, Directorate General of Mines and Safety requirements, etc. The contractor shall ascertain requirement of approvals as applicable in such plants and initiation of action as required shall be in contractor's scope.

2.6 SAFETY

These activities shall be carried out by contractor as specified elsewhere in the tender document. All safety procedures for different types of work as per the safety rules from time to time by EIL/IOCL shall be binding and adhered to by the contractor. Safety report generation for different situations as per the rules and required by EIL/IOCL are to be adhered to. HSE policy of IOCL shall be binding upon the contractor.

2.7 VENDOR LIST

For most of the systems/equipment, the approved vendor list of EIL is enclosed in the bid document, which shall be adhered to. While for other items, not listed in the approved vendor list, the suppliers who would be involved for design, engineering and supply of equipment and materials are to be proposed by the contractor (for EIL/IOCL approval) during detailed engineering with the documentary evidence of having supplied similar equipment, systems and/or materials for similar applications with proven track record. Any change for new contractor/supplier after award of contract for supply will not be permitted. It will be necessary to purchase certain items as a system and not as individual equipment. These have to be identified and furnished during detailed engineering for approval of the EIL/ IOCL.

2.8 WASTE DISPOSAL

All wastes generated like surplus earth after use/surplus construction materials to be disposed-off from time to time by the contractor to the disposal locations as directed by the Engineer-in-Charge.

2.9 DESCRIPENCIES / VARIATIONS IN SPECIFICATIONS / STANDARDS

Bidders may bring out variations, deviations, if any, in related data sheets, equipment list, drawings, specifications, standards, codes, scope and any other contractual

clauses before submission of bids and seek clarifications. In case of any contradiction on specification brought out at the post award stage of job, decision of EIL/ IOCL shall be final & binding upon the Contractor without any time & cost implication.

2.10 SUPPLY OF CONSUMABLES & CHEMICALS

Supply of all chemicals (**except HCl & NaOH**), spares and consumables required for the Operation and Maintenance of the plant during start-up, pre-commissioning, 30 days trial runs and up to successful commissioning shall be in the scope of supply of the LSTK contractor. HCl and NaOH shall be free issue supply by IOCL. Special chemicals required, if any, shall be clearly defined by the contractor with respect to quality and quantity and the supply of the same shall also be in Contractor's scope. Minimum two nos. of manufacturers shall be specified by the bidder for these special chemicals. Unloading, handling and storage of all chemicals and consumables (including provision of necessary facilities) shall be done by the contractor.

Also, contractor's scope regarding supply of chemicals, spares, consumables and other requirements during two years operation duration shall be as per Specifications No. B269-472/475/476-17-44-SS-1003.

2.11 SPARES

2.11.1 MANDATORY SPARES

Contractor's scope regarding supply of mandatory spares shall be as per the specifications attached in the tender.

2.11.2 ERECTION & COMMISSIONING SPARES

Contractor shall ensure adequate supply of all spares as required by him for successful erection & commission of the plants till handing over to the client. The lump sum price quoted shall be deemed to be inclusive of cost of such spares.

2.11.3 SPECIAL TOOLS AND TACKLES

Contractor shall ensure supply of all special tools and tackles for commissioning of the entire plants till handing over. The lump sum price quoted shall be deemed to be inclusive of cost of such tools and tackles.

2.11.4 TWO YEARS RECOMMENDED SPARES

Two years normal operation spares required are to be identified by the bidder and shall be in the bidder's scope during the Two Years Operation and Maintenance Contract. These Spares as identified by the Bidder shall be over and above the minimum spares list as indicated in the Annexure-1 of the O&M Specifications document No. B269-472/475/476-17-44-SS-1003.

2.11.5 STORAGE OF SPARES

All spare parts supplied by the bidder shall be properly wrapped, packaged and stored by the contractor so that they will be preserved in original and new condition under the normal conditions of storage to be anticipated in India and shall be properly tagged and coded so that later identification as to intended equipment usage will be facilitated. They shall be packed separately clearly marked as 'spare parts'. Packing lists shall be furnished so that the parts can be handled without uncrating if desired.

2.12 MECHANICAL COMPLETION / PRE-COMMISSIONING / COMMISSIONING / GUARANTEE & TOLERANCES

Mechanical Completion

Mechanical completion of the Plant shall mean that all installations works of the Plant have been completed and hydrotested in accordance with approved construction drawings, approved specifications, applicable codes, accepted International good engineering practices and all the activities have been completed in a comprehensive manner by the Contractor.

Pre-Commissioning

Pre-commissioning activities are defined as those activities which are required to be performed after completion / installation, inspection, hydrotesting, etc. of the Plant to make it ready for commissioning.

Commissioning

The Plant shall be considered "Ready for Commissioning" when 30 days trial runs are over and all the facilities have been completed along with their auxiliaries and support facilities in every respect including charging of lubes, chemicals, filters media,

preparation of solution, etc. as recommended by IOCL / EIL in standard format with all exceptions, if any, resolved.

Commissioning of the Plant shall mean taking the feed in the system, passing it through normal route and establishing the process control parameters. The Plant shall be considered to be commissioned successfully with instrumentation / control system, process, utilities & support system have been on uninterrupted stable operation for not less than 72 hours while producing treated water of desired quality. Whether the 72 hours operation has been successful or not shall be decided by IOCL/EIL based on observations recorded during 72 hours. The countdown for 72 hours operation shall start on after the system has been on stable operation with all controls and safety systems in normal operation for a period of not less than 48 hours.

GUARANTEE

Contractor shall guarantee the following parameters (details as specified in clause no. 2.13 below):

- Hydraulic capacity of the plant
- Polished condensate quality

TOLERANCES

The guaranteed figures are subject to the following tolerances for acceptance of the plant.

- i) Capacity measurement $\pm 2\%$.
- ii) Quality measurement as per accuracies guaranteed by the instrument supplier.

In case of any variation over the tolerances given above, contractor shall rectify the plant at his own cost within a time mutually agreed upon by the contractor and IOCL/EIL to bring the plant performance in line with the guaranteed figures.

2.13 PERFORMANCE AND GUARANTEES

- a. After the system has been stabilized by the contractor during 30 days trial runs and plant is successfully commissioned, the contractor shall conduct a performance guarantee test run for CPU. The procedure for performance testing shall be submitted by the contractor to the EIL/ IOCL for review & approval. The duration for the performance guarantee test run shall be 72 hours continuous operation of the plant.

The performance guarantee test run for CPU shall be carried out at the design conditions (including design capacities & design unpolished condensate quality) at CPU inlet as specified in the Process Datasheet of CPU (Doc. No.B269-476-02-DS-1901).

During the performance guarantee test runs, the following guarantee parameters shall be fulfilled (within the tolerances as specified) at design conditions as specified above.

☞ **Guaranteed Hydraulic Capacity of the Plant:**

System/Parameter	Value
Hydraulic Capacity	2 chains each of 140 m ³ /h feed unpolished condensate

☞ **Polished Condensate quality (parameters to be guaranteed by the contractor at the outlet of MB Exchanger):**

2

S. No.	Parameter	Unit	Value
1.	pH	-	6-7-7.3
2.	Conductivity at 20 deg C	micro S/cm	≤0.2 (max)
3.	Total Hardness as CaCo ₃	mg/l	BDL
4.	Turbidity	NTU	BDL
5.	Total Silica as SiO ₂	mg/l	≤0.02
6.	Total Iron as Fe	mg/l	≤ 0.01
7.	Total Copper as Cu	mg/l	≤0.003
8.	Na + K	mg/l	≤ 0.01
9.	Chlorides as Cl	mg/l	BDL
10.	KMnO ₄ value at 100deg C,	mg/l	<1

BDL: Below Detectable Limit

☞ **Oil Concentration at outlet of Secondary Activated Carbon Filters (parameters to be guaranteed by the contractor):**

2

System/Parameter	Value
Oil & Grease	BDL

BDL: Below Detectable Limit

In case the designed feed unpolished condensate quantity & quality is not available as specified in the tender document, the PGTR may be carried out (if so desired by M/s IOCL) for the actual conditions within the design conditions for the plant, while performing to the desired treated outlet quality as per the requirement of the tender.

- b) Any loss of consumable/material during pre-commissioning, trial runs, commissioning, etc. prior to handing over of plant to IOCL shall be made up by the contractor to the quantities specified in the design calculations as initial charge without any extra time & cost to IOCL.
- c) If on testing, any material or equipment or the unit does not meet the design, rated or guaranteed performance related there to, the contractor shall forthwith, within the scope of work of contractor and at no additional cost to IOCL, undertake such additional tests and / or operations as are necessary to identify the cause of such failure. Such tests and / or operations shall be conducted in conjunction with IOCL, if the plant as a whole fails to meet the guarantees.
- d) If as a result of such tests and / or operations it is determined that the design, rated and / or guaranteed outputs or capacities have not been met because of defect in any material(s) (including machines and equipment) supplied by the Contractor, the Contractor shall forthwith in consultation with the Engineer-in charge take steps necessary to cause the defect to be identified and rectified, either by replacement of the defected material, machine or equipment or part thereof or by repair or replacement thereof at sole cost and expenses of Contractor.
- e) In the event that certain of the guaranteed performance have not been met, the Contractor shall make suitable additions, deletions or modifications, if required after obtaining approval of IOCL/EIL to the process and the Plant to ensure the guaranteed results.

2.14 PROJECT MANAGEMENT

Effective project management within time frame is also a part of the contractor's scope. The system of organization & control; feedback & corrective measures; communication & project execution scheme to be submitted.

Planning, scheduling and monitoring is essential for timely completion of the project and effective project management system to be adopted as enumerated.

3.0 BATTERY LIMIT CONDITIONS

Battery limit conditions for unpolished condensate & polished condensate lines (to & from CPU) shall be as per the Process Datasheet of CPU (Doc. No. B269-476-02-DS-1901).

The following utilities shall be supplied at the Common RO-DMP, ZLDP and CPU Battery Limit:

- Plant Air
- Instrument Air
- MP Steam
- MP BFW
- LP Steam
- Service Water
- Drinking Water
- Nitrogen
- Power
- Fire Water
- Cooling Water

4.0 SCOPE OF CONTRACTOR'S WORK/ SUPPLY (ISBL)

The Contractor's scope of supply of equipment as minimum shall be as given in this specification, Process Datasheets, Equipment List, PFD, P&IDs, and as specified elsewhere in the Tender Document.

All works required inside the battery limit of CPU for treatment including all associated facilities as per tender requirements shall be in contractor's scope of supply.

For all the equipment listed in tender or as required to make the plant complete in all respects to deliver the required quantity & quality of treated products, the contractor has to supply piping, valves and fittings, instruments, electrical items, consumables, etc. and all other items as indicated in the equipment list, datasheets, P&IDs, PFDs etc., or as required to make the plant complete with respect to safe trouble free operation of the plant.

The proposed CPU shall be designed for the conditions as specified in the Process Datasheet and as described in the subsequent sections of this specification and as described elsewhere in the Tender Document.

Hydraulic Design of CPU shall ensure that all chain (including the future chain) can be operated simultaneously.

Feed Polished Condensate Heat Exchanger and Trim Cooler in the CPU shall be provided under shed.

Equipment list for CPU shall be as per the Equipment List (Document No. B269-476-17-44-EL-1001) attached with the tender. Bidder may include in his scope any additional requirements/equipment, if so warranted by him, in order to meet the guarantees as specified in Clause No. 2.13 of this specification.

Also, all other works (including civil & structural works) mentioned elsewhere in the tender document or as shown in the drawings but not listed herein shall also be deemed to have been included in contractor's scope of work.

The CPU shall be controlled from the Common Control Building which shall house the Substation and Control room along with associated facilities for the RODMP, ZLDP and CPU Plants.

The Control system for RODMP, ZLDP and CPU shall be PLC based. All signals of the CPU shall be routed to the Common Control Room for Monitoring and Control of the Plants. Separate PLC based control systems are envisaged for RO-DMP+CPU and ZLD.

All Signals of CPU shall be repeated in the MCR of the Refinery for Monitoring. The detailed Instrumentation scope shall be as per the Instrumentation Specifications provided in the Tender.

Power for CPU shall be supplied from the Common Substation housed in the Control Building for the RODM, ZLDP and CPU Plants. All Motor Controls shall be located in the Common Substation. Detailed Electrical scope shall be as per the Electrical Specifications attached in the Tender Document.

Space shall be kept in SS/SRR, control room, junction boxes etc. for electric connections, instrumentation and control signals of one future chain.

5.0 GENERAL DESIGN & ENGINEERING REQUIREMENTS

- Line Size Criteria to be based on following pipe/line velocities:
 - ☞ Pump Discharge : 2.0 m/sec (maximum)
 - ☞ Pump Suction : 1.2 m/sec (maximum)
 - ☞ Gravity Lines : 0.8 m/sec (maximum)
- Piping class shall be as given below for the indicated services. Corresponding material shall be as per EIL Piping Specifications.

Service	Piping Class
Suspect Condensate from battery limit up to inlet isolation valve (manual) of MB-CPU.	A1A
Polished Condensate lines from downstream of outlet isolation valve (manual) of MB-CPU up to battery limit	A1K
Hydrochloric Acid (30%) Solution	A91S
Low pressure Steam	A2A-IH
Service Water	A93A
Plant Air	A3A
Instrument Air	A93M
Nitrogen	A3A
From inlet isolation valve (manual) of MB-CPU up to outlet isolation valve (manual) of MB-CPU including all frontal piping for MB-CPU and piping on MB-CPU. Caustic (up to 5% concentration), HCl (up to 5% concentration), DM water for Regeneration.	A1K
Caustic (above 5% concentration)	A19A
Drinking Water	J92A
Cooling Water Supply & Cooling Water Return	A93A (AG) (0.5"-16") A92A (UG) (burial depth upto 3.0 m)
For all incoming lines, same class of piping, as available at the Plant battery limit, shall be used up to their respective first unit. Material, for services not listed here, shall be subject to EIL's review and approval during engineering.	
<u>In case, different material & line size is specified in the tender drawings (Schematic Flow Diagram, PFDs, P&IDs, etc.), the material & line size specified in the drawings shall be provided as a minimum.</u>	

- Following types of valves shall be used for the Indicated Services.

Service	Valve Type
Condensate lines	Gate & Globe Valve/ Butterfly Valves
Conc. Hydrochloric Acid	Ball Valve
Caustic Solution Lines	Plug Valve (Lubricated)
Chemical Solution Lines	Ball Valves / Diaphragm Valves
Sampling Lines	Gate followed by Globe Valve
Individual Suction and discharge of Centrifugal pumps	Gate valves
Other type of valves such as Check Valve (NRV), Control Valve etc. shall be provided, wherever required. Isolation valves shall be provided in each unit as per the valve specs. MOC of the valves shall be compatible with MOC of the pipe.	
Spectacle blinds shall be provided downstream of all tank drain lines as well as at other main isolation places, wherever required.	
Piping components and its type shall be provided, as appropriate, which shall be subject to EIL's review and approval during Detailed Engineering.	
All Butterfly Valves shall be double offset tight shut-off valves.	
Valves shall be provided as per the P&IDs.	

- For a full liquid system at the discharge of centrifugal pumps/blowers, the design pressure shall be as under.

$$P(\text{des}) = P(\text{max}) \text{ suction} + \text{DELTA } P(\text{max})$$

where,

$P(\text{max}) \text{ suction}$ = Maximum pressure at suction vessel bottom during suction system relieving conditions.

$\text{DELTA } P(\text{max})$ = Pump differential pressure at pump shutoff head with maximum operating density. If not known:

$\text{DELTA } P(\text{max}) = 1.2 \times \text{DELTA } H \times \text{Density}(\text{max})$: constant speed pump

$\text{DELTA } P(\text{max}) = 1.1 \times 1.2 \times \text{DELTA } H \times \text{Density}(\text{max})$: variable speed pump

$\text{DELTA } P(\text{max}) = 1.3 \times \text{DELTA } H \times \text{Density}(\text{max})$: high head multistage pump

$\text{DELTA } P(\text{max}) = 1.3 \times 1.1 \times \text{Del } H \times \text{Density}(\text{max})$: variable speed high head multistage Pump

Where, DELTA H is the pump head at rated condition

- For a full liquid system at the discharge of positive displacement pumps, the design pressure shall be the higher of:

$$P(\text{des}) = P(\text{rated}) \text{ discharge} + 2 \text{ kg/cm}^2$$

$$P(\text{des}) = 1.1 \times P(\text{rated}) \text{ discharge}$$

- Vessels operating under vacuum shall be, in general, designed for an external pressure of 1.033 kg/cm² abs and full internal vacuum, unless otherwise specified.
- All the pumps which are to be located below FGL shall have a suitable pump house building having RCC construction below FGL and RCC lintel and brick masonry work above FGL. All pump pedestals shall have arrangement for collection of leakage and connection to the nearest drain. Edges of pump pedestals in pump house shall be kept in one line on pump motor side so as to render clear walkway. The clear distance between adjacent pump/blower pedestals shall be minimum 900 mm. Minimum clearance of 500 mm shall be provided around pumps / blowers / equipment pedestal for paving, etc. applicable guidelines shall be followed for the minimum clearances between the adjacent equipment/pumps/blowers etc.
- Common delivery header and suction header of pumps (and blowers) shall be provided with a blind flange on one end. Recirculation lines for the pumps shall be provided by the vendor as indicated in the tender PFDs / P&IDs and also shall be provided as per process requirements/ turndown requirements.
- All working & standby pumps (including warehouse/store standby) shall also be provided with the respective motors. All motor shall have running indication in control room. Motors of all pumps and blowers, if not housed under shed/room, shall be covered with canopy. Suction line/filter of blowers shall also be provided with canopy.
- Rated capacity of all the blowers shall be minimum 10% more than the normal process requirements. Also, head of all the pumps (except RO high pressure pumps) shall be minimum 10% more than the total calculated head (including static head and losses in pipes, fittings, instruments, etc.) based on normal process requirements. All sets of rotating equipment viz. pumps, blowers, compressors, etc. shall be provided with at least one standby of same capacity as the operating equipment.

- Chemical dosing pumps shall be designed to cater for minimum to maximum hydraulic requirements. All chemical dosing pumps shall be provided with pressure safety valves and pulsation dampeners on individual pump discharge. All chemical handling pumps shall have permanent flushing connection (inlet and outlet).
- All pumps shall be flooded suction type, unless otherwise specified, fully primed under Low Liquid Level in the suction sump/ tank. Also, for all pumps with flooded suction, LWL in the tank/sump shall be above the top of pump casing.
- Effective liquid depth (side water depth) of tank/ sump shall be considered between Low Water Level (LWL) & Top Water Level (TWL) and shall exclude free board & dead volume depth (liquid depth below LWL). The tank/sump floor shall slope towards suction pit/channel. All RCC sumps shall be made water tight and designed as water retaining structure as per engineering specifications. All above ground holdup tanks/ sumps shall be provided with overflow lines, drain etc. and provision shall be made to route the overflows from all the sumps, tanks and pump leakages to OWS sump.
- All Acid, Alkali, and other hazardous chemical dosing pumps & dosing tanks shall be located inside a kerbed area, suitably lined (floor, inside kerb wall and all structures inside the kerb area) with acid/alkali proof tiling. The pumps & tanks shall be located on elevated platform, with platform elevation higher than kerb height (minimum 150 mm). Proper floor slope shall be provided for area drainage. Internal drainage of the kerb area should be routed to a neutralization pit and after neutralization shall be routed to the backwash waste sump in RODM section. Drains of all chemicals storage tanks shall be provided with spectacle blind in addition to valves.
- Flushing connections shall be provided in all chemical & sludge handling units & lines. Flow measurement shall be provided at all chemical dosing lines. Safety measures for hazardous chemical handling shall be strictly followed as per industry norms and manufacturers recommendation.
- Block & bleed valve arrangements shall be provided at backwash inlet and regeneration (acid & alkali) inlet of individual MB.
- Plant air, Service water & LP steam hose connection with flexible hose pipe with suitable length at pump houses, sludge handling area, chemical storage and handling area and others wherever applicable shall be provided. Safety Shower and eyewash facility, service water and plant air hose connection shall be provided near bulk storage

& other chemical handling areas. FRP grating, hand rail and members shall be used in chemical and highly corrosive area.

- All piping at battery limit shall be left with flange connection. The ISBL piping shall be through pipe racks, pipe sleepers and trenches /underground lines as per the Engineering Specifications. U/G piping shall have a minimum cushion of 1.2 m below FGL. Wherever such cushion is not feasible, pipe shall be encased in R.C.C. pipe.
- All valves shall be located at operable height from the ground/permanent platform. Platform for operation of valves shall have a minimum width of 900 mm with galvanized grating / chequered plate. All below grade valves shall be operable from grade by providing extended spindle and hand wheel arrangement.
- All motorized valves and all auto ON/OFF valves shall have provision for manual override.
- All instrument indication facility shall be readable from grade.
- Access to the platform shall be by ladders. Access shall be by staircase if unit requires frequent attention of operating personnel. Approach & platform shall be provided wherever adjustable weir, instruments, measuring scale, etc. are kept. Adjoining units shall be connected with operating platform (with Hand-railing).
- The complete battery limit area of Reverse Osmosis Based Demineralization Plant (RO-DMP) & Condensate Polishing Unit (CPU) shall be RCC paved as per the specifications given elsewhere in the tender.
- Cathodic protection shall be considered for all tanks which are not provided on RCC/pile foundation.
- Contractor to provide all headers with end flange to accommodate connections for installation of one more treatment chain in future.
- The equipment layout to be prepared such that the space allocated for the future chain is easily accessible for erection/construction/installation.
- Future piping connections, flanges and space for the future equipment, piping, instruments, piping fittings etc. shall be provided to install the chain (Oil Coalescer, Activated Carbon Filters and Mixed Bed Exchanger) for future Alkylation unit.

- The Equipment Layout shall be prepared such that all units are accessible for routine maintenance/repair. It shall also facilitate convenience for regular monitoring of units by operating staff.
- Road approach shall be provided for crane movement for all major and critical equipment.
- Draining arrangement shall be provided for all units/equipment, as necessary.
- Sampling points shall be provided for each treatment section including adequate sampling points for measuring water quality at intermediate points and chemical solution concentration.
- All piping, instrumentation, electrical and other mechanical works as necessary are in Contractor's scope.
- Sizes/specifications as given in various datasheets of the tender are minimum requirements, which are to be followed by the bidders as a minimum. Higher sizes, if process design demands, shall be provided by the bidders at no extra cost to IOCL. These are part of the detail engineering review/approval by EIL.
- Type and minimum size of manholes (for pressure vessels, tanks, covered sumps, underground sewer etc.) shall be as per EIL standards. All vessels with a bottom manhole shall have a clear height of 1.2 m below the manhole elevation.
- The specifications/requirements are bare minimum only. The vendor shall follow good engineering practices and incorporate maximum operational flexibility in the system.

6.0 FORMAT FOR CHEMICAL AND UTILITY CONSUMPTION FIGURES

All Utilities & Chemicals Consumption which are envisaged to be used in CPU for Normal Operation as well as for start-up / shutdown requirements shall be listed by the contractor.

6.1 Maximum Consumption Figures for Utilities

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/day (1 Day = 24 Hours)
Power	kW		
Service Water	m ³ /hr		
Drinking Water	m ³ /hr		

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/day (1 Day = 24 Hours)
Plant Air	Nm ³ /hr		
Instrument Air	Nm ³ /hr		
Nitrogen	Nm ³ /hr		
LP Steam	Kg/hr		
Cooling Water	m ³ /hr		
Fire water	m ³ /hr		
Any Other			

6.2 Maximum Consumption Figures for Chemicals

Description of Chemical	Dosing Rate in ppm (Normal / Design)	Consumption in kg/d at Design Flow	Purity of Chemical	Solution Strength
Hydrochloric acid (HCl)				
Caustic (NaOH)				
Morpholine				
Any Other				

Note: MSDS for all the chemicals are to be provided by the contractor. Chlorine gas and H₂SO₄ should not be used in the plant.

7.0 LIST OF ENCLOSURES

All works as per following enclosures are part of contractor's scope of work/supply:

S. No.	Document No.	Document Title
1.	B269-476-02-DS-1901	Process Datasheet of CPU
2.	B269-476-17-44-EL-1001	Equipment List
3.	B269-475-17-44-1001	Equipment Layout
4.	B269-476-17-44-1111 to 1117	P&IDs
5.	B269-476-17-44-DS-1001 to 1016	Datasheets

SCOPE OF WORKS/SUPPLY **(PLOT PLAN AND WATER)** **CONDENSATE POLISHING UNIT (CPU)** **(PNCP COMPLEX)**

PROJECT : PANIPAT REFINERY EXPANSION PROJECT (P-25)

OWNER : IOCL, PANIPAT

PMC : ENGINEERS INDIA LIMITED

JOB NO. : B269

2	03.03.2022	REVISED & ISSUED WITH TA-02	SC	VS	PKG
1	24.08.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
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A	09.04.2021	ISSUED FOR INPUTS/COMMENTS	SC	VS	PKG
Rev. No	Date	Purpose	Prepared By	Checked by	Approved by

1.0 INTRODUCTION

Indian Oil Corporation Limited (IOCL) operates 15.0 million metric tons per annum (MMTPA) refinery at Panipat in state of Haryana, India. The refinery is currently implementing facilities to manufacture 100% BS-VI fuel mandated by Auto Fuel Policy.

In order to meet the demand growth of petroleum products and also to increase its profitability and competitiveness in the long run, IOCL intends to enhance the refinery capacity from 15 to 25 MMTPA. The Expansion Project consists of a new Crude / Vacuum Distillation unit (CDU/VDU) of capacity of 10 MMTPA followed by a SR LPG Treater (SR LPGT), MS Block comprising of NHT, CCRU & Isomerization Unit, Alkylation/ SARU, DHDT, VGO-HDT, RHCU, INDMAX including CR LPG Treater, and PRU. A new PP unit and Catalytic De-waxing Unit are included as value augmentation unit. Auxiliary facilities i.e., HGU, SWS/ARU and SRU and Utility / Offsite (U&O) facilities for the entire project are included in the facility.

A Condensate Polishing Unit (CPU) is envisaged for treatment of unpolished condensate generated in New Units in PNCP Complex to produce polished condensate. Two chains (both working) each of 50 m³/h capacity shall be provided for the complex. This document constitutes the scope of work/supply for the Condensate Polishing Unit.

2.0 DETAILED SCOPE OF SUPPLY/WORK

The scope of work for CPU shall be as follows but not limited to as given herein:

The scope of work shall include Project Management; Residual Process Design & Detailed Engineering; Procurement; Fabrication; Inspection; Supply; Manufacture; Transportation of all equipment/materials to the work site & Storage at site; assembly, erection & installation; Construction and Erection of Civil & Structural, Mechanical, Electrical, Instrumentation & Piping works; tie-in with existing facilities; Acid /Alkali proof tiling; Painting; Testing; Pre-commissioning, trial run for 30 days before commissioning; commissioning; Training of IOCL's personnel; performance guarantee test run for 72 hours continuous operation in presence of IOCL's & EIL's Representatives; guaranteeing and handing over of CPU to the Client on lump sum turnkey basis as per design basis, equipment list, standards, P&IDs, data sheets, drawings, etc., all

complete within Contractor's specified battery limits including supply of spares, chemicals & consumables.

HAZOP for the complete CPU including implementation of HAZOP recommendation shall be under contractor's scope of work. HAZOP chairman shall be engaged by the contractor at his own cost and his CV shall be submitted by the contractor to EIL/IOCL for acceptance. HAZOP requirements shall be as per the HAZOP specifications attached in the tender.

3D modeling (in PDMS software as defined in the Piping specifications) for CPU shall also be included in scope of work of the contractor.

SMART P&IDs shall be prepared for the plant during detailed engineering review and as built.



All equipment described in these specifications; datasheets & equipment list; as shown in the P&IDs & PFDs; as mentioned elsewhere in the tender document or as necessary for completeness but not listed above shall also be deemed to have been included in Contractor's scope. All works required to meet requirements given in design/process/operation requirements defined elsewhere in the bid document shall also be deemed to have been included in Contractor's scope.

2.1 PROCESS

Process documents enclosed are the basic documents and are to be followed for execution of job leading to successful commissioning and performance guarantee test run of the Plant. During the course of execution, updating/modification to the process documents that would become necessary is to be carried out with the approval of EIL/IOCL. The resultant work arising out of this will also form the part of scope from detailed engineering to handing over of the plant with no cost implication to IOCL.

The tender specifies the scheme (refer to the PFDs / SFDs and P&IDs attached in relevant sections in tender document) & Contractor's scope of supply in subsequent sections of this document as minimum requirements. Bidder may include in his scope any additional requirements, if so warranted to meet process guarantees and for smooth, safe and trouble free operation of the plants.

2.2 ENGINEERING

The design basis, data sheets, drawings, standards, specification, codes to be followed for different types of works are brought out in the various engineering sections forming part of the tender document. Contractor shall carry out residual process design & detail engineering works for the plant and submit various drawings and documents for approval of EIL/IOCL before these are released for construction.

2.3 CONSTRUCTION AND INSTALLATION

These activities shall be carried out by the contractor as specified elsewhere in the tender document.

2.4 QUALITY ASSURANCE

These activities shall be carried out by the contractor as specified elsewhere in the tender document.

2.5 STATUTORY CLEARANCES

All the applicable safety codes, national laws and local regulations shall be followed by the successful bidder for the design, engineering, fabrication, erection, commissioning & handing over of the Plant / Equipment and necessary approvals shall be obtained from the concerned statutory authorities by the contractor. Statutory bodies from which approvals may have to be taken include State Pollution Control Board, Chief Inspector of Boilers / IBR, Factory Inspectorate, Labour Authorities, Electrical Inspectorate and Chief Controller of Explosive, Directorate General of Mines and Safety requirements, etc. The contractor shall ascertain requirement of approvals as applicable in such plants and initiation of action as required shall be in contractor's scope.

2.6 SAFETY

These activities shall be carried out by contractor as specified elsewhere in the tender document. All safety procedures for different types of work as per the safety rules from time to time by EIL/IOCL shall be binding and adhered to by the contractor. Safety report generation for different situations as per the rules and required by EIL/IOCL are to be adhered to. HSE policy of IOCL shall be binding upon the contractor.

2.7 VENDOR LIST

For most of the systems/equipment, the approved vendor list of EIL is enclosed in the bid document, which shall be adhered to. While for other items, not listed in the approved vendor list, the suppliers who would be involved for design, engineering and supply of equipment and materials are to be proposed by the contractor (for EIL/IOCL approval) during detailed engineering with the documentary evidence of having supplied similar equipment, systems and/or materials for similar applications with proven track record. Any change for new contractor/supplier after award of contract for supply will not be permitted. It will be necessary to purchase certain items as a system and not as individual equipment. These have to be identified and furnished during detailed engineering for approval of the EIL/ IOCL.

2.8 WASTE DISPOSAL

All wastes generated like surplus earth after use/surplus construction materials to be disposed-off from time to time by the contractor to the disposal locations as directed by the Engineer-in-Charge.

2.9 DESCRIPENCIES / VARIATIONS IN SPECIFICATIONS / STANDARDS

Bidders may bring out variations, deviations, if any, in related data sheets, equipment list, drawings, specifications, standards, codes, scope and any other contractual clauses before submission of bids and seek clarifications. In case of any contradiction on specification brought out at the post award stage of job, decision of EIL/ IOCL shall be final & binding upon the Contractor without any time & cost implication.

2.10 SUPPLY OF CONSUMABLES & CHEMICALS

Supply of all spares and consumables required for the Operation and Maintenance of the plant during start-up, pre-commissioning, 30 days trial runs and up to successful commissioning shall be in the scope of supply of the LSTK contractor. HCl, NaOH & Morpholine shall be free issue supply by IOCL. Unloading, handling and storage of all consumables (including provision of necessary facilities) shall be done by the contractor.

2.11 SPARES

2.11.1 MANDATORY SPARES

Contractor's scope regarding supply of mandatory spares shall be as per the Mandatory Spare List B269-81-17-44-MS-1001 and specifications attached in the tender.

2.11.2 ERECTION & COMMISSIONING SPARES

Contractor shall ensure adequate supply of all spares as required by him for successful erection & commission of the plant till handing over to the client. The lump sum price quoted shall be deemed to be inclusive of cost of such spares.

2.11.3 SPECIAL TOOLS AND TACKLES

Contractor shall ensure supply of all special tools and tackles for commissioning of the entire plant till handing over. The lump sum price quoted shall be deemed to be inclusive of cost of such tools and tackles.

2.11.4 TWO YEARS RECOMMENDED SPARES

Two years normal operation spares required are to be identified by the bidder and shall be in the bidder's scope of supply.

2.11.5 STORAGE OF SPARES

All spare parts supplied by the bidder shall be properly wrapped, packaged and stored by the contractor so that they will be preserved in original and new condition under the normal conditions of storage to be anticipated in India and shall be properly tagged and coded so that later identification as to intended equipment usage will be facilitated. They shall be packed separately clearly marked as 'spare parts'. Packing lists shall be furnished so that the parts can be handled without uncrating if desired.

2.12 MECHANICAL COMPLETION / PRE-COMMISSIONING / COMMISSIONING / GUARANTEE & TOLERANCES

Mechanical Completion

Mechanical completion of the Plant shall mean that all installations works of the Plant have been completed and hydrotested in accordance with approved construction drawings, approved specifications, applicable codes, accepted International good engineering practices and all the activities have been completed in a comprehensive manner by the Contractor.

Pre-Commissioning

Pre-commissioning activities are defined as those activities which are required to be performed after completion / installation, inspection, hydrotesting, etc. of the Plant to make it ready for commissioning.

Commissioning

The Plant shall be considered "Ready for Commissioning" when 30 days trial runs are over and all the facilities have been completed along with their auxiliaries and support facilities in every respect including charging of lubes, chemicals, filters media, preparation of solution, etc. as recommended by IOCL / EIL in standard format with all exceptions, if any, resolved.

Commissioning of the Plant shall mean taking the feed in the system, passing it through normal route and establishing the process control parameters. The Plant shall be considered to be commissioned successfully with instrumentation / control system, process, utilities & support system have been on uninterrupted stable operation for not less than 72 hours while producing treated water of desired quality. Whether the 72 hours operation has been successful or not shall be decided by IOCL/EIL based on observations recorded during 72 hours. The countdown for 72 hours operation shall start on after the system has been on stable operation with all controls and safety systems in normal operation for a period of not less than 48 hours.

GUARANTEES

Contractor shall guarantee the following parameters (details as specified in clause no. 2.13 below):

- Hydraulic capacity of the plant

- Polished condensate quality

TOLERANCES

The guaranteed figures are subject to the following tolerances for acceptance of the plant.

- Capacity measurement $\pm 2\%$.
- Quality measurement as per accuracies guaranteed by the instrument supplier.

In case of any variation over the tolerances given above, contractor shall rectify the plant at his own cost within a time mutually agreed upon by the contractor and IOCL/EIL to bring the plant performance in line with the guaranteed figures.

2.13 PERFORMANCE AND GUARANTEES

- After the system has been stabilized by the contractor during 30 days trial runs and plant is successfully commissioned, the contractor shall conduct a performance guarantee test run for CPU. The procedure for performance testing shall be submitted by the contractor to the EIL/ IOCL for review & approval. The duration for the performance guarantee test run shall be 72 hours continuous operation of the plant.

The performance guarantee test run for CPU shall be carried out at the design conditions (including design capacities & design unpolished condensate quality) at CPU inlet as specified in the Process Datasheet of CPU (Doc. No.B269-81-02-DS-1901).

During the performance guarantee test runs, the following guarantee parameters shall be fulfilled (within the tolerances as specified) at design conditions as specified above.

☞ Guaranteed Hydraulic Capacity of the Plant:

System/Parameter	Value
Hydraulic Capacity	50 m ³ /h feed unpolished condensate for each chain

☞ Polished Condensate quality (parameters to be guaranteed by the contractor at the outlet of MB Exchanger):

S. No.	Parameter	Unit	Value
1.	pH	-	6.5-7.3

2

S. No.	Parameter	Unit	Value
2.	Conductivity at 20 deg C	micro S/cm	0.2 (max)
3.	Total Hardness as CaCo3	mg/l	BDL
4.	Turbidity	NTU	BDL
5.	Total Silica as SiO2	mg/l	≤0.02
6.	Total Oil Content (TOC)	mg/l	≤ 0.3
7.	Total Iron as Fe	mg/l	≤ 0.005
8.	Sodium as Na	mg/l	≤ 0.005
9.	Chlorides as Cl	mg/l	≤ 0.005
10.	KMnO4 value at 100deg C,	mg/l	<1

BDL: Below Detectable Limit

☞ **Oil Concentration at outlet of Secondary Activated Carbon Filters (parameters to be guaranteed by the contractor):**

System/Parameter	Value (Hold)
Oil & Grease	BDL

BDL: Below Detectable Limit

In case the designed feed unpolished condensate quantity & quality is not available as specified in the tender document, the PGTR may be carried out (if so desired by M/s IOCL) for the actual conditions within the design conditions for the plant, while performing to the desired treated outlet quality as per the requirement of the tender.

- b) Any loss of consumable/material during pre-commissioning, trial runs, commissioning, etc. prior to handing over of plant to IOCL shall be made up by the contractor to the quantities specified in the design calculations as initial charge without any extra time & cost to IOCL.
- c) If on testing, any material or equipment or the unit does not meet the design, rated or guaranteed performance related there to, the contractor shall forthwith, within the scope of work of contractor and at no additional cost to IOCL, undertake such additional tests and / or operations as are necessary to identify the cause of such failure. Such tests and / or operations shall be conducted in conjunction with IOCL, if the plant as a whole fails to meet the guarantees.
- d) If as a result of such tests and / or operations it is determined that the design, rated and / or guaranteed outputs or capacities have not been met because of defect in

any material(s) (including machines and equipment) supplied by the Contractor, the Contractor shall forthwith in consultation with the Engineer-in charge take steps necessary to cause the defect to be identified and rectified, either by replacement of the defected material, machine or equipment or part thereof or by repair or replacement thereof at sole cost and expenses of Contractor.

- e) In the event that certain of the guaranteed performance have not been met, the Contractor shall make suitable additions, deletions or modifications, if required after obtaining approval of IOCL/EIL to the process and the Plant to ensure the guaranteed results.

2.14 PROJECT MANAGEMENT

Effective project management within time frame is also a part of the contractor's scope. The system of organization & control; feedback & corrective measures; communication & project execution scheme to be submitted.

Planning, scheduling and monitoring is essential for timely completion of the project and effective project management system to be adopted as enumerated.

3.0 BATTERY LIMIT CONDITIONS

Battery limit conditions for unpolished condensate & polished condensate lines (to & from CPU) shall be as per the Process Datasheet of CPU (Doc. No. B269-81-02-DS-1901).

Contractor shall route the condensate lines from the battery limit to the New CPU Location. All tie-in requirements with the existing CPU unit as indicated in the Tender P&IDs and Specifications shall be in the scope of the contractor. The contractor shall identify the tie-in locations and finalize the same in consultation with IOCL/EIL including the isolation and shutdown requirements for executing the piping tie-in connections.

The following utilities are available in the existing RODM-CPU Plant. Contractor to identify and finalize the tie-in locations with the utilities near/in the existing RO shed as per requirement in consultation with IOCL/EIL.

- Plant Air
- Instrument Air

- LP Steam
- Service Water
- Drinking Water
- Nitrogen
- Power
- Cooling Water
- Fire Water

4.0 SCOPE OF CONTRACTOR'S WORK/ SUPPLY (ISBL)

The Contractor's scope of supply of equipment as minimum shall be as given in this specification, Process Datasheets, Equipment List, PFD, P&IDs, and as specified elsewhere in the Tender Document.

All works required inside the battery limit of CPU for treatment including all associated facilities as per tender requirements shall be in contractor's scope of supply.

For all the equipment listed in tender or as required to make the plant complete in all respects to deliver the required quantity & quality of treated products, the contractor has to supply piping, valves and fittings, instruments, electrical items, consumables, etc. and all other items as indicated in the equipment list, datasheets, P&IDs, PFDs etc., or as required to make the plant complete with respect to safe trouble free operation of the plant.

The proposed CPU shall be designed for the conditions as specified in the Process Datasheet and as described in the subsequent sections of this specification and as described elsewhere in the Tender Document. The proposed CPU shall be located within the plot area of existing RODM-CPU of PNCP. The exact location shall be as identified in Overall Plot Plan for PNCP Area (Doc. No.B269-99981-41-00002).

Hydraulic Design of CPU shall ensure that both chains can be operated simultaneously.

Equipment list for CPU shall be as per the Equipment List (Document No. B269-81-17-44-EL-1001) attached with the tender. Bidder may include in his scope any additional requirements/equipment, if so warranted by him, in order to meet the guarantees as specified in Clause No. 2.13 of this specification.

Feed Polished Condensate Heat Exchanger, Trim Cooler, ACFs (Primary &

Secondary) & Mixed Bed Exchanger in the CPU shall be provided under a new shed which shall be an extension of the existing RO Shed.

All Piping and Electrical & Instrumentation cable routing for the New CPU shall be done by the contractor in the existing RODM-CPU plant and it shall be ensured that the existing facilities are kept undisturbed and the maintenance accesses to the units are not blocked.

The following facilities of existing RODMP & CPU shall be utilized by the contractor for completeness of proposed CPU after identification of tie-in points at suitable locations:

S. No.	Equipment	Tag No.
i.	Polished Condensate Tank	51-T-001 A/B
ii.	Unpolished Condensate Feed Tank	51-T-002 A/B
iii.	Acid Measuring Tank-CPU	51-T-003 A/B
iv.	Alkali Measuring Tank-CPU	51-T-004 A/B
v.	ACF Backwash Tank	51-T-005
vi.	ACF Backwash Pumps	51-P-003 A/B
vii.	MB Air scour Blower	51-K-001 A/B
viii.	DM Water Regeneration Pumps	51-P-004 A/B
ix.	Morpholine Dosing Tank	46-T-022 A/B

Tie-in point identification of process/utilities lines shall be done at site with IOCL/EIL. The tie-in locations shall be finalized after approval from IOCL/EIL.

The backwash waste of ACF shall be routed to the OWS network as per the existing philosophy of backwash routing. Necessary drain connections for the same shall be provided

The regeneration waste of MB shall be routed to existing Waste Disposal Tank (Tag No.46-T-021) of RODM Plant as per the existing philosophy. Drain / Waste Water routing / connection in the existing drain shall be provided by the contractor.

The routing of lines (condensate, cooling water, chemicals, waste and utilities) shall be planned such that there are no hindrances/constraints in the existing plant operation and maintenance access.

Also, all other works (including civil & structural works) mentioned elsewhere in the tender document or as shown in the drawings but not listed herein shall also be deemed to have been included in contractor's scope of work.

A separate PLC based Control system shall be provided by the contractor for the proposed CPU in the control room for the existing Control Room of the RODM / CPU Plant. All signals of the CPU shall be routed to the Control Room for Monitoring and Control of the Plant. Required integration of new and existing signals shall be done in the new control system provided for the CPU.

Level indications of the Existing Unpolished and Polished Condensate Tanks shall be repeated in the New Control System of the CPU and shall be utilized for monitoring and trip purposes.

Status signals of Backwashing and Regeneration cycles of the existing ACF and MB units shall also be made available in the New PLC system for monitoring.

All Signals of CPU shall be repeated in the MCR of the Refinery for Monitoring. The detailed Instrumentation scope shall be as per the Instrumentation Specifications provided in the Tender.

Power for CPU shall be supplied from the Substation for the existing RODM-CPU Plant. All Motor Controls shall be located in the existing Substation. Detailed Electrical scope shall be as per the Electrical Specifications attached in the Tender Document.

5.0 GENERAL DESIGN & ENGINEERING REQUIREMENTS

- Line Size Criteria to be based on following pipe/line velocities:
 - ☞ Pump Discharge : 2.0 m/sec (maximum)
 - ☞ Pump Suction : 1.2 m/sec (maximum)
 - ☞ Gravity Lines : 0.8 m/sec (maximum)
- Piping class shall be as given below for the indicated services. Corresponding material shall be as per EIL Piping Specifications.

Service	Piping Class
Suspect Condensate from battery limit upto inlet of Existing Unpolished Condensate Feed Tank (51-T-002 A/B)	A1A
Unpolished Condensate Lines from Existing Unpolished condensate Feed Tank (51-T-002 A/B) suction line to inlet isolation valve (manual) of MB Exchanger	A1A
Polished Condensate lines from downstream of outlet	A1K

Service	Piping Class
isolation valve (manual) of MB-CPU up to Existing Polished Condensate Tank (51-T-001 A/B) Inlet line	
Polished Condensate lines from Existing Polished Condensate Tank (51-T-001 A/B) Suction line to Battery Limit	A1K
Hydrochloric Acid (30%) Solution	A91S
Low Pressure Steam	A2A-IH
Service Water	A93A
Plant Air	A3A
Instrument Air	A93M (SS 316 upto 1" size)
Nitrogen	A3A
From inlet isolation valve (manual) of MB-CPU up to outlet isolation valve (manual) of MB-CPU including all frontal piping for MB-CPU and piping on MB-CPU. Caustic (up to 5% concentration), HCl (up to 5% concentration), DM water for Regeneration.	A1K
Caustic (above 5% concentration)	A19A
Drinking Water	J92A (0.5" to 6" size) (burial depth up to 1.5M)
Cooling Water Supply & Cooling Water Return	A93A (AG) (0.5"-16") A92A (UG) (burial depth upto 3.0 m)
For all incoming lines, same class of piping, as available at the Plant battery limit, shall be used up to their respective first unit. Material, for services not listed here, shall be subject to EIL's review and approval during engineering.	
<u>In case, different material & line size is specified in the tender drawings (Schematic Flow Diagram, PFDs, P&IDs, etc.), the material & line size specified in the drawings shall be provided as a minimum.</u>	

➤ Following types of valves shall be used for the Indicated Services.

Service	Valve Type
Condensate lines	Gate & Globe Valve/ Butterfly Valves
Conc. Hydrochloric Acid	Ball Valve
Caustic Solution Lines	Plug Valve (Lubricated)
Chemical Solution Lines	Ball Valves / Diaphragm Valves

Sampling Lines	Gate followed by Globe Valve
Individual Suction and discharge of Centrifugal pumps	Gate valves
Other type of valves such as Check Valve (NRV), Control Valve etc. shall be provided, wherever required. Isolation valves shall be provided in each unit as per the valve specs. MOC of the valves shall be compatible with MOC of the pipe.	
Spectacle blinds shall be provided downstream of all tank drain lines as well as at other main isolation places, wherever required.	
Piping components and its type shall be provided, as appropriate, which shall be subject to EIL's review and approval during Detailed Engineering.	
All Butterfly Valves shall be double offset tight shut-off valves.	2
Valves shall be provided as per the P&IDs.	

- For a full liquid system at the discharge of centrifugal pumps/blowers, the design pressure shall be as under.

$$P(\text{des}) = P(\text{max}) \text{ suction} + \text{DELTA } P(\text{max})$$

where,

$P(\text{max}) \text{ suction}$ = Maximum pressure at suction vessel bottom during suction system relieving conditions.

$\text{DELTA } P(\text{max})$ = Pump differential pressure at pump shutoff head with maximum operating density. If not known:

$\text{DELTA } P(\text{max}) = 1.2 \times \text{DELTA } H \times \text{Density}(\text{max})$: constant speed pump

$\text{DELTA } P(\text{max}) = 1.1 \times 1.2 \times \text{DELTA } H \times \text{Density}(\text{max})$: variable speed pump

$\text{DELTA } P(\text{max}) = 1.3 \times \text{DELTA } H \times \text{Density}(\text{max})$: high head multistage pump

$\text{DELTA } P(\text{max}) = 1.3 \times 1.1 \times \text{DEL } H \times \text{Density}(\text{max})$: variable speed high head multistage Pump

Where, $\text{DELTA } H$ is the pump head at rated condition

- For a full liquid system at the discharge of positive displacement pumps, the design pressure shall be the higher of:

$$P(\text{des}) = P(\text{rated}) \text{ discharge} + 2 \text{ kg/cm}^2$$

$$P(\text{des}) = 1.1 \times P(\text{rated}) \text{ discharge}$$

- Vessels operating under vacuum shall be, in general, designed for an external pressure of 1.033 kg/cm² abs and full internal vacuum, unless otherwise specified.
- Common delivery header and suction header of pumps (and blowers) shall be provided with a blind flange on one end. Recirculation lines for the pumps shall be provided by the vendor as indicated in the tender PFDs / P&IDs and also shall be provided as per process requirements/ turndown requirements.
- All working & standby pumps (including warehouse/store standby) shall also be provided with the respective motors. All motor shall have running indication in control room. Motors of all pumps and blowers, if not housed under shed/room, shall be covered with canopy. Suction line/filter of blowers shall also be provided with canopy.
- Rated capacity of all the blowers shall be minimum 10% more than the normal process requirements. Also, head of all the pumps shall be minimum 10% more than the total calculated head (including static head and losses in pipes, fittings, instruments, etc.) based on normal process requirements. All sets of rotating equipment viz. pumps, blowers, compressors, etc. shall be provided with at least one standby of same capacity as the operating equipment.
- Chemical dosing pumps shall be designed to cater for minimum to maximum hydraulic requirements. All chemical dosing pumps shall be provided with pressure safety valves and pulsation dampeners on individual pump discharge. All chemical handling pumps shall have permanent flushing connection (inlet and outlet).
- All pumps shall be flooded suction type, unless otherwise specified, fully primed under Low Liquid Level in the suction sump/ tank. Also, for all pumps with flooded suction, LWL in the tank/sump shall be above the top of pump casing.
- All Acid, Alkali, and other hazardous chemical dosing pumps & dosing tanks shall be located inside a kerbed area, suitably lined (floor, inside kerb wall and all structures inside the kerb area) with acid/alkali proof tiling. The pumps & tanks shall be located on elevated platform, with platform elevation higher than kerb height (minimum 150 mm). Proper floor slope shall be provided for area drainage. Internal drainage of the kerb area should be routed to a neutralization pit and after neutralization shall be routed to the backwash waste sump in RODM section. Drains of all chemicals storage tanks shall be provided with spectacle blind in addition to valves.

- Flushing connections shall be provided in all chemical & sludge handling units & lines. Flow measurement shall be provided at all chemical dosing lines. Safety measures for hazardous chemical handling shall be strictly followed as per industry norms and manufacturers recommendation.
- Block & bleed valve arrangements shall be provided at backwash inlet and regeneration (acid & alkali) inlet of individual MB.
- Plant air, Service water & LP steam hose connection with flexible hose pipe with suitable length at pump houses, sludge handling area, chemical storage and handling area and others wherever applicable shall be provided.
- All piping at battery limit shall be left with flange connection. The ISBL piping shall be through pipe racks, pipe sleepers and trenches /underground lines as per the Engineering Specifications. U/G piping shall have a minimum cushion of 1.2 m below FGL. Wherever such cushion is not feasible, pipe shall be encased in R.C.C. pipe.
- All valves shall be located at operable height from the ground/permanent platform. Platform for operation of valves shall have a minimum width of 900 mm with galvanized grating / chequered plate. All below grade valves shall be operable from grade by providing extended spindle and hand wheel arrangement.
- All motorized valves and all auto ON/OFF valves shall have provision for manual override.
- All instrument indication facility shall be readable from grade.
- Access to the platform shall be by ladders. Access shall be by staircase if unit requires frequent attention of operating personnel. Approach & platform shall be provided wherever adjustable weir, instruments, measuring scale, etc. are kept. Adjoining units shall be connected with operating platform (with Hand-railing).
- The complete battery limit area of CPU shall be RCC paved as per the specifications given elsewhere in the tender.
- The Equipment Layout shall be prepared such that all units are accessible for routine maintenance/repair. It shall also facilitate convenience for regular monitoring of units by operating staff.

- Road approach shall be provided for crane movement for all major and critical equipment.
- Draining arrangement shall be provided for all units/equipment, as necessary.
- Sampling points shall be provided for each treatment section including adequate sampling points for measuring water quality at intermediate points and chemical solution concentration.
- All piping, instrumentation, electrical and other mechanical works as necessary are in Contractor's scope.
- Sizes/specifications as given in various datasheets of the tender are minimum requirements, which are to be followed by the bidders as a minimum. Higher sizes, if process design demands, shall be provided by the bidders at no extra cost to IOCL. These are part of the detail engineering review/approval by EIL.
- Type and minimum size of manholes (for pressure vessels, tanks, covered sumps, underground sewer etc.) shall be as per EIL standards. All vessels with a bottom manhole shall have a clear height of 1.2 m below the manhole elevation.
- The specifications/requirements are bare minimum only. The vendor shall follow good engineering practices and incorporate maximum operational flexibility in the system.

6.0 FORMAT FOR CHEMICAL AND UTILITY CONSUMPTION FIGURES

All Utilities & Chemicals Consumption which are envisaged to be used in CPU for Normal Operation as well as for start-up / shutdown requirements shall be listed by the contractor.

6.1 Maximum Consumption Figures for Utilities

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/day (1 Day = 24 Hours)
Power	kW		
Service Water	m ³ /hr		
Drinking Water	m ³ /hr		
Plant Air	Nm ³ /hr		
Instrument Air	Nm ³ /hr		
Nitrogen	Nm ³ /hr		
LP Steam	Kg/hr		
Cooling Water	m ³ /hr		

Description of Utility	Unit	Hourly Rate (Max.)	Maximum Consumption Figure/day (1 Day = 24 Hours)
Fire water	m ³ /hr		
Any Other			

6.2 Maximum Consumption Figures for Chemicals

Description of Chemical	Dosing Rate in ppm (Normal / Design)	Consumption in kg/d at Design Flow	Purity of Chemical	Solution Strength
Hydrochloric acid (HCl)				
Caustic (NaOH)				
Morpholine				
Any Other				

Note: MSDS for all the chemicals are to be provided by the contractor. Chlorine gas and H₂SO₄ should not be used in the plant.

7.0 LIST OF ENCLOSURES

All works as per following enclosures are part of contractor's scope of work/supply:

S. No.	Document No.	Document Title
1.	B269-81-02-DS-1901	Process Datasheet of CPU
2.	B269-81-17-44-EL-1001	Equipment List
3.	B269-81-17-44-MS-1001	Mandatory Spares List for CPU
4.	B269-81-17-44-1111 to 1116	P&IDs
5.	B269-81-17-44-DS-1001 to 1005	Datasheets

EQUIPMENT LIST
(PLOT PLAN AND WATER DEPARTMENT)
OF
RO-MB BASED DM PLANT
FOR
PANIPAT REFINERY EXPANSION PROJECT (P-25)
INDIAN OIL CORPORATION LIMITED

5	03.03.2022	REVISED & ISSUED WITH TA-02	SC	VS	PKG
4	23.02.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
3	16.06.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
2	24.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
1	01.12.2020	REVISED & REISSUED FOR TENDER	SC	VS	PKG
Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
A.	CTBD TREATMENT SECTION					
1.	B269-475-17-44-DS-1001	2W	475-T-101 A/B	Blow down Collection Tank	Effective Capacity:7475m ³ each Size: 23 m dia x 18 m LD + 1.0 m FB + 1.0 m DVD	CS Epoxy Painted
2.	B269-475-17-44-DS-1002	3 (2W+1S)	475-P-101 A/B/C	HRSCC-I Feed Pumps	Capacity:310 m ³ /h Head: 15 m	C: CS, I:CS
3.	B269-475-17-44-DS-1003	2W	475-T-102 A/B	Flash Mixing Tank-I	Effective Capacity: 22.5 m ³ L x B x H: 3 m x 3 m x 2.5 m SWD + 0.3 m FB	RCC Epoxy Coating
4.	B269-475-17-44-DS-1004	2W	475-MX-101 A/B	Flash Mixer-I	Diameter: 500 mm	I:SS316 L S:SS431
5.	B269-475-17-44-DS-1005	2W	475-CL-101 A/B	High Rate Solid Contact Clarifier –I	Capacity: 370 m ³ /h Size: 17.5m dia x 4 m SWD + 0.5 m FB	RCC Epoxy Coating
6.	B269-475-17-44-DS-1006	1W	475-T-103	Filter Feed Tank-I	Effective Capacity: 300m ³ L x B x H: 16 m X 6.5 m x 3 m SWD + 0.5 m FB + 0.5 DVD	RCC Epoxy Painted
7.	B269-475-17-44-DS-1007	3(2W+1S)	475-P-102 A/B/C	Filter Feed Pumps-I	Capacity:300 m ³ /h Head: 45 m	C: CS, I:CS
8.	B269-475-17-44-DS-1008	5(4W+1S)	475-G-101 A/B/C/D/E	Dual Media Filters (vertical)-I	Capacity: 150 m ³ /h each Dia: 4 m, Height.: 2.6 m (T/T) Garnet & anthracite media: As per design	CS Epoxy Coated

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S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
9.	B269-475-17-44-DS-1009	5(4W+1S)	475-G-102 A/B/C/D/E	Activated Carbon Filters-I	Capacity: 150 m ³ /h each Dia: 4.0 m, Height.: 3.6 m (T/T)	CS Epoxy Coated
10.	B269-475-17-44-DS-1010	2(1W+1S)	475-P-103 A/B	Filter Backwash Pump –I	Capacity: 230 m ³ /h Head: 25 m	C: CS, I:CS
11.	B269-475-17-44-DS-1011	2(1+1S)	475-K-101 A/B	Filter Air scouring blowers	Capacity: 630 Nm ³ /h Head: 5 m	C: CI Gr. 260 I: CI Gr. 260 S: EN-8
12.	B269-475-17-44-DS-1012	1W	475-S-101	HRSCC-I Sludge Sump	Effective Capacity: 120 m ³ Size 10 m L X 6m W x 2 m SWD + 0.5 m FB	RCC Epoxy Coated
13.	B269-475-17-44-DS-1013	2W	475-MX-102 A/B	HRSCC- I Sludge Sump Agitator	Diameter: 1000 mm	Impeller: SS 316L Shaft : SS 431
14.	B269-475-17-44-DS-1014	2(1W+1S)	475-P-104 A/B	HRSCC-I Sludge Transfer Pumps	Capacity: 25 m ³ /h Head: 25 m (16 hrs working)	C: CS, I:SS 304
B.	<u>TERTIARY TREATMENT SECTION</u>					
15.	B269-475-17-44-DS-1015	1W	475-T-104	UF-I Feed Collection Tank	Effective Capacity:8139m ³ each Size: 24m Dia x 18m LD + 1.0 m DVD + 1.0 m FB	CS Epoxy Coated
16.	B269-475-17-44-DS-1016	4(3W+1S)	475-P-105 A/B/C/D	UF Feed Pumps	Capacity: 352m ³ /h Head: 40 m	C: CS, I:CS

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
17.	B269-475-17-44-DS-1017	4(3W+1S)	475-G-103 A/B/C/D	Auto Backwash Filters-I	Capacity: 352m ³ /h Rating : 200µm	Shell: CS Epoxy Coated; Mesh: SS316
18.	B269-475-17-44-DS-1018	4(3W+1S)	475-UF-101 A/B/C/D	Ultra-Filtration Skids-I (Note-1)	Capacity: 293m ³ /h Net permeate Flow per skid (88% recovery)	Membrane: PVDF/PES
19.	B269-475-17-44-DS-1019	1W	475-S-102	Backwash Waste Holding Sump-I	Effective Capacity: 250 m ³ L x B x D: 10 m x 10 m x 2.5 m SWD + 0.5 m FB	RCC Epoxy Coated
20.	B269-475-17-44-DS-1020	2(1W+1S)	475-P-106 A/B	Backwash Waste Transfer Pump -I	Capacity: 150 m ³ /h Head: 35 m	C: CS, I:CS
21.	B269-475-17-44-DS-1021	1W	475-T-105	RO-I Feed Tank	Effective Capacity: 3052 m ³ Size: 18.0 m dia x 12 m LD + 1.0 m FB + 1.0 m DVD	CS Epoxy Coated
22.	B269-475-17-44-DS-1022	3(2W+1S)	475-P-107 A/B/C	UF Backwash pumps-I	Capacity: 410 m ³ /h Head: 30 m	C: CS, I:CS
23.	B269-475-17-44-DS-1023	3(2W+1S)	475-P-108 A/B/C	RO-I Cartridge Filter Feed Pumps	Capacity: 500 m ³ /h Head: 40 m	C: SS316L, I:SS316L
24.	B269-475-17-44-DS-1024	5(4W+1S)	475-G-104 A/B/C/D/E	RO-I Cartridge Filters	Capacity: 250 m ³ /h Rating : 5µm absolute	Shell: CS Epoxy Coated; Cartridge Membrane: PP
25.	B269-475-17-44-DS-1025	6(4W+1S + 1SS)	475-P-109 A/B/C/D/E/F	RO-I Feed Pumps (VFD Driven)	Capacity: 250 m ³ /h Head: 165 m	C: SS316L, I:SS316L
26.	B269-475-17-44-DS-1026	5(4W+1S)	475-RO-101 A/B/C/D/E	Reverse Osmosis-I (RO) Skid	187.5 m ³ /h permeate flow each skid; 75% Recovery (Minimum)	Membrane-Polyamide / Tube: FRP/GRP (ASME)

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
27.	B269-475-17-44-DS-1027	1W	475-T-106	RO-II Feed Tank	Effective Capacity: 1980 m ³ Size: 14.5 m Dia x 12 m LD + 1.0 m FB + 1.0 m DVD	CS Epoxy Coated
28.	B269-475-17-44-DS-1028	6 (4W+1S + 1SS)	475-P-110 A/B/C/D/E/F	RO-II Feed Pumps (VFD Driven)	Capacity: 241 m ³ /h Head: 160 m	C: SS316L, I:SS316L
29.	B269-475-17-44-DS-1029	5 (4W+1S)	475-RO-102 A/B/C/D/E	Reverse Osmosis-II (RO) Skid	217 m ³ /h permeate flow each skid; 90% Recovery (Minimum)	Membrane-Polyamide / Tube: FRP/GRP (ASME)
30.	B269-475-17-44-DS-1030	1W	475-T-107	RO-III Feed Tank	Effective Capacity: 251 m ³ Size: 8 m Dia x 5.0 m LD + 0.5 m FB + 0.5 m DVD	CS Epoxy Coated
31.	B269-475-17-44-DS-1031	4 (2W+1S + 1SS)	475-P-111 A/B/C/D	RO-III Feed Pumps (VFD Driven)	Capacity: 125m ³ /h Head: 250 m	C: SDSS, I:SDSS
32.	-	3 (2W+1S)	475-LZ-101 A/B/C	Turbocharger	Capacity: 43m ³ /h	SDSS
33.	B269-475-17-44-DS-1032	3(2W+1S)	475-RO-103 A/B/C	Reverse Osmosis-III (RO) Skid	82 m ³ /h permeate flow each skid; 65% Recovery (Minimum)	Membrane-Polyamide / Tube: FRP/GRP (ASME)
34.	B269-475-17-44-DS-1033	3(2W+1S)	475-C-101 A/B/C	Degasser Tower	Capacity: 435 m ³ /h Dia: 3.2m, Ht: 4.0 m (T/T) Packing Height: 2 m (minimum)	CS with Glass Flake Vinyl Ester Lining Packing : PP Pall Rings
35.	B269-475-17-44-DS-1034	1W	475-T-108	Degassed Water Tank	Effective Capacity: 665 m ³ Size: 13 m Dia x 5 m LD + 1.0 m FB + 0.5 m DVD	CS with Glass Flake Vinyl Ester Lining

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
36.	B269-475-17-44-DS-1035	3(2W+1S)	475-K-102 A/B/C	Degasser Air Blowers	9350 Nm3/h, 100 mm Head (Centrifugal)	C : CS, I : CS, S: EN-8
37.	B269-475-17-44-DS-1036	7(5W+2S)	475-P-112 A/B/C/D/E/F/G	MB Feed Pumps	Capacity:170 m ³ /h Head: 60 m	C: SS316L , I: SS316L
38.	B269-475-17-44-DS-1037	7(5W+2S)	475-MB-101 A/B/C/D/E/F/G	Mixed Bed Exchanger	170 m3/hFeed water flow; 2.5 m Dia, Ht : 2.7 m (T/T)	CS with Glass Flake Vinyl Ester Lining
39.	B269-475-17-44-DS-1038	2(1W+1S)	475-K-103 A/B	MB Air Scouring Blowers RODM	650 Nm3/h, 5 m Head (Rotary lobe)	C : CS, I : CS, S: EN-8
40.	B269-475-17-44-DS-1039	2(1W+1S)	475-P-113 A/B	MB Regeneration Pumps for RODM	Capacity: 40 m3/h Head: 30 m	C: SS316L, I: SS316L
41.	B269-475-17-44-DS-1040			DELETED		
42.	B269-475-17-44-DS-1041			DELETED		
43.		-	-	DM Water Storage Tank	AS PER PROCESS DATASHEET	
44.		-	-	DM Water Transfer Pumps	AS PER PROCESS DATASHEET	
C.	RO REJECT RECOVERY SECTION					
45.	B269-475-17-44-DS-1042	1W	475-T-109	Flash Mixing Tank – II	Effective Capacity: 6 m ³ L x B x H: 2 m x 1.5 m x 2 m SWD + 0.3 m FB	RCC Epoxy Screed Lining
46.	B269-475-17-44-DS-1043	1W	475-MX-103	Flash Mixer – II	Diameter: 400 mm	I:SS316 FRP COATED S:SS431 FRP COATED
47.	B269-475-17-44-DS-1044	1W	475-CL-102	High Rate Solid Contact Clarifier – II	Capacity: 140 m ³ /h Size: 12 m Dia x 4 m SWD + 0.5 m FB	RCC Epoxy Screed Lining

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
48.	B269-475-17-44-DS-1045	1W	475-S-104	HRSCC-II Sludge Sump	Effective Capacity: 80 m ³ Size 8 m L X 5 m W x 2.0 m SWD + 0.5 m FB	RCC Epoxy Screed Lining
49.	B269-475-17-44-DS-1046	2W	475-MX-104 A/B	HRSCC - II Sludge Sump Agitator	Diameter: 800 mm	I:SS316 FRP COATED S:SS431 FRP COATED
50.	B269-475-17-44-DS-1047	2(1W+1S)	475-P-115 A/B	HRSCC-II Sludge Transfer Pumps	Capacity: 15m ³ /h Head: 25 m	C: SDSS, I:SDSS
51.	B269-475-17-44-DS-1048	1W	475-T-110	Filter Feed Tank-II	Effective Capacity: 150 m ³ L x B x H: 10 m X 6 m x 2.5 m SWD + 0.5 m FB	RCC Epoxy Screed Lining
52.	B269-475-17-44-DS-1049	2(1W+1S)	475-P-116 A/B	Filter Feed Pumps-II	Capacity:130 m ³ /h Head: 60 m	C:SDSS I:SDSS
53.	B269-475-17-44-DS-1050	2(1W+1S)	475-G-105 A/B	Dual Media Filters (vertical)-II	Capacity: 130 m ³ /h each Dia: 3.8 m, Height.: 2.6 m Garnet & anthracite media: As per design	CS GFVER Coated
54.	B269-475-17-44-DS-1051	2(1W+1S)	475-G-106 A/B	Activated Carbon Filters-II	Capacity: 130 m ³ /h each Dia: 3.8m, Ht.: 3.6 m (T/T)	CS GFVER Coated
55.	B269-475-17-44-DS-1052	2(1W+1S)	475-P-117 A/B	Filter Backwash Pump-II	Capacity:230m ³ /h Head: 25 m	C:SDSS I:SDSS
56.	B269-475-17-44-DS-1053	2(1W+1S)	475-K-104 A/B	Filter Air Scouring blowers -II	Capacity: 560 Nm ³ /h Head: 5 m	C: CI Gr. 260 I: CI Gr. 260 S: EN-8
57.	B269-475-17-44-DS-1054	2(1W+1S)	475-G-107 A/B	Auto Backwash Filters-II	Capacity: 130 m ³ /h Rating : 200µm	Shell: CS GFVER Coated; Mesh: SDSS

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S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
58.	B269-475-17-44-DS-1055	2(1W+1S)	475-UF-102 A/B	Ultra-Filtration Skids -II (Note-1)	Capacity: 108 m ³ /h Net Permeate Flow per skid (88% recovery)	Membrane: PVDF/PES
59.	B269-475-17-44-DS-1056	1W	475-S-105	Backwash Waste Holding Sump-II	Effective Capacity: 195 m ³ L x B x D: 10 m x 9.5 m x 2.0 m SWD + 0.5 m FB	RCC Epoxy Screed Lining
60.	B269-475-17-44-DS-1057	2(1W+1S)	475-P-118 A/B	Backwash Waste Transfer Pump –II	Capacity: 90 m ³ /h Head: 25 m	C: SDSS I: SDSS
61.	B269-475-17-44-DS-1058	1W	475-T-111	RO-IV Feed Tank	Effective Capacity: 133m ³ Size: 6.5 m dia x 4.0 m LD + 0.5 m FB + 0.5 m DVD	CS Glass Flaked Vinyl Ester Resin Coated
62.	B269-475-17-44-DS-1059	3(2W+1S)	475-P-119 A/B/C	UF Backwash pumps-II	Capacity: 310 m ³ /h Head: 30 m	C: SDSS I: SDSS
63.	B269-475-17-44-DS-1060	2(1W+1S)	475-P-120 A/B	RO-IV Cartridge Filter Feed Pumps	Capacity: 108 m ³ /h Head: 40 m	C: SDSS I: SDSS
64.	B269-475-17-44-DS-1061	2(1W+1S)	475-G-108 A/B	RO-IV Cartridge Filters	Capacity: 108 m ³ /h Rating: 5µm absolute	Shell: CS GFVER Coated; Cartridge Membrane: PP
65.	B269-475-17-44-DS-1062	3(1W+1S+1SS)	475-P-121 A/B/C	RO-IV Feed Pumps (VFD Driven)	Capacity: 59.5 m ³ /h Head: 500 m	C: SDSS I: SDSS
66.	-	2 (1W+1S)	475-PX-101 A/B	RO-IV Pressure Exchanger	Capacity: 48.5 m ³ /h	As per Mfg. Std

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
67.	B269-475-17-44-DS-1063	3(1W+1S + 1SS)	475-P-122 A/B/C	RO-IV Pressure Exchanger Booster Pump	Capacity: 48.5 m ³ /h Head: DDE	C: SDSS I:SDSS
68.	B269-475-17-44-DS-1064	2(1W+1S)	475-RO-104 A/B	Reverse Osmosis-IV (RO) Skid	59.5 m ³ /h permeate flow each skid; 55% Recovery (Minimum)	Membrane-Polyamide / Tube: FRP/GRP (ASME)
D.	CHEMICAL HANDLING SECTION					
69.	B269-475-17-44-DS-1065	2W	475-T-112 A/B	Antiscalant Solution Dosing Tanks	Effective Capacity: 3.14 m ³ each Size: 2 m dia x 1 m SWD + 0.3 m FB + 0.2 m DVD	Solid FRP
70.	B269-475-17-44-DS-1066	2(1W+1S)	475-MX-105 A/B	Antiscalant Solution Dosing Tanks Agitators	Diameter: 600 mm	Impeller: SS 316L Shaft : SS 431
71.	B269-475-17-44-DS-1067	3(2W+1S)	475-P-123 A/B/C	Antiscalant Solution Dosing Pumps for RO-I& II	Capacity: 50 LPH Head: 45 m	C: PP/PVDF, D:TEFLON
72.	B269-475-17-44-DS-1068	3(2W+1S)	475-P-124 A/B/C	Antiscalant Solution Dosing Pumps for RO-III & IV	Capacity: 25 LPH Head: 45 m	C: PP/PVDF, D:TEFLON
73.	B269-475-17-44-DS-1069	2(1W+1S)	475-P-125 A/B	Antiscalant Solution Dosing Pumps for ZLD Evaporator	Capacity: 100 LPH Head: 45 m	C: PP/PVDF, D:TEFLON
74.	B269-475-17-44-DS-1070	2W	475-T-113	Sodium Bisulphite Solution Dosing Tanks	Effective Capacity: 1.2 m ³ each Size: 1.25 m dia x 1 m SWD + 0.3 m FB + 0.2 DVD	Solid FRP

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
75.	B269-475-17-44-DS-1071	2(1W+1S)	475-MX-106 A/B	Sodium Bisulphite Solution Dosing Tanks Agitators	Diameter: 300 mm	Impeller: SS 316L Shaft : SS 431
76.	B269-475-17-44-DS-1072	2(1W+1S)	475-P-126 A/B	Sodium Bisulphite Solution Dosing Pumps	Capacity: 60 LPH Head: 50 m	C: PP/PVDF, D:TEFLON
77.	B269-475-17-44-DS-1073	2 (1W+1S)	475-T-114 A/B	Acid Dilution/ Measuring Tanks for MB	Effective Capacity: 1.5 m ³ each Size: 1.4 m dia x 1.0 m LD + 0.3 m FB each + 0.2 m DVD	FRP (Vinyl ester lining)
78.	B269-475-17-44-DS-1074	2 (1W+1S)	475-T-115 A/B	Caustic Dilution/ Measuring Tanks for MB	Effective Capacity: 1.5 m ³ each Size: 1.4 m dia x 1.0 m LD + 0.3 m FB each + 0.2 m DVD	KCS (PWHT)
79.	B269-475-17-44-DS-1075	2(1W+1S)	475-P-127 A/B	Caustic Dosing Pump for RO-II	Capacity: 50 LPH Head: 45 m	C: PP/PVDF, D:TEFLON
80.	B269-475-17-44-DS-1076	3(2W+1S)	475-LZ-102 A/B/C	Centrifuge	Capacity: 30 m ³ /h	Bowl: SS316 Shaft/Scroll: SS316
81.	B269-475-17-44-DS-1077	1W	475-T-116	RO Cleaning Tank	Effective Capacity: 10 m ³ Size: 3 m dia x 1.5 m SWD + 0.5 m DVD + 0.5 m FB	Solid FRP
82.	B269-475-17-44-DS-1078	1W	475-MX-107	RO Cleaning Tank Agitator	Diameter: 1000 mm	Impeller: SS 316L Shaft : SS 431
83.	B269-475-17-44-DS-1079	2(1W+1S)	475-P-128 A/B	RO Cleaning Circulation Pumps	Capacity: 150 m ³ /h, 40 m head	C : SS 316L, I : SS 316 L
84.	B269-475-17-44-DS-1080	1	475-G-109	RO Cleaning Cartridge filters	Capacity: 150 m ³ /h Rating : 5 µm (Absolute)	Shell: CSEP, Cartridge Membrane: PP

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
85.	B269-475-17-44-DS-1081			DELETED		
86.	B269-475-17-44-DS-1082			DELETED		
87.	B269-475-17-44-DS-1083	2W	475-T-118 A/B	FeCl ₃ Solution Dosing Tank (10%)(COMMON FOR RODM/ZLD)	Effective Capacity: 3.77 m ³ each Size: 2 m dia x 1.2 m SWD + 0.3 m FB + 0.2 m DVD	Solid FRP
88.	B269-475-17-44-DS-1084	2W	475-MX-108 A/B	FeCl ₃ Solution Dosing Tank Agitators	Diameter: 600 mm	Impeller: SS 316L Shaft : SS 431
89.	B269-475-17-44-DS-1085	3(2W+1S)	475-P-130 A/B/C	FeCl ₃ Solution Dosing Pumps for HRSCC-I & UF-I	Capacity: 120 LPH Head: 15 m	C: PP/PVDF, D:TEFLON
90.	B269-475-17-44-DS-1086	3(2W+1S)	475-P-131 A/B/C	FeCl ₃ Solution Dosing Pumps for HRSCC-II & UF-II	Capacity: 30 LPH Head: 15 m	C: PP/PVDF, D:TEFLON
91.	B269-475-17-44-DS-1087	2W	475-T-119 A/B	Lime Solution Dosing Tank	Effective Capacity: 63.5 m ³ each L x B x H: 4.6 m x 4.6 m x 3 m LD + 0.2 m DVD + 0.3 m FB each	RCC with Acid/ Alkali Resistant Proof Tiling
92.	B269-475-17-44-DS-1088	2W	475-MX-109 A/B	Lime Solution Dosing tank Agitator	Diameter: 1500 mm	Impeller: SS 316L Shaft : SS 431
93.	B269-475-17-44-DS-1089	2(1W+1S)	475-P-133 A/B	Lime Solution Dosing Pumps for RODM HRSCC-I & II	Capacity:200 LPH Head: 20 m	C: SS304, I: SS304

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
94.	B269-475-17-44-DS-1090	2W	475-T-120A/B	Polyelectrolyte Solution Dosing Tank (COMMON FOR RODMZLD)	Effective Capacity: 27.47 m ³ each Size: 3.6 m dia x 2.7 m LD + 0.3 m FB each + 0.2 m DVD	Solid FRP
95.	B269-475-17-44-DS-1091	2W	475-MX-110 A/B	Polyelectrolyte Solution Dosing tank Agitator	Diameter: 1200 mm	Impeller: SS 316L Shaft : SS 431
96.	B269-475-17-44-DS-1092	2(1W+1S)	475-P-134 A/B	Polyelectrolyte Solution Dosing Pumps for RODM HRSCC-I	Capacity: 2 m ³ /h Head: 20 m	C: PP/PVDF, D:TEFLON
97.	B269-475-17-44-DS-1093	2(1W+1S)	475-P-135 A/B	Polyelectrolyte Solution Dosing Pumps for RODM HRSCC-II	Capacity: 500 LPH Head: 20 m	C: PP/PVDF, D:TEFLON
98.	B269-475-17-44-DS-1094	2W	475-T-121 A/B	Soda Ash Solution Dosing Tanks(COMMON FOR RODM/ZLD)	Effective Capacity:37.7 m ³ each Size: 4 m dia x 3 m LD + 0.3 m FB + 0.2 m DVD	Solid FRP
99.	B269-475-17-44-DS-1095	2W	475-MX-111 A/B	Soda Ash Solution Dosing Tanks Agitators	Diameter: 1000 mm	Impeller: SS 316L Shaft : SS 431
100.	B269-475-17-44-DS-1096	3(2W+1S)	475-P-136 A/B/C	Soda Ash Solution Dosing Pumps RODM HRSCC-I & II	Capacity: 100 LPH Head:20 m	C: PP/PVDF, D:TEFLON
101.	B269-475-17-44-DS-1097	2(1W+1S)	475-P-137 A/B	HCl Unloading and Transfer Pump	Capacity: 15 m ³ /h Head: 15 m	C: PP, I:PP
102.	B269-475-17-44-DS-1098	2W	475-T-122 A/B	HCL Bulk Storage Tank	Effective Capacity: 78.5 m ³ each Size: 5 m dia x 4 m LD + 0.5 m FB + 0.5 DVD	Solid FRP

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
103.	B269-475-17-44-DS-1099	2(1W+1S)	475-P-138A/B	HCl Dosing Pumps for RO-I	Capacity: 50 LPH Head: 40 m	C: PP/PVDF, D:TEFLON
104.	B269-475-17-44-DS-1100	3(2W+1S)	475-P-139A/B/C	HCl Dosing Pumps for RO-III & IV	Capacity: 20 LPH Head:40 m	C: PP/PVDF, D:TEFLON
105.	B269-475-17-44-DS-1101	3 (2W+1S)	475-P-140 A/B/C	HCl Dosing Pumps for RODM HRSCC-I and HRSCC-II	Capacity: 30 LPH Head: 20 m	C: PP/PVDF, D:TEFLON
106.	B269-475-17-44-DS-1102	2(1W+1S)	475-P-141 A/B	Caustic Unloading and Transfer Pump	Capacity: 15 m ³ /h Head: 15 m	C : SS 316L, I : SS 316 L
107.	B269-475-17-44-DS-1103	1W	475-T-123	Caustic bulk storage tank (40%)	Effective Capacity: 407 m ³ each Size: 9 m dia x 6.4 m LD + 1.0 m FB + 0.5 DVD	KCS (PWHT)
108.	B269-475-17-44-DS-1104	2W	475-T-124 A/B	Caustic Dilution/ storage tank (20%)	Effective Capacity: 407 m ³ each Size: 9 m dia x 6.4 m LD + 1.0 m FB + 0.5 DVD	KCS (PWHT)
109.	B269-475-17-44-DS-1105	2(1W+1S)	475-P-142 A/B	Caustic Transfer Pumps	Capacity: 20 m ³ /h Head: 60 m	C: SS 316L, I : SS 316 L
110.	B269-475-17-44-DS-1106	2W	475-T-125 A/B	CEB-I (Acid) Dosing Tanks for UF	Effective Capacity: 0.4 m ³ Size: 1 m dia x 0.5 m LD + 0.2 m DVD + 0.3 m FB each	Solid FRP
111.	B269-475-17-44-DS-1107	2(1W+1S)	475-P-143 A/B	CEB-I (HCl) Dosing Pump UF-I	Capacity: 1500 LPH Head: 35 m	C: PP/PVDF, D:TEFLON
112.	B269-475-17-44-DS-1108	2(1W+1S)	475-P-144 A/B	CEB- I (HCl) Dosing Pump UF-II	Capacity: 600 LPH Head: 35 m	C: PP/PVDF, D:TEFLON

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
113.	B269-475-17-44-DS-1109	2W	475-T-126 A/B	CEB-II (Caustic) Dosing Tanks for UF (20%)	Effective Capacity: 0.4 m ³ Size: 1 m dia x 0.5 m LD + 0.2 m DVD + 0.3 m FB each	Solid FRP
114.	B269-475-17-44-DS-1110	2(1W+1S)	475-P-145 A/B	CEB- II (NaOH) Dosing Pump UF-I	Capacity: 4 m ³ /h Head: 35 m	C: PP/PVDF, D:TEFLON
115.	B269-475-17-44-DS-1111	2(1W+1S)	475-P-146 A/B	CEB- II (NaOH) Pump UF-II	Capacity: 150 LPH Head: 35 m	C: PP/PVDF, D:TEFLON
116.	B269-475-17-44-DS-1112	2W	475-T-127 A/B	CEB-III (NaOCl) Dosing Tanks for UF	Effective Capacity: 0.4 m ³ Size: 1 m dia x 0.5 m LD + 0.2 m DVD + 0.3 m FB each	Solid FRP
117.	B269-475-17-44-DS-1113	2(1W+1S)	475-P-147 A/B	CEB-III (NaOCl)Dosing Pump UF-I	Capacity: 1500 LPH Head: 35 m	C: PP/PVDF, D:TEFLON
118.	B269-475-17-44-DS-1114	2(1W+1S)	475-P-148 A/B	CEB-III (NaOCl) Dosing Pump UF-II	Capacity: 500 LPH Head: 35 m	C: PP/PVDF, D:TEFLON
119.	B269-475-17-44-DS-1115	2W	475-T-128 A/B	DWPE (Chemical) Solution Dosing Tanks	Effective Capacity: 37.7 m ³ each Size: 4 m dia, 3 m LD + 0.2 m DVD + 0.3 m FB each	Solid FRP
120.	B269-475-17-44-DS-1116	2W	475-MX-112 A/B	DWPE (Chemical) Solution Dosing Tanks Agitators	Diameter: 1200 mm	Impeller: SS 316L Shaft : SS 431
121.	B269-475-17-44-DS-1117	2(1W+1S)	475-P-149 A/B	DWPE (Chemical) Solution Dosing Pumps	Capacity: 3m ³ /h Head: 20 m	C: SS304 L, I: SS304 L

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
122.	B269-475-17-44-DS-1118	2W	475-T-129 A/B	Morpholine Dosing Tank RODM & CPU	Effective Capacity: 1 m ³ Size: 1.0 m dia x 1.3 m LD + 0.3 m FB each + 0.2 m DVD	SS 316 L
123.	B269-475-17-44-DS-1119	2(1W+1S)	475-P-150 A/B	Morpholine Dosing Pump RODM	Capacity: 60 LPH Head: 20 m	C: SS304 L, D: PTFE
124.	-	2	475-LZ-103 A/B	Lime Slaker System	Capacity: 500 kg/h	DDE
125.	B269-475-17-44-DS-1121	2(1W+1S)	475-P-132 A/B	Lime Slaker Pumps	Capacity: During Detail Engineering Head : 15 m	C:SS316 I:SS316
126.	B269-475-17-44-DS-1122	1	475-S-106	Centrate Sump-I (HRSCC-I)	Effective Capacity: 40 m ³ L x B x D: 4 m x 5 m x 2.0 m SWD + 0.5 m FB	RCC Epoxy Coated
127.	B269-475-17-44-DS-1123	2(1W+1S)	475-P-151 A/B	Centrate Transfer Pump-I (HRSCC-I)	Capacity: 30 m ³ /h Head : 30 m	C: CS I: CS
128.	B269-475-17-44-DS-1124	1	475-S-107	Centrate Sump-II (HRSCC-II)	Effective Capacity: 40 m ³ L x B x D: 4 m x 5 m x 2.0 m SWD + 0.5 m FB	RCC Epoxy Coated
129.	B269-475-17-44-DS-1125	2(1W+1S)	475-P-152 A/B	Centrate Transfer Pump-II (HRSCC-II)	Capacity: 30 m ³ /h Head : 30 m	C:SDSS I:SDSS
130.	B269-475-17-44-DS-1126	1	475-S-108	Centrate Sump-III (Lime Soda Clarifer)	Effective Capacity: 40 m ³ L x B x D: 4 m x 5 m x 2.0 m SWD + 0.5 m FB	RCC Epoxy Coated

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

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
131.	B269-475-17-44-DS-1127	2(1W+1S)	475-P-153 A/B	Centrate Transfer Pump-III (Lime Soda Clarifer)	Capacity: 30 m ³ /h Head : 30 m	C:SDSS I:SDSS
132.				DELETED		
133.				DELETED		
E.	<u>BUILDINGS</u>					
134.	B269-475-17-44-DS-1120	1	475-CH-101	CHEMICAL HOUSE	40.0m [L] x 30.0m [W] x 12.0 m [H] (Minimum)	RCC frame structure + Brick work
135.	-	1	-	UF-RO-MB SHED	50 m W x 100 m L X 6 m Clear Height	Precoated galvalume steel sheet roofing and side cladding
136.	-	1	-	CONTROL BUILDING (FOR RODM/CPU/ZLD)	AS PER ENGINEERING STANDARDS	RCC frame structure + Brick work
137.	-	1	-	CENTRIFUGE BUILDING	10 m [L] x 8 m [W] x 6m [H] (Minimum)	RCC column structure with shed on the first floor
138.	-	1	-	DEGASSER TOWER STRUCTURE	25 m [L] x 15 m [W] x 14.0 m [H] (Minimum)	RCC column structure




NOTES:


1. *Cleaning in Place (CIP) system if recommended by the UF supplier(s), to be included for UF Skids. Facility details of the same shall be confirmed by the Contractor and included in the scope of works. Additional Tank(s) may be provided for each chemical used in chemical cleaning of membrane filtration skids if recommended by system supplier. Same shall be in the scope of the Contractor.*


2. *All other equipment described elsewhere in the tender document (including technical & process specifications, drawings etc.), and/or as required to make the plant complete from trouble free operation & safety point of view, but not listed above shall also be deemed to have been included in the RWTP Contractor's scope of work.*
3. *W: Working; SB: Stand by; L: Length; B: Breadth/Width; H: Height; SWD: Side Water Depth; D: Depth; DDE: During Detail Engineering; I: Impeller; S: Shaft; EP: Epoxy Painted; EC: Epoxy Coating; SDSS: Super Duplex Stainless Steel; GFVER: Glass Flaked Vinyl Ester Resin*
4. *All other works including civil, mechanical, electrical, piping, instrumentation, construction, erection, testing, painting works, etc., shall be as per the tender requirements.*
5. *The sizes specified in the equipment list are minimum requirements. Vendor to confirm the same during detailed engineering.*
6. *Equipment list shall be updated during detail engineering based on UF and RO membrane supplier's recommendation.*
7. *HRSCC –I & II Sludge Transfer Pumps shall be provided in a common underground pump house. The pump house shall be provided with a clear height of 3 m above the finished floor level. Monorail of adequate capacity and a dewatering pit and dewatering pump shall be considered in the pump house.*


Fe2(SO4)3/ PAC SOLUTION DOSING PUMPS (LAMELLA CLARIFIER)									
PROJECT : PANIPAT REFINERY EXPANSION (P-25)					CLIENT : IOCL			JOB NO. : B269	
UNIT : RAW WATER TREATMENT PLANT					UNIT NO.: 472			ITEM NO. : 472-P-106 A/B	
SERVICE : DOSING OF Fe2(SO4)3/PAC SOLUTION TO LAMELLA CLARIFIER									
TYPE : POSITIVE DISPLACEMENT, DIAPHRAGM									
PROPERTIES OF LIQUID									
LIQUID HANDLED							10% Fe2(SO4)3/PAC SOLUTION		
PUMPING TEMPERATURE (°C)							AMBIENT		
VISCOSITY AT PUMPING TEMPERATURE (cp)							~1.0		
LIQUID DENSITY (kg/m³)							~1000		
PRESENCE OF CORROSIVE / TOXIC COMPONENTS							YES		
SOLIDS IN SUSPENSION (YES / NO)							NO		
SIZE OF SOLID PARTICLES (mm)(MAX)							NA		
OPERATING CONDITIONS									
FLOW RATE					MAX. (LPH)		NOTE-1		
					NORMAL(LPH)		1000		
					MIN. (LPH)		NOTE-1		
SUCTION PRESSURE (kg/cm2.a)							ATM.		
MAXIMUM SUCTION PRESSURE (kg/cm2.g)							NOTE-1		
DISCHARGE PRESSURE (kg/cm2.a)							2.5		
DIFFERENTIAL PRESSURE (kg/cm2.a)							1.5		
DIFFERENTIAL HEAD (mLC)							15		
NPSH AVAILABLE (m) MIN.							FLOODED SUCTION		
NO. OF PUMPS							2 (1W+1SB)		
CAPACITY CONTROL FOR VOLUMETRIC PUMPS									
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC							N.A.		
TYPE							N.A.		
RANGE (%)							N.A.		
PRECISION AT MIN. RATE (%)							N.A.		
MECHANICAL DATA									
0							3.5		
DESIGN TEMPERATURE (°C)							65		
MATERIAL CODE					CASING		PP/PVDF		
					DIAPHRAGM		TEFLON		
SEAL TYPE (MECHANICAL / PACKING)							PACKING		
LINE RATING IN / OUT							150# / 150#		
DRIVER							ELECTRIC MOTOR		
NOTES:									
1	TO BE FURNISHED BY THE CONTRACTOR DURING DETAIL ENGINEERING.								
2	THE PUMP MOTOR SHALL BE DESIGNED FOR OPEN DISCHARGE CONDITION.								
3	THE PUMP SHALL BE CAPABLE OF AUTO START / AUTO OPERATION.								
4	DELETED								


TREATED WATER RESERVOIR						
PROJECT : PANIPAT REFINERY EXPANSION (P-25) PROJECT			CLIENT : IOCL		JOB NO. : B269	
UNIT : RAW WATER TREATMENT PLANT			UNIT NO.: 472		ITEM NO.: 472-T-111	
SERVICE : TO STORE UF TREATED WATER						
PROCESS DATA						
DESIGN FLOW (m ³ /hr)			2400			
NOMINAL CAPACITY (m ³)			DURING DETAIL ENGINEERING			
TOTAL EFFECTIVE CAPACITY (m ³)			16400			
STORAGE TEMPERATURE (°C)			AMBIENT			
DESIGN TEMPERATURE (°C)			65			
SP. GR. OF LIQUID AT STORAGE TEMPERATURE (°C)			1.0			
VISCOSITY AT STORAGE TEMPERATURE (Cp)			~1			
BLANKETING GAS			N.A.			
UNIT DESCRIPTION						
NO. OF COMPARTMENTS			2			
EFFECTIVE VOLUME OF EACH COMPARTMENT (m ³)			8200			
TYPE			DURING DETAIL ENGINEERING			
DIMENSIONS OF RESERVOIR (m)			DURING DETAIL ENGINEERING			
DEPTH (M)			2M BELOW GROUND, 1M ABOVE GROUND			
FREE BOARD ABOVE TWL (m)			0.5			
TOTAL HEIGHT (m)			3.5			
RESIDENCE TIME (hrs) (@ DESIGN FLOW) (MINIMUM)			DURING DETAIL ENGINEERING			
SLOPE FOR TANK BOTTOM			AS PER ENGG. SPECS.			
OVERFLOW ARRANGEMENT REQUIRED (YES / NO)			YES			
BOTTOM DRAIN REQUIRED (YES / NO)			YES			
ANY BAFFLE ARRANGEMENT REQUIRED (YES / NO)			NO			
FLAME ARRESTOR REQUIRED			NO			
LEVEL INDICATION REQUIRED (YES / NO)			YES			
LEVEL TRANSMITTER (YES / NO)			YES (IN EACH COMPARTMENT)			
LEVEL SWITCHES (YES / NO)			NO			
LEVEL TRANSMITTER / SWITCH PLATFORM (YES / NO)			YES			
LEVEL ALARM (YES/NO)			YES			
VENT			YES			
MATERIAL OF CONSTRUCTION						
TANK			RCC			
PAINTING/LINING			EPOXY PAINTED			
CORROSION ALLOWANCE (SHELL/BOTTOM/ROOF)			3.0/3.0/1.5			
STAIRS / HANDRAILINGS / OPERATING PLATFORM			AS PER ENGG. SPECS.			
DESIGN CODE			API 650 (LATEST EDITION)			
NOTES:						
1	REFER P&ID NO. B269-02-42-472-1111 OF RAW WATER SYSTEM FOR DETAILS OF TREATED WATER RESERVOIR					
2	COMPLETE TREATED WATER RESERVOIR SHALL BE COVERED WITH RCC SLAB. SUITABLE VENT SHALL BE PROVIDED ON TOP OF RESERVOIR.					
						
2	08.03.2022	REVISED AND ISSUED FOR TECHNICAL AMMENDMENT-02	DD	VS	PKG	
1	21.07.2021	REISSUED FOR TENDER	DD	VS	PKG	
0	05.05.2020	ISSUED FOR TENDER	DD	VS	PKG	
A	31.03.2020	ISSUED FOR INPUTS/ COMMENTS	DD	VS	PKG	
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED	
	ENGINEERS INDIA LIMITED DELHI		NEW	TREATED WATER RESERVOIR	PROCESS DATA SHEET B269-472-17-44-DS-1049	REV. 2




TREATED WATER SUMP					
PROJECT : PANIPAT REFINERY EXPANSION (P-25) PROJECT			CLIENT : IOCL	JOB NO. : B269	
UNIT : RAW WATER TREATMENT PLANT			UNIT NO.: 472	ITEM NO.: 472-S-108	
SERVICE : TO STORE OF TREATED WATER					
PROCESS DATA					
DESIGN FLOW (m ³ /hr)			2400		
NOMINAL CAPACITY (m ³)			DURING DETAIL ENGINEERING		
TOTAL EFFECTIVE CAPACITY (m ³)			600		
STORAGE TEMPERATURE (°C)			AMBIENT		
DESIGN TEMPERATURE (°C)			65		
SP. GR. OF LIQUID AT STORAGE TEMPERATURE (°C)			1.0		
VISCOSITY AT STORAGE TEMPERATURE (Cp)			~1		
BLANKETING GAS			N.A.		
UNIT DESCRIPTION					
NO. OF COMPARTMENTS			1		
TYPE			DURING DETAIL ENGINEERING		
DIMENSIONS OF SUMP (m)			DURING DETAIL ENGINEERING		
DEPTH (M)			DURING DETAIL ENGINEERING		
FREE BOARD ABOVE TWL (m)			DURING DETAIL ENGINEERING		
TOTAL HEIGHT (m)			DURING DETAIL ENGINEERING		
RESIDENCE TIME (MIN) (@ DESIGN FLOW) (MINIMUM)			15		
SLOPE FOR TANK BOTTOM			AS PER ENGG. SPECS.		
OVERFLOW ARRANGEMENT REQUIRED (YES / NO)			NO		
BOTTOM DRAIN REQUIRED (YES / NO)			NO		
ANY BAFFLE ARRANGEMENT REQUIRED (YES / NO)			NO		
FLAME ARRESTOR REQUIRED			NO		
LEVEL INDICATION REQUIRED (YES / NO)			NO		
LEVEL TRANSMITTER (YES / NO)			NO		
LEVEL SWITCHES (YES / NO)			NO		
LEVEL TRANSMITTER / SWITCH PLATFORM (YES / NO)			NO		
LEVEL ALARM (YES/NO)			NO		
VENT			YES 		
MATERIAL OF CONSTRUCTION					
TANK			RCC		
PAINTING/LINING			EPOXY PAINTED		
CORROSION ALLOWANCE (SHELL/BOTTOM/ROOF)			3.0/3.0/1.5		
STAIRS / HANDRAILINGS / OPERATING PLATFORM			AS PER ENGG. SPECS.		
DESIGN CODE			API 650 (LATEST EDITION)		
NOTES:					
1	REFER P&ID NO. B269-02-42-472-1111 OF RAW WATER SYSTEM FOR DETAILS OF TREATED WATER SUMP				
2	COMPLETE TREATED WATER SUMP SHALL BE COVERED WITH RCC SLAB. SUITABLE VENT SHALL BE PROVIDED ON TOP OF TREATED WATER SUMP 				
2	08.03.2022	REVISED AND ISSUED FOR TECHNICAL AMMENDMENT-02	DD	VS	PKG
1	21.07.2021	REISSUED FOR TENDER	DD	VS	PKG
0	05.05.2020	ISSUED FOR TENDER	DD	VS	PKG
A	31.03.2020	ISSUED FOR INPUTS/ COMMENTS	DD	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
	ENGINEERS INDIA LIMITED DELHI		NEW	TREATED WATER SUMP	PROCESS DATA SHEET B269-472-17-44-DS-1050
					REV. 2


FILTER BACKWASH PUMPS-I					
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269	
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-P-103 A/B 3	
SERVICE : TO BACKWASH DMF & ACF					
TYPE : CENTRIFUGAL, HORIZONTAL					
PROPERTIES OF LIQUID					
LIQUID HANDLED				UF FEED WATER	
PUMPING TEMPERATURE (°C)				AMBIENT	
VISCOSITY AT PUMPING TEMPERATURE (cp)				1.0	
LIQUID DENSITY (kg/m³)				~1000	
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				YES	
SOLIDS IN SUSPENSION (YES / NO)				YES	
SIZE OF SOLID PARTICLES (mm)(MAX)				NOTE-1	
OPERATING CONDITIONS					
FLOW RATE		MAX. (m³/hr)		230	
		NORMAL(m³/hr)		NOTE-1	
		MIN. (m³/hr)		NOTE-1	
SUCTION PRESSURE (kg/cm².a)				ATM. + LD	
MAXIMUM SUCTION PRESSURE (kg/cm².g)				NOTE-1	
DISCHARGE PRESSURE (kg/cm².a)				3.5	
DIFFERENTIAL PRESSURE (kg/cm².g)				2.5	
DIFFERENTIAL HEAD (m)				25	
NPSH AVAILABLE (m) MIN.				FLOODED SUCTION 3	
NO. OF PUMPS				2 (1W+1S)	
CAPACITY CONTROL FOR VOLUMETRIC PUMPS					
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC				N.A.	
TYPE				N.A.	
RANGE (%)				N.A.	
PRECISION AT MIN. RATE (%)				N.A.	
MECHANICAL DATA					
DESIGN PRESSURE (kg/cm².g)				5.0	
DESIGN TEMPERATURE (°C)				65	
MATERIAL CODE		CASING		CS	
		IMPELLER		CS	
SEAL TYPE (MECHANICAL / PACKING)				MECHANICAL	
LINE RATING IN / OUT				150# / 150#	
DRIVER				ELECTRIC MOTOR	
NOTES:					
1	TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR.				
2	THE PUMP MOTOR SHALL BE DESIGNED FOR OPEN DISCHARGE CONDITION.				
3	THE PUMP SHALL BE CAPABLE OF AUTO START / STOP OPERATION.				
4	THE PUMPS SHALL BE ABLE TO MEET REQUIRED PLANT T/D FLOW REQUIREMENTS.				
5	THE PUMPS SHALL BE SELECTED FOR PARALLEL OPERATION.				
3	03.03.2022	REVISED & ISSUED WITH TA-02	SC	VS	PKG
2	24.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
1	01.12.2020	REVISED & REISSUED FOR TENDER	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	FILTER BACKWASH PUMPS-I	PROCESS DATA SHEET B269-475-17-44-DS-1010	REV. 3


FILTER AIR SCOURING BLOWERS-I						
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269		1
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-K-101 A/B		
SERVICE : TO PROVIDE AIR SCOURING IN DMF & ACF				TYPE : TRI LOBE		
PROPERTIES OF GAS						
GAS HANDLED				AIR		
COMPOSITION (% by VOL.)				79% N ₂ , 21% O ₂		
MOLECULAR WEIGHT				29		
RATIO OF SPECIFIC HEATS (K = Cp/Cv)				1.4		
COMPRESSIBILITY FACTOR				1.0		
OPERATING CONDITIONS						
FLOW RATE	NORMAL(m3/hr)		630		1	
	MAX. (m3/hr)		NOTE-1			
	MIN. (m3/hr)		NOTE-1			
SUCTION TEMPERATURE (°C)				AMBIENT		
SUCTION PRESSURE (kg/cm2.a)				ATM.		
DISCHARGE PRESSURE (kg/cm2.a)				1.5		
DIFFERENTIAL PRESSURE (kg/cm2)				0.5		
DIFFERENTIAL HEAD (MWC)				5		
COMPRESSION RATIO				(NOTE-1)		
NO. OF BLOWERS				2 (1W+1S) 1		
CAPACITY CONTROL						
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC				NOTE-1		
TYPE				NOTE-1		
RANGE (%)				NOTE-1		
PRECISION AT MIN. RATE (%)				NOTE-1		
MECHANICAL DATA						
DESIGN PRESSURE (kg/cm2.g)				2.5		
DESIGN TEMPERATURE (°C)				150		
MATERIAL	CASING		CI 210 GR 260			
	ROTOR		CI 210 GR 260			
	SHAFT		EN-8			
LINE RATING IN / OUT				150# / 150#		
DRIVER				ELECTRIC MOTOR		
LOCATION				NOTE-1		
NOTES:						
1	TO BE FURNISHED/CONFIRMED BY THE CONTRACTOR.					
2	SUCTION AND DISCHARGE SILENCERS AND FLOW DAMPNERS TO BE PROVIDED.					
3	BLOWER TO BE PROVIDED WITH SUCTION FILTER, RELIEF VALVE, ETC.					
1	03.03.2022	REVISED & ISSUED WITH TA-02	SC	VS	PKG	
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG	
A	23.04.2020	ISSUED FOR INPUT / COMMENTS	SC	VS	PKG	
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED	
		ENGINEERS INDIA LIMITED NEW DELHI	FILTER AIR SCOURING BLOWERS-I	PROCESS DATA SHEET		REV.
				B269-475-17-44-DS-1011		1



ULTRAFILTRATION-I SKIDS		
PROJECT : PANIPAT REFINERY EXPANSION	CLIENT : IOCL	JOB NO. : B269
UNIT : RO-MB BASED DM PLANT	UNIT NO.: 475	ITEM NO.: 475-UF-101 A/B/C/D
SERVICE : FILTRATION OF FINE SUSPENDED SOLIDS		
PROCESS DATA		
LIQUID HANDLED	ABF-I OUTLET WATER/ CLEANING CHEMICALS	
LIQUID DENSITY (Kg/m ³)	~1000	
VISCOSITY AT STORAGE TEMPERATURE (Cp)	1	
VAPOUR PRESSURE	NOTE-1	
OPERATING/ MECHANICAL DESIGN TEMPERATURE (deg C)	AMBIENT/65	
OPERATING PRESSURE (kg/cm2.g)	4.0-5.0	
DESIGN PRESSURE (kg/cm ² .g)	5 (MINIMUM) (NOTE-1)	
ULTRA FILTRATION MEMBRANES	<div><div></div>2</div>	
DESIGN FEED FLOW RATE (INSTANTANEOUS) (m3/hr)	352 EACH SKID (NOTE-1)	
AVERAGE FEED FLOW RATE (m3/hr)	333 EACH SKID	
UF NET PERMEATE FLOW RATE (m3/hr)	293 EACH SKID	
UF GROSS PERMEATE FLOW RATE (m3/hr)	NOTE-1	
WATER REQUIRED FOR BACKWASH / CLEANING (m3/day)	NOTE-1	
NORMAL OPERATING FEED PRESSURE (kg/cm2.g)	NOTE-1	
FLOW REVERSIBILITY REQUIRED (YES/NO)	NOTE-1	
BACKWASH FLUX (LMH)	NOTE-1	
BACKWASH FREQUENCY	NOTE-1	
CHEMICAL ENHANCED BACKWASH FREQUENCY	NOTE-1	
CIP FREQUENCY	NOTE-1	
NORMAL BACKWASH PRESSURE	NOTE-1	
MAXIMUM BACKWASH PRESSURE	NOTE-1	
RECOVERY (%)	88%	
NO. OF SKIDS	4 (3W + 1 S)	
MODE OF OPERATION	DEAD END/ CROSS FLOW (NOTE-7)	
DIAMETER OF MEMBRANE (inch)	NOTE-1	
LENGTH OF MEMBRANE (inch)	NOTE-1	
FILTRATION AREA PER MEMBRANE (m2)	NOTE-1	
FLOW DIRECTION	INSIDE-OUT/OUTSIDE-IN	
GROSS FLUX (LMH)	50	
TOTAL MEMBRANE SURFACE FILTRATION AREA (m2) (MINIMUM)	NOTE-1	
TYPE OF MEMBRANE	HOLLOW FIBRE / SINGLE LAYERED	
LUMEN FIBRE INNER DIAMETER	NOTE-1	
DESIGNED TO REMOVE MOLECULAR WEIGHT	< 1,50,000 DALTONS	
GUARANTEED LIFE OF MEMBRANES	5 YEARS	
MAKE OF MEMBRANE SUPPLIERS	AS PER EIL APPROVED VENDOR LIST	
MAKE OF PRESSURE TUBE SUPPLIERS	AS PER EIL APPROVED VENDOR LIST	
MOC OF FLANGE JOINTS AND VICTAULIC CONNECTIONS	NOTE-1	
MOC OF FRAMES	NOTE-1	
GASKETS & ELASTOMERS	EPDM/BUNA	
BOLTS & WASHERS	NOTE-1	
MOC OF PERMEATE PIPING	NOTE-1	
MOC OF MEMBRANES	POLY ETHER SULFONE/PVDF	
MOC OF PRESSURE TUBE	PVC/POLYSULFONE/FRP/ABS	
MOC OF DRAIN & VENT PIPING	PVC SCHEDULE 80 (ASTM-D1784,1785)	
APPLICABLE DESIGN CODE	ASME	
SHEET 1 OF 2		
	ENGINEERS INDIA LIMITED NEW DELHI	ULTRAFILTRATION-I SKIDS
	PROCESS DATA SHEET B269-475-17-44-DS-1018	REV. 2


ULTRAFILTRATION-I SKIDS					
PARAMETERS		FEED		OUTLET	
Net Flow (m ³ /hr)		333 (AVERAGE FLOW) #		293 NET PERMEATE/SKID #	
pH		TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR DURING DETAIL ENGINEERING			
Temperature (deg C)					
Turbidity, NTU					
Total Suspended Solids (TSS), mg/l				<1	
Total Dissolved Solids (TDS), mg/l					
Salt Rejection of Membranes, %					
Conductivity, micro mho/cm					
Oil & Grease, mg/l				BDL	
BOD, mg/l					
COD, mg/l					
Total Hardness as CaCO3					
Calcium Hardness as CaCO3					
Magnesium Hardness as CaCO3					
Chlorides, mg/l					
Sulphates as SO ₄ mg/l					
Sodium as Na, mg/l					
Phosphates, mg/l					
Ammoniacal Nitrogen, mg/l					
Kjeldahl Nitrogen, mg/l					
Total Silica, mg/l					
Turbidity, NTU				<1	
Silt Density Index (SDI)				<3#	
Iron as Fe, mg/l					
Alkalinity as CaCO3					
All other metals					
# : INCLUDED IN GUARANTEED PARAMETERS BESIDES RECOVERIES IN UF					
NOTES :					
1	TO BE FURNISHED/CONFIRMED BY THE CONTRACTOR.				
2	CONTRACTOR TO PROVIDE PROCESS PARAMETER GUARANTEE AS PER DATASHEET & TENDER SPECIFICATIONS.				
3	DELETED				
4	CONTRACTOR TO GIVE BACKUP PROCESS CALCULATIONS FOR ALL THE DATA IN THE DATASHEET. CALCULATIONS SHOULD INCLUDE ALL THE WATER LOST DUE TO BACKFLUSH, FAST FLUSH AND TIME LOST.				
5	CONTRACTOR TO DESIGN THE SYSTEM SUCH A WAY THAT RECOVERY AS SPECIFIED IN THE DATASHEET FROM UF SKIDS IS OBTAINED EVEN AT THE END OF FIFTH YEAR.				
6	A MOVING PLATFORM OF SUITABLE SIZE SHALL BE PROVIDED FOR MAINTENANCE OF UF SYSTEM.				
7	IF CROSS FLOW CONFIGURATION FOR THE UF SYSTEM IS PROVIDED, THE CAPACITIES OF UPSTREAM UNITS TO THE UF SHALL BE REVISED TO ENSURE DESIGN THROUGHPUT FROM THE UF SYSTEM.				
8	ONE SET OF AIR BLOWERS (1W + 1S) SHALL BE PROVIDED FOR AIR SCOURING IF ENVISAGED FOR THE UF SYSTEM BASED ON THE UF SYSTEM SUPPLIER RECOMMENDATIONS				
9	CIP SYSTEM SHALL BE PROVIDED BY THE VENDOR IF RECOMMENDED BY UF SYSTEM SUPPLIER.				
2	03.03.2022	REVISED & ISSUED WITH TA-02	SC	VS	PKG
1	01.12.2020	REVISED & REISSUED FOR TENDER	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	ULTRAFILTRATION-I SKIDS	PROCESS DATA SHEET B269-475-17-44-DS-1018	REV. 2

DEGASSED WATER TANK					
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269	
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-T-108	
SERVICE : TO STORE DEGASSED RO-II PERMEATE					
PROCESS DATA					
LIQUID STORED				RO-II PERMEATE	
DESIGN FLOW (m ³ /h)				867	
NOMINAL CAPACITY OF EACH TANK (m ³)				862	
EFFECTIVE LIQUID HOLD UP OF EACH TANK (m ³)				665	
PRESENCE OF CORROSIVE/TOXIC COMPONENTS				NO	
STORAGE TEMPERATURE (°C)				AMBIENT TO 45	
DESIGN TEMPERATURE (°C)				65	
DENSITY OF LIQUID AT STORAGE TEMPERATURE				~1	
VISCOSITY AT STORAGE TEMPERATURE (Cp)				~1	
STORAGE PRESSURE (kg/cm ² abs.)				ATM.+ LIQUID COLUMN	
DESIGN POSITIVE PRESSURE (kg/cm ² abs.)				ATM.+ FULL OF LIQUID	
DESIGN VACUUM PRESSURE				NA	
BLANKETING GAS				NA	
UNIT SPECIFICATION					
NO. OF TANKS				1	
TYPE				CIRCULAR, FIXED CONICAL ROOF	
DIAMETER (m)/ DIMENSIONS (m x m)				13.0	
EFFECTIVE LIQUID DEPTH (m)				5.0	
DVD (m) (MINIMUM)+FREE BOARD ABOVE TWL (m)				0.5 + 1.0	
TOTAL HEIGHT (m)				6.5	
RESIDENCE TIME (hrs) (@ DESIGN FLOW) (MINIMUM)				1	
SLOPE FOR TANK BOTTOM				AS PER ENGG. SPECS.	
OVERFLOW ARRANGEMENT (YES / NO)				YES	
BOTTOM DRAIN (YES / NO)				YES	
HEATING COIL (YES / NO)				NO	
INSULATION (YES/NO)				NO	
ANY BAFFLE ARRANGEMENT (YES/NO)				NO	
VENT				YES	
FLAME ARRESTOR (YES/NO)				NO	
LEVEL INDICATOR (YES / NO) (TYPE)				YES	
LEVEL TRANSMITTER (YES / NO) (TYPE)				YES	
LEVEL TRANSMITTER PLATFORM (YES / NO)				YES	
MATERIAL OF CONSTRUCTION					
TANK				CS	
INTERNAL PAINTING/LINING				GLASS FLAKED VINYL ESTER LINING 	
CORROSION ALLOWANCE (mm) (SHELL/BOTTOM/ROOF)				3.0/3.0/1.5	
STAIRS / HANDRAILINGS / OPERATING PLATFORM				AS PER ENGG. SPECS.	
RUNGS				NO	
DESIGN CODE				API 650 (LATEST EDITION)	
NOTES:					
1	03.03.2022	REVISED & ISSUED WITH TA-02	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUT / COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	DEGASSED WATER TANK	PROCESS DATA SHEET B269-475-17-44-DS-1034 	REV. 1

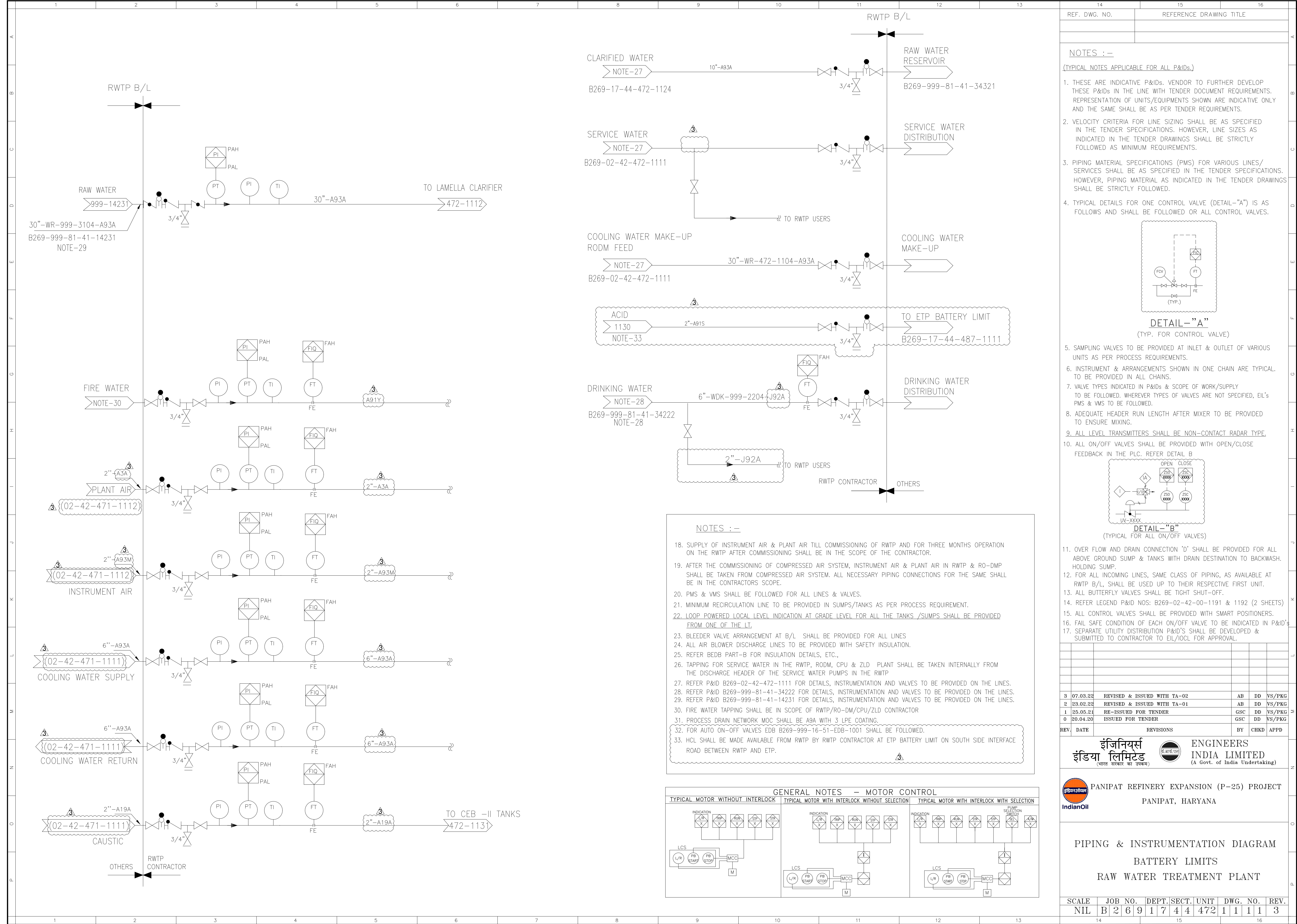
DUAL MEDIA FILTERS-II				
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL	JOB NO. : B269	
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475	ITEM NO.: 475-G-105 A/B	
SERVICE : FILTRATION OF CLARIFIED WATER			TYPE : VERTICAL	
PROCESS DATA				
FLOW RATE PER UNIT (MAX.) (m3/hr)			130	
INFLUENT CHARACTERISTICS				
OIL & GREASE (mg/l)			BDL	
TSS (mg/l)			<25	
EFFLUENT CHARACTERISTICS				
TSS (mg/l)			NOTE-1	
OPERATING CONDITIONS				
TEMPERATURE (oC)			AMBIENT	
PRESSURE (kg/cm2.g)			4.5	
PRESSURE DROP ACROSS CLEAN BED (kg/cm2)			0.2 - 0.3	
DESIGN CONDITIONS				
TEMPERATURE (oC)			65	
PRESSURE (kg/cm2.a)			8 Minimum (To be designed for shut off pressure of Filter Feed Pump)	
MAX. ALLOWABLE PRESSURE DROP ACROSS BED (kg/cm2)			0.5	
NUMBER OF UNITS			2 (1 W+1 S)	
TYPE			VERTICAL	
MODEL			NOTE-1	
HYDRAULIC LOADING (m3/m2/hr) (MAX)			12	
SUPPORTING MEDIA			NOTE-1	
DEPTH OF GRAVEL BED (mm) (minimum)			300	
DEPTH OF GARNET BED (mm) (minimum)			500	
DEPTH OF ANTHRACITE BED (mm) (minimum)			500	
F.B. ABOVE MEDIA (mm) (minimum)			750 (75%)	
MIN. SPACE BELOW WATER DISTRIBUTOR (mm)			400	
DIAMETER OF FILTER (I.D) (m)			3.8 (MINIMUM)	
LENGTH OF FILTER (T/T) (MIN.) (m)			2.6 (MINIMUM)	
BACKWASH PROVISION			YES	
BACKWASH CONTROL ARRANGEMENT			AUTOMATIC	
BACKWASH RATE (m3/m2/hr)			18	
BACKWASH WATER			UF-II PERMEATE WATER	
BACKWASH FLOW RATE (m3/hr)			225	
Sheet 1 of 2				
	ENGINEERS INDIA LIMITED NEW DELHI	DUAL MEDIA FILTERS-II	PROCESS DATA SHEET	REV
			B269-475-17-44-DS-1050	1

DUAL MEDIA FILTERS-II					
DURATION OF BACKWASH (min)			15 (once in a day)		
AIR SCOURING			YES		
AIR SCOURING RATE (Nm ³ /m ² /hr)			45 (NOTE-1)		
DURATION OF AIR SCOURING (min)			5		
TYPE OF TOP AND BOTTOM ENDS			DISHED ENDS		
PRESSURE SAFETY VALVE			YES		
CORROSION ALLOWANCE FOR SHELL/ ENDS (mm)			3.0 / 3.0		
TYPE OF INSULATION (HOT/COLD)			NOT REQUIRED		
INSULATION THICKNESS (mm)			NA		
NO.& DIA.OF MANHOLES (mm)			NOTE-1		
FILTER INTERNAL DISTRIBUTION		TOP SYSTEM	INVERTED BELL MOUTH/SPLASH PLATE		
		BOTTOM SYSTEM	HEADER LATERAL SYSTEM ON CONCRETE SUB FILL/STRAINER ON PLATE (WITH NOZZLE)		
MEDIA DETAILS					
TYPE OF MEDIA			ANTHRACITE AND GARNET		
DETAIL OF ANTHRACITE (TO BE CONFIRMED BY VENDOR)					
EFFECTIVE SIZE (mm)			0.6-0.8		
UNIFORMITY COEFFICIENT			<1.3		
ACID SOLUBILITY			<1%		
CAUSTIC SOLUBILITY			<1%		
HARDNESS (MOH)			3-3.8		
SPECIFIC GRAVITY			1.6		
CARBON CONTENT %			> 90		
DETAILS OF GARNET (TO BE CONFIRMED BY VENDOR)					
EFFECTIVE SIZE (mm)			0.3-0.6		
UNIFORMITY COEFFICIENT			<103		
ACID SOLUBILITY			INSOLUBLE		
HARDNESS (MOH)			7.5-8.0		
SPECIFIC GRAVITY			4.0-4.2		
SILICA CONTENT %			<40% (NO FREE SILICA)		
MATERIAL OF CONSTRUCTION					
SHELL & HEADS			CS ASTM SA516 Gr. 60/70 △₁		
SPECIAL SURFACE FINISH INSIDE (YES/NO)			YES, GLASS FLAKED VINYL ESTER LINING, AS PER ENGG. △₁		
DETAILS OF SURFACE FINISH			AS PER ENGG. SPECS		
GASKET			ASBESTOS FREE		
INTERNAL NUTS, BOLTS & WASHERS			MONEL/ SS-316		
EXTERNAL NUTS, BOLTS & WASHERS			AS PER ENGG. SPEC.		
FILTER BED SUPPORT AND FRAME			AS PER ENGG. SPEC.		
EXTERNAL SURFACE TREATMENT			PAINTING AS PER ENGG. SPEC.		
NOTES:					
1	To be furnished/confirmed by the contractor.				
1	03.03.2022	REVISED & ISSUED WITH TA-02	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUT / COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
SHEET 2 OF 2					
	ENGINEERS INDIA LIMITED NEW DELHI		DUAL MEDIA FILTERS-II		PROCESS DATA SHEET B269-475-17-44-DS-1050
				REV.	1

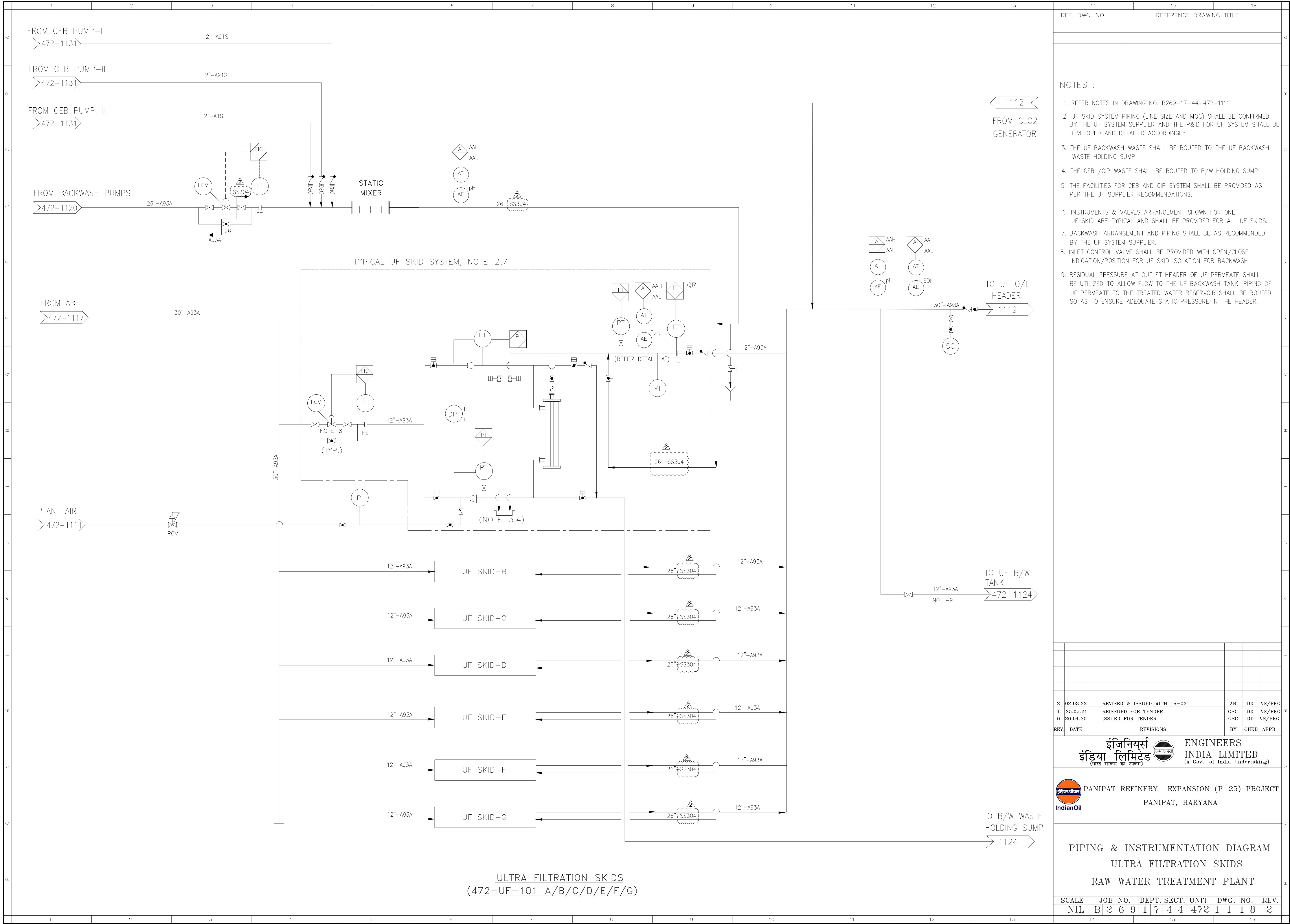
ULTRAFILTRATION-II SKIDS			
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL	JOB NO. : B269
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475	ITEM NO.: 475-UF-102 A/B
SERVICE : FILTRATION OF FINE SUSPENDED SOLIDS			
PROCESS DATA			
LIQUID HANDLED		ABF-II OUTLET WATER/ CLEANING CHEMICALS	
LIQUID DENSITY (Kg/m ³)		~1000	
VISCOSITY AT STORAGE TEMPERATURE (Cp)		1	
VAPOUR PRESSURE		NOTE-1	
OPERATING/ MECHANICAL DESIGN TEMPERATURE (deg C)		AMBIENT/65	
OPERATING PRESSURE (kg/cm2.g)		4.0-5.0	
DESIGN PRESSURE (kg/cm ² .g)		5 (MINIMUM) (NOTE-1) 	
ULTRA FILTRATION MEMBRANES			
DESIGN FEED FLOW RATE (INSTANTANEOUS) (m3/hr)		130 EACH SKID (NOTE-1)	
AVERAGE FEED FLOW RATE (m3/hr)		123 EACH SKID	
UF NET PERMEATE FLOW RATE (m3/hr)		108 EACH SKID	
UF GROSS PERMEATE FLOW RATE (m3/hr)		NOTE-1	
WATER REQUIRED FOR BACKWASH / CLEANING (m3/day)		NOTE-1	
NORMAL OPERATING FEED PRESSURE (kg/cm2.g)		NOTE-1	
FLOW REVERSIBILITY REQUIRED (YES/NO)		NOTE-1	
BACKWASH FLUX (LMH)		NOTE-1	
BACKWASH FREQUENCY		NOTE-1	
CHEMICAL ENHANCED BACKWASH FREQUENCY		NOTE-1	
CIP FREQUENCY		NOTE-1	
NORMAL BACKWASH PRESSURE		NOTE-1	
MAXIMUM BACKWASH PRESSURE		NOTE-1	
RECOVERY (%)		88%	
NO. OF SKIDS		2 (1W + 1 S)	
MODE OF OPERATION		DEAD END/ CROSS FLOW (NOTE-7)	
DIAMETER OF MEMBRANE (inch)		NOTE-1	
LENGTH OF MEMBRANE (inch)		NOTE-1	
FILTRATION AREA PER MEMBRANE (m2)		NOTE-1	
FLOW DIRECTION		INSIDE-OUT/OUTSIDE-IN	
GROSS FLUX (LMH)		50	
TOTAL MEMBRANE SURFACE FILTRATION AREA (m2) (MINIMUM)		NOTE-1	
TYPE OF MEMBRANE		HOLLOW FIBRE / SINGLE LAYERED	
LUMEN FIBRE INNER DIAMETER		NOTE-1	
DESIGNED TO REMOVE MOLECULAR WEIGHT		< 1,50,000 DALTONS	
GUARANTEED LIFE OF MEMBRANES		5 YEARS	
MAKE OF MEMBRANE SUPPLIERS		AS PER EIL APPROVED VENDOR LIST	
MAKE OF PRESSURE TUBE SUPPLIERS		AS PER EIL APPROVED VENDOR LIST	
MOC OF FLANGE JOINTS AND VICTAULIC CONNECTIONS		NOTE-1	
MOC OF FRAMES		NOTE-1	
GASKETS & ELASTOMERS		EPDM/BUNA	
BOLTS & WASHERS		NOTE-1	
MOC OF PERMEATE PIPING		NOTE-1	
MOC OF MEMBRANES		POLY ETHER SULFONE/PVDF	
MOC OF PRESSURE TUBE		PVC/POLYSULFONE/FRP/ABS	
MOC OF DRAIN & VENT PIPING		PVC SCHEDULE 80 (ASTM-D1784,1785)	
APPLICABLE DESIGN CODE		ASME	
SHEET 1 OF 2			
	ENGINEERS INDIA LIMITED NEW DELHI	ULTRAFILTRATION-II SKIDS	PROCESS DATA SHEET
			REV.
		B269-475-17-44-DS-1055	
		2	

ULTRAFILTRATION-II SKIDS					
PARAMETERS		FEED	OUTLET		
Net Flow (m³/hr)		123 (AVERAGE FLOW) #	108 NET PERMEATE/SKID #		
pH		TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR DURING DETAIL ENGINEERING			
Temperature (deg C)					
Turbidity, NTU					
Total Suspended Solids (TSS), mg/l			<1		
Total Dissolved Solids (TDS), mg/l					
Salt Rejection of Membranes, %					
Conductivity, micro mho/cm					
Oil & Grease, mg/l			BDL		
BOD, mg/l					
COD, mg/l					
Total Hardness as CaCO3					
Calcium Hardness as CaCO3					
Magnesium Hardness as CaCO3					
Chlorides, mg/l					
Sulphates as SO₄ mg/l					
Sodium as Na, mg/l					
Phosphates, mg/l					
Ammoniacal Nitrogen, mg/l					
Kjeldahl Nitrogen, mg/l					
Total Silica, mg/l					
Turbidity, NTU			<1		
Silt Density Index (SDI)			<3#		
Iron as Fe, mg/l					
Alkalinity as CaCO3					
All other metals					
# : INCLUDED IN GUARANTEED PARAMETERS BESIDES RECOVERIES IN UF					
NOTES :					
1	TO BE FURNISHED/CONFIRMED BY THE CONTRACTOR.				
2	CONTRACTOR TO PROVIDE PROCESS PARAMETER GUARANTEE AS PER DATASHEET & TENDER SPECIFICATIONS.				
3	DELETED				
4	CONTRACTOR TO GIVE BACKUP PROCESS CALCULATIONS FOR ALL THE DATA IN THE DATASHEET. CALCULATIONS SHOULD INCLUDE ALL THE WATER LOST DUE TO BACKFLUSH, FAST FLUSH AND TIME LOST.				
5	CONTRACTOR TO DESIGN THE SYSTEM SUCH A WAY THAT RECOVERY AS SPECIFIED IN THE DATASHEET FROM UF SKIDS IS OBTAINED EVEN AT THE END OF FIFTH YEAR.				
6	A MOVING PLATFORM OF SUITABLE SIZE SHALL BE PROVIDED FOR MAINTENANCE OF UF SYSTEM.				
7	IF CROSS FLOW CONFIGURATION FOR THE UF SYSTEM IS PROVIDED, THE CAPACITIES OF UPSTREAM UNITS TO THE UF SHALL BE REVISED TO ENSURE DESIGN THROUGHPUT FROM THE UF SYSTEM.				
8	ONE SET OF AIR BLOWERS (1W + 1S) SHALL BE PROVIDED FOR AIR SCOURING IF ENVISAGED FOR THE UF SYSTEM BASED ON THE UF SYSTEM SUPPLIER RECOMMENDATIONS				
9	CIP SYSTEM SHALL BE PROVIDED BY THE VENDOR IF RECOMMENDED BY UF SYSTEM SUPPLIER.				
SHEET 2 OF 2					
1	01.12.2020	REVISED & ISSUED WITH TA-02	SC	VS	PKG
1	01.12.2020	REVISED & REISSUED FOR TENDER	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	ULTRAFILTRATION-II SKIDS	PROCESS DATA SHEET B269-475-17-44-DS-1055	REV. 2

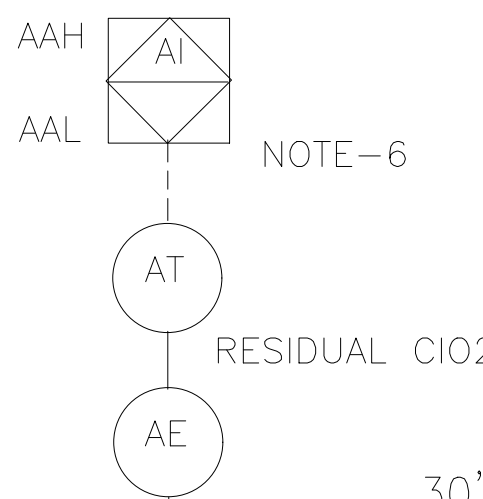
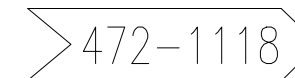
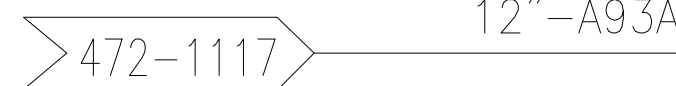
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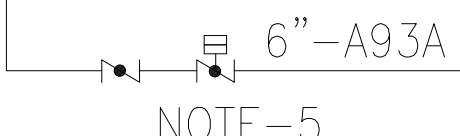
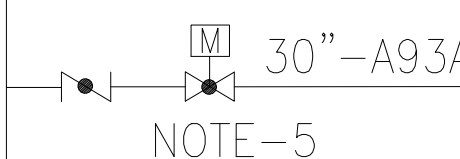
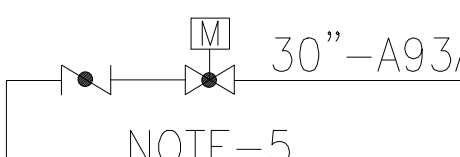
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CONNECTIONS AT
MINIMUM DISTANCE
FROM RESERVOIR



(REFER P&ID NO: B269-02-42-472-1111)

(REFER P&ID NO: B269-02-42-472-1111)

(REFER P&ID NO: B269-999-81-41-34222)

1. REFER GENERAL NOTES IN P&ID NO: B269-17-44-472-1111
2. REFER SCOPE OF WORK (DOC NO: B269-472-17-44-SS-1001) FOR CONTRACTOR'S SCOPE REGARDING CONSTRUCTION OF TREATED WATER RESERVOIR AND DRINKING WATER SUMP.
3. REFER TREATED WATER DISTRIBUTION P&ID, B269-01-41-472-1111
4. REFER DRINKING WATER P&ID No. B269-999-81-41-34222
5. VALVES SHALL OPEN/CLOSE BASED ON LEVEL IN EACH COMPARTMENT AND DRINKING WATER SUMP.
6. DOSING OF CLO2 SHALL BE CONTROLLED TO MAINTAIN RESIDUAL CLO2 OF 0.2-0.4 PPM AT THE OUTLET.

3	02.03.22	REVISED & ISSUED WITH TA-02	AJ	DD	VS/
2	23.02.22	REVISED & ISSUED WITH TA-01	AJ	DD	VS/
1	25.05.21	REISSUED FOR TENDER	GSC	DD	VS/
0	20.04.20	ISSUED FOR TENDER	GSC	DD	VS/
REV.	DATE	REVISIONS	BY	CHKD	AP

**इंजिनियर्स
इंडिया लिमिटेड**
(भारत सरकार का उपक्रम)



**ENGINEERS
INDIA LIMITED**
(A Govt. of India Undertaking)



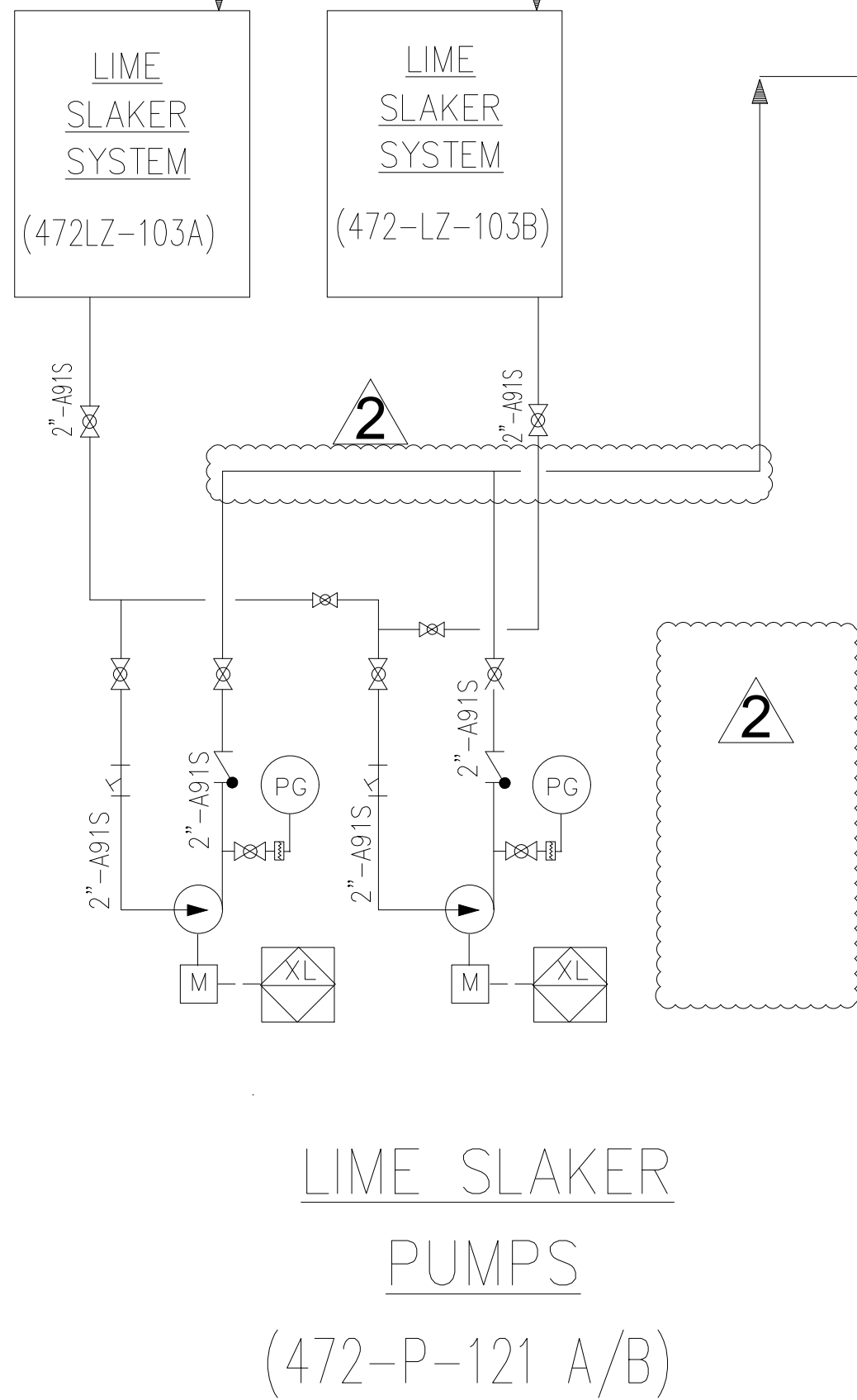
PANIPAT REFINERY EXPANSION (P-25) PROJECT
PANIPAT, HARYANA

PIPING & INSTRUMENTATION DIAGRAM
TREATED WATER RESERVOIR &
DRINKING WATER SUMP
RAW WATER TREATMENT PLANT

SCALE	JOB NO.				DEPT.	SECT.	UNIT	DWG. NO.				RE		
NIL	B	2	6	9	1	7	4	4	472	1	1	1	9	3

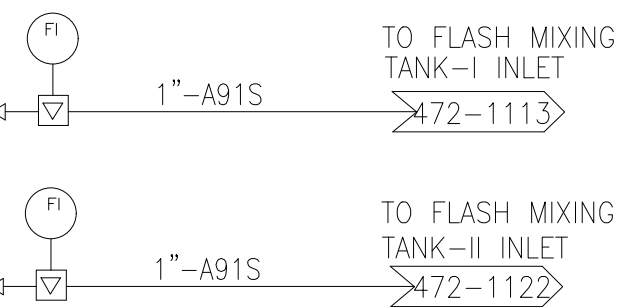
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SERVICE WATER
472-1111



LIME SOLUTION DOSING TANKS (472-T-103 A/B)

LIME SOLUTION DOSING PUMPS (472-P-108 A/B)



NOTES :-


1. REFER GENERAL NOTES IN P&ID NO: B269-17-44-472-1111
2. LIME SLAKER SYSTEM TO BE PROVIDED FOR LIME SOLUTION PREPARATION & DOSING TO LIME SOLUTION DOSING TANKS THROUGH SLAKER PUMPS OF 2 NOS (1W + 1SB)

REV.	DATE	REVISIONS	BY	CHKD	APPD
2	28.02.22	REVISED & ISSUED WITH TA-02	AB	DD	VS/PKG
1	25.05.21	REISSUED FOR TENDER	GSC	DD	VS/PKG
0	20.04.20	ISSUED FOR TENDER	GSC	DD	VS/PKG

इंजिनियर्स
इंडिया लिमिटेड
(भारत सरकार का उपक्रम)



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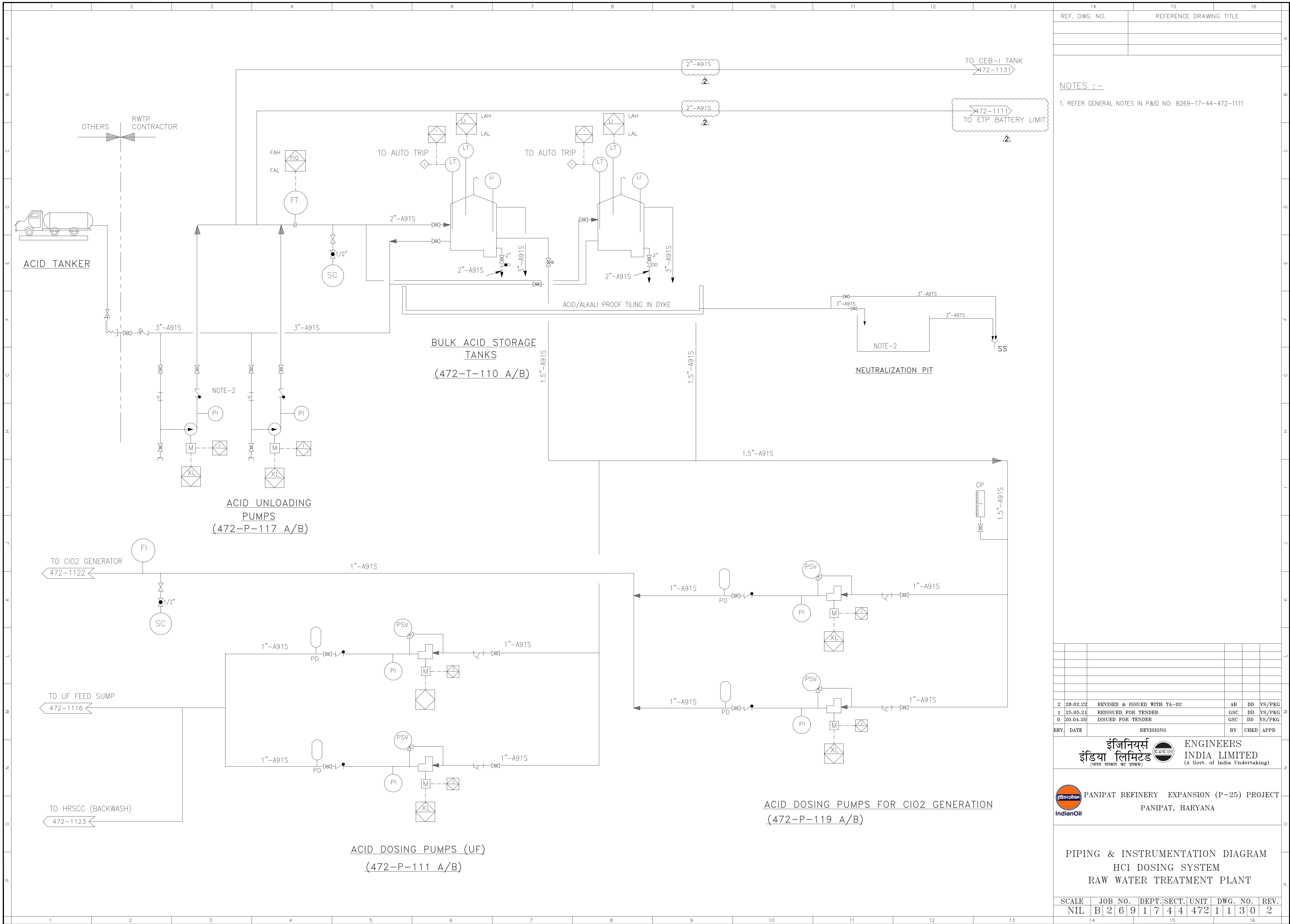


PANIPAT REFINERY EXPANSION (P-25) PROJECT
PANIPAT, HARYANA

PIPING & INSTRUMENTATION DIAGRAM
LIME DOSING SYSTEM
RAW WATER TREATMENT PLANT

SCALE	JOB NO.	DEPT.	SECT.	UNIT	DWG. NO.	REV.
NIL	B 2 6 9	1	7	4 4	472 1 1 2 8	2

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NOTES :-
1. REFER GENERAL NOTES IN P&ID NO: B269-17-44-472-1111

REV.	DATE	REVISIONS	BY	CHKD	APPD
2	28.02.22	REVISED & ISSUED WITH TA-02	AB	DD	VS/PKG
1	25.05.21	REISSUED FOR TENDER	GSC	DD	VS/PKG
0	20.04.20	ISSUED FOR TENDER	GSC	DD	VS/PKG

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(A Govt. of India Undertaking)

PANIPAT REFINERY EXPANSION (P-25) PROJECT
PANIPAT, HARYANA

PIPING & INSTRUMENTATION DIAGRAM
HCl DOSING SYSTEM
RAW WATER TREATMENT PLANT

SCALE	JOB NO.	DEPT.	SECT.	UNIT	DWG. NO.	REV.
NIL	B 2 6 9	1	7	4 4	472 1 1 3 0	2

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SERVICE WATER
472-1111

472-1130
ACID

AUTO TRIP

LAH
LAL

LT

YL
LI

M

2"-A91S

2"-A91S

2"-A91S

CAUSTIC
472-1111

SERVICE WATER
472-1111

AUTO TRIP

LAH
LAL

LT

YL
LI

M

2"-A19A

2"-A19A

2"-A19A

2"-A19A

2"-A19A

SERVICE WATER
472-1111

AUTO TRIP

LAH
LAL

LT

YL
LI

M

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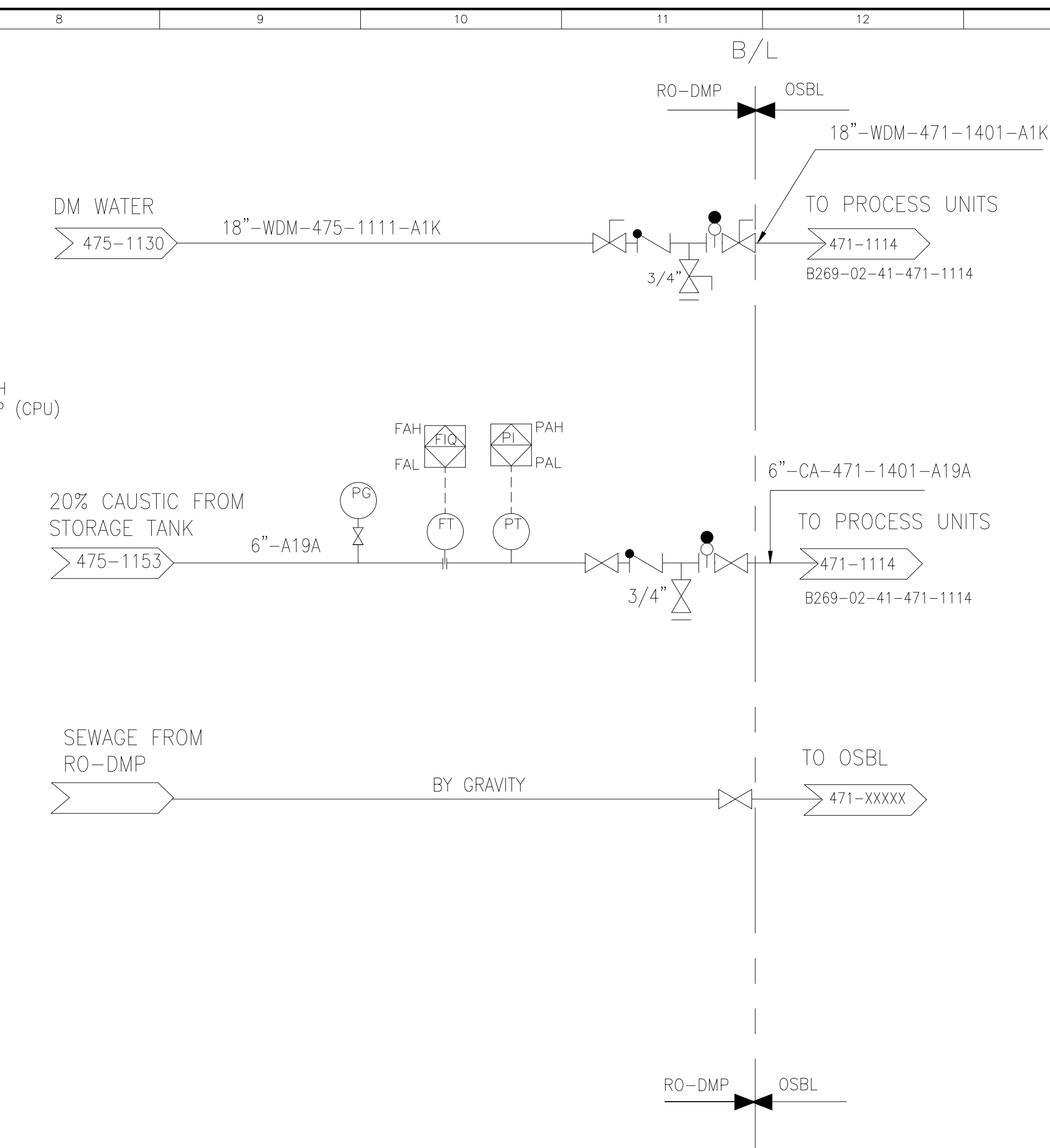
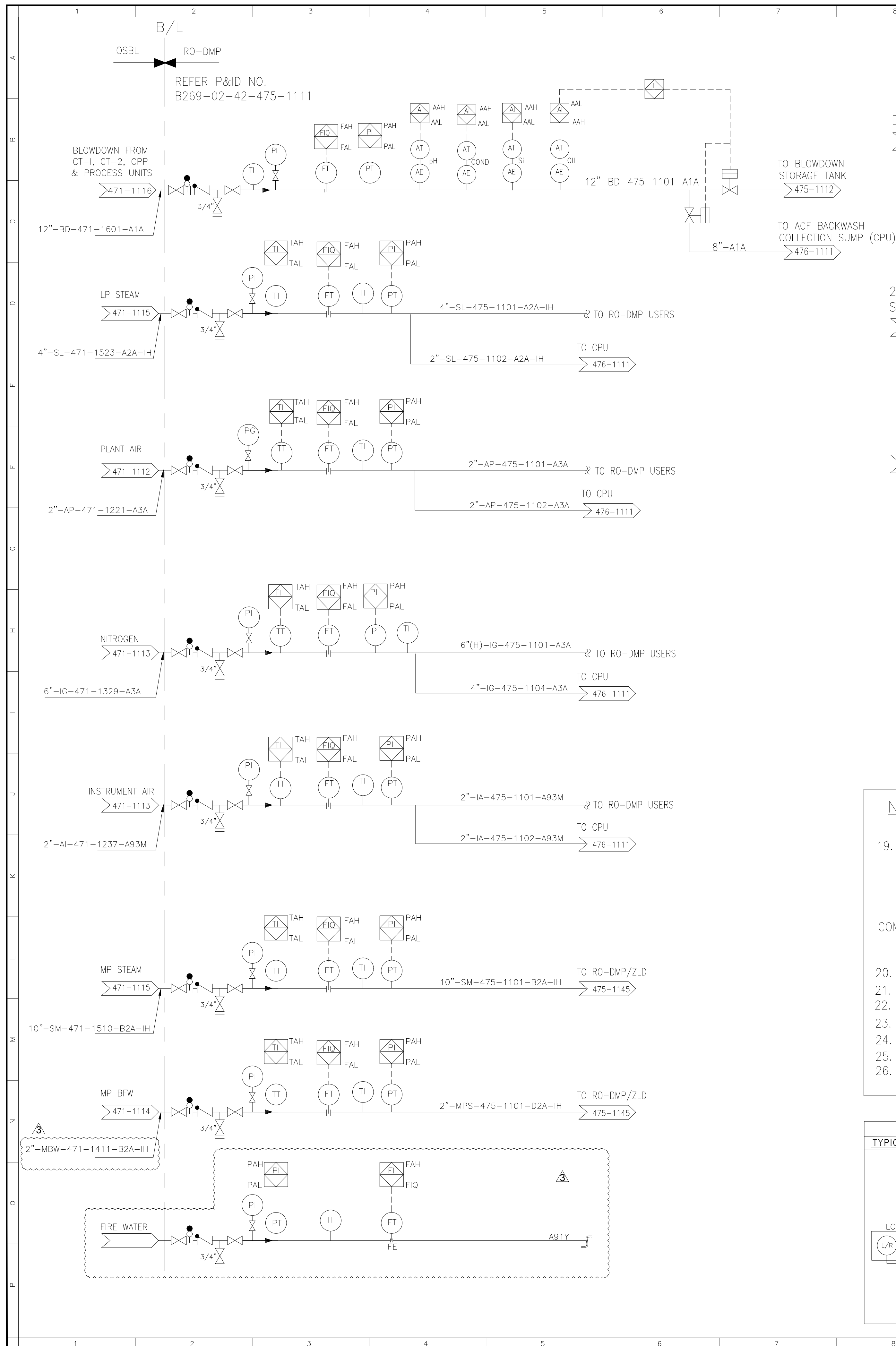
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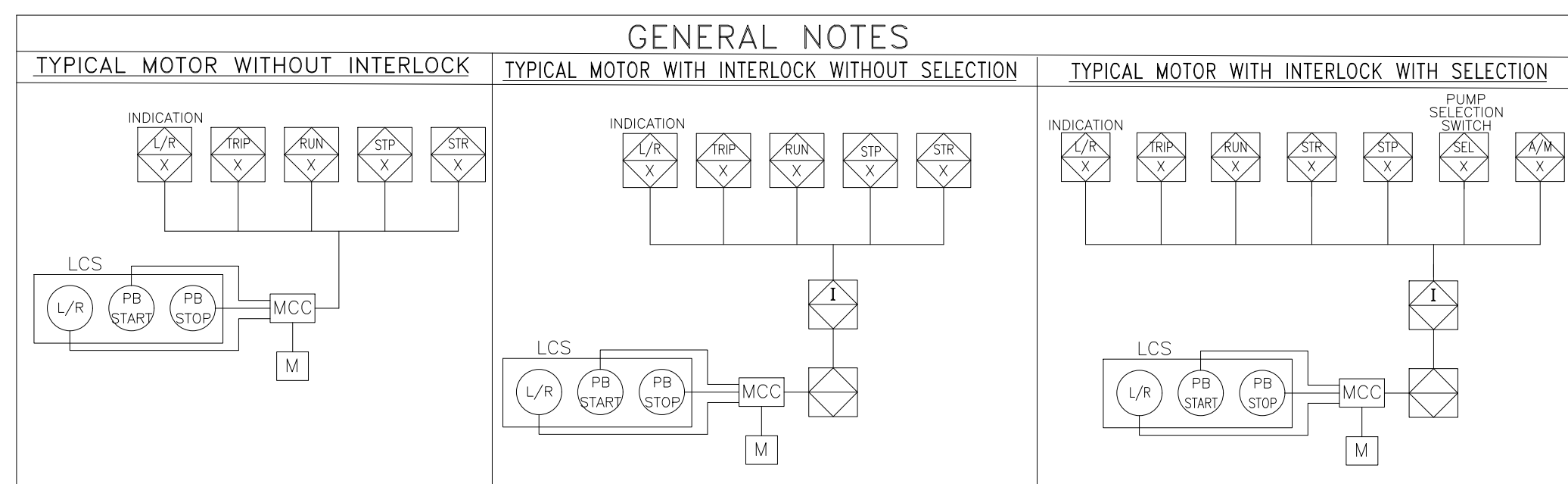
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NOTES :-

19. SUPPLY OF INSTRUMENT AIR & PLANT AIR TILL COMMISSIONING OF RWTP & RO-DM PLANT & DURING OPERATION OF 3 MONTHS AFTER COMMISSIONING OF RWTP & RO-DM PLANT SHALL BE IN SCOPE OF RWTP CONTRACTOR SINCE RWTP & RO-DMP SHALL BE COMMISSIONED BEFORE COMMISSIONING OF COMPRESSED AIR SYSTEM (PLANT AIR & INSTRUMENT AIR). AFTER COMMISSIONING OF COMPRESSED AIR SYSTEM, INSTRUMENT AIR & PLANT AIR IN RWTP & RO-DMP SHALL BE TAKEN FROM COMPRESSED AIR SYSTEM.
20. PMS & VMS SHALL BE FOLLOWED FOR ALL LINES & VALVES.
21. RECIRCULATIONLINE ALONG WITH GLOBE VALVE TO BE PROVIDED IN SUMPS/TANKS AS PER PROCESS REQUIREMENT.
22. LOCAL LEVEL INDICATION FOR ALL THE TANKS SHALL BE PROVIDED FROM ONE OF THE LT.
23. ALL BLOWER LINES TO BE PROVIDED WITH SAFETY INSULATION.
24. DELETED
25. PROCESS DRAIN NETWORK MOC SHALL BE A9A WITH 3 LPE COATING.
26. FOR AUTO ON-OFF VALVES EDB B269-999-16-51-EDB-1001 SHALL BE FOLLOWED.



14

REF. DWG. NO.

15

REFERENCE DRAWING TITLE

16

NOTES :-

(TYPICAL NOTES APPLICABLE FOR ALL P&IDs.)

1. THESE ARE INDICATIVE P&IDs. VENDOR TO FURTHER DEVELOP THESE P&IDs IN THE LINE WITH TENDER DOCUMENT REQUIREMENTS. REPRESENTATION OF UNITS/EQUIPMENTS SHOWN ARE INDICATIVE ONLY AND THE SAME SHALL BE AS PER TENDER REQUIREMENTS.

2. VELOCITY CRITERIA FOR LINE SIZING SHALL BE AS SPECIFIED IN THE TENDER SPECIFICATIONS. HOWEVER, LINE SIZES AS INDICATED IN THE TENDER DRAWINGS SHALL BE STRICTLY FOLLOWED AS MINIMUM REQUIREMENTS.

3. PIPING MATERIAL SPECIFICATIONS (PMS) FOR VARIOUS LINES/ SERVICES SHALL BE AS SPECIFIED IN THE TENDER SPECIFICATIONS. HOWEVER, PIPING MATERIAL AS INDICATED IN THE TENDER DRAWINGS SHALL BE STRICTLY FOLLOWED.

4. TYPICAL DETAILS FOR ONE CONTROL VALVE (DETAIL-"A") IS AS FOLLOWS AND SHALL BE FOLLOWED OR ALL CONTROL VALVES.

FCV

FT

5. SAMPLING VALVES TO BE PROVIDED AT INLET & OUTLET OF VARIOUS UNITS AS PER PROCESS REQUIREMENTS.

6. INSTRUMENT & ARRANGEMENTS SHOWN IN ONE CHAIN ARE TYPICAL. TO BE PROVIDED IN ALL CHAINS.

7. VALVES TYPE INDICATED IN PROCESS SPECIFICATIONS (SCOPE OF WORK/SUPPLY) TO BE FOLLOWED. WHEREVER TYPES OF VALVES ARE NOT SPECIFIED, EIL's PMS & VMS TO BE FOLLOWED.

8. ADEQUATE HEADER RUN LENGTH AFTER MIXER TO BE PROVIDED TO ENSURE MIXING.

9. ALL LEVEL TRANSMITTER SHALL BE NON-CONTACT RADAR TYPE.

10. ALL ON/OFF VALVES SHALL BE PROVIDED WITH OPEN/CLOSE FEEDBACK IN THE PLC. REFER DETAIL B

OPEN

CLOSE

250

XXXX

250

XXXX

250

XXXX

250

XXXX

UV-XXXX

DETAIL-"B"

(TYPICAL FOR ALL ON/OFF VALVES)

11. OVER FLOW AND DRAIN CONNECTION 'D' SHALL BE PROVIDED FOR ALL ABOVE GROUND SUMP & TANKS WITH DRAIN DESTINATION TO BETWEEN WASTE COLLECTION SUMP-1.

12. FOR ALL INCOMING LINES, SAME CLASS OF PIPING, AS AVAILABLE AT RODMP B/L, SHALL BE USED UP TO THEIR RESPECTIVE FIRST UNIT.

13. ALL VALVES SHALL BE TIGHT SHUT-OFF.

14. REFER LEGEND P&ID NOS. B269-02-42-00-1191 & 1192 (2 SHEETS)

15. ALL CONTROL VALVES SHALL BE PROVIDED WITH SMART POSITIONERS.

16. FAIL SAFE CONDITION OF EACH ON/OFF VALVE TO BE INDICATED IN P&ID'S

17. SEPARATE UTILITY DISTRIBUTION P&ID'S SHALL BE DEVELOPED & SUBMITTED BY CONTRACTOR TO EIL/IOCL FOR APPROVAL.

18. REFER PROCESS P&ID FOR DM WATER SYSTEM FOR INSTRUMENT AND DETAILS OF INCOMING AND OUTGOING LINES TO AND FROM RO-DM PLANT (P&ID NO. B269-02-42-475-1111)

3

07.03.22

REVISED AND ISSUED WITH TA-02

AB

SC

VS/PKG

2

25.08.21

REVISED AND REISSUED FOR TENDER

AB

SC

VS/PKG

1

27.05.21

REVISED AND REISSUED FOR TENDER

AB

SC

VS/PKG

0

29.04.20

ISSUED FOR TENDER

GSC

SC

VS/PKG

REV.

DATE

REVISIONS

BY

CHKD

APPD

इंजीनियर्स

इंडिया लिमिटेड

(भारत सरकार का उद्यम)

ENGINEERS

INDIA LIMITED

(A Govt. of India Undertaking)

इंडियन ऑयल

IOCL - PANIPAT REFINERY
EXPANSION PROJECT (P-25)
PANIPAT, HARYANA

पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम

PIPING & INSTRUMENTATION DIAGRAM

RO BASED DM PLANT

BATTERY LIMIT (SHEET 1 OF 2)

SCALE

JOB NO.

DEPT.

SECT.

UNIT

DWG. NO.

REV.

NIL

B 2

6

9

1 7

4 4

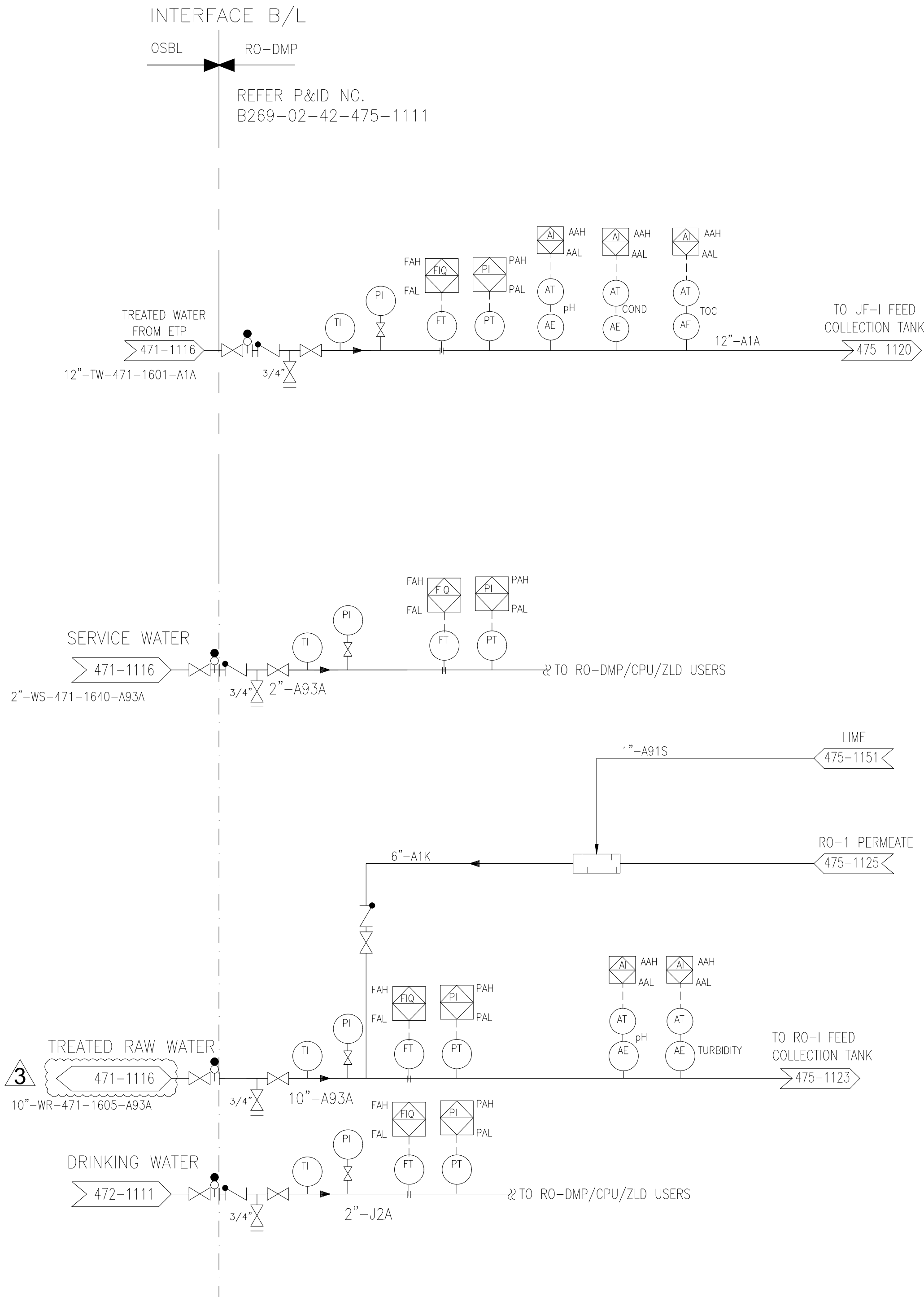
475 1 1 1 3

14

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16

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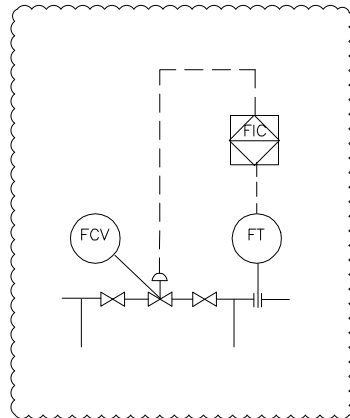
NOTES :-

- SUPPLY OF INSTRUMENT AIR & PLANT AIR TILL COMMISSIONING OF RWTP & RO-DM PLANT & DURING OPERATION OF 3 MONTHS AFTER COMMISSIONING OF RWTP & RO-DM PLANT SHALL BE IN SCOPE OF RWTP CONTRACTOR SINCE RWTP & RO-DMP SHALL BE COMMISSIONED BEFORE COMMISSIONING OF COMPRESSED AIR SYSTEM (PLANT AIR & INSTRUMENT AIR). AFTER COMMISSIONING OF COMPRESSED AIR SYSTEM, INSTRUMENT AIR & PLANT AIR IN RWTP & RO-DMP SHALL BE TAKEN FROM COMPRESSED AIR SYSTEM.
- PMS & VMS SHALL BE FOLLOWED FOR ALL LINES & VALVES.
- RECIRCULATIONLINE ALONG WITH GLOBE VALVE TO BE PROVIDED IN SUMPS/TANKS AS PER PROCESS REQUIREMENT.
- LOCAL LEVEL INDICATION FOR ALL THE TANKS SHALL BE PROVIDED FROM ONE OF THE LT.
- ALL BLOWER LINES TO BE PROVIDED WITH SAFETY INSULATION.
- DELETED.

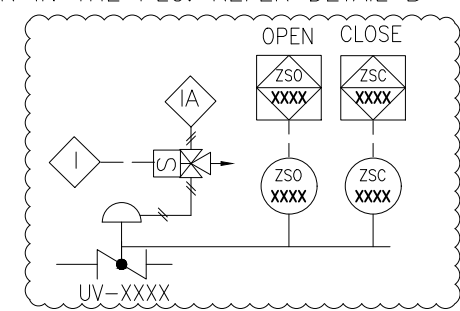
NOTES :-

(TYPICAL NOTES APPLICABLE FOR ALL P&IDs.)

- THESE ARE INDICATIVE P&IDs. VENDOR TO FURTHER DEVELOP THESE P&IDs IN THE LINE WITH TENDER DOCUMENT REQUIREMENTS. REPRESENTATION OF UNITS/EQUIPMENTS SHOWN ARE INDICATIVE ONLY AND THE SAME SHALL BE AS PER TENDER REQUIREMENTS.
- VELOCITY CRITERIA FOR LINE SIZING SHALL BE AS SPECIFIED IN THE TENDER SPECIFICATIONS. HOWEVER, LINE SIZES AS INDICATED IN THE TENDER DRAWINGS SHALL BE STRICTLY FOLLOWED AS MINIMUM REQUIREMENTS.
- PIPING MATERIAL SPECIFICATIONS (PMS) FOR VARIOUS LINES/ SERVICES SHALL BE AS SPECIFIED IN THE TENDER SPECIFICATIONS. HOWEVER, PIPING MATERIAL AS INDICATED IN THE TENDER DRAWINGS SHALL BE STRICTLY FOLLOWED.
- TYPICAL DETAILS FOR ONE CONTROL VALVE (DETAIL-"A") IS AS FOLLOWS AND SHALL BE FOLLOWED OR ALL CONTROL VALVES.



- SAMPLING VALVES TO BE PROVIDED AT INLET & OUTLET OF VARIOUS UNITS AS PER PROCESS REQUIREMENTS.
- INSTRUMENT & ARRANGEMENTS SHOWN IN ONE CHAIN ARE TYPICAL. TO BE PROVIDED IN ALL CHAINS.
- VALVES TYPE INDICATED IN PROCESS SPECIFICATIONS (SCOPE OF WORK/SUPPLY) TO BE FOLLOWED. WHEREVER TYPES OF VALVES ARE NOT SPECIFIED, EIL's PMS & VMS TO BE FOLLOWED.
- ADEQUATE HEADER RUN LENGTH AFTER MIXER TO BE PROVIDED TO ENSURE MIXING.
- ALL LEVEL TRANSMITTER SHALL BE NON-CONTACT RADAR TYPE.
- ALL ON/OFF VALVES SHALL BE PROVIDED WITH OPEN/CLOSE FEEDBACK IN THE PLC, REFER DETAIL B



DETAIL-"B"
(TYPICAL FOR ALL ON/OFF VALVES)

- OVER FLOW AND DRAIN CONNECTION 'D' SHALL BE PROVIDED FOR ALL ABOVE GROUND SUMP & TANKS WITH DRAIN DESTINATION TO BETWEEN WASTE COLLECTION SUMP-1.
- FOR ALL INCOMING LINES, SAME CLASS OF PIPING, AS AVAILABLE AT RODMP B/L, SHALL BE USED UP TO THEIR RESPECTIVE FIRST UNIT.
- ALL VALVES SHALL BE TIGHT SHUT-OFF.
- REFER LEGEND P&ID NOS: B269-475-17-44-1191 & 1192 (2 SHEETS)
- ALL CONTROL VALVES SHALL BE PROVIDED WITH SMART POSITIONERS.
- FAIL SAFE CONDITION OF EACH ON/OFF VALVE TO BE INDICATED IN P&ID'S
- SEPARATE UTILITY DISTRIBUTION P&ID'S SHALL BE DEVELOPED & SUBMITTED BY CONTRACTOR TO EIL/IOCL FOR APPROVAL.
- REFER PROCESS P&ID FOR DM WATER SYSTEM FOR INSTRUMENT AND DETAILS OF INCOMING AND OUTGOING LINES TO AND FROM RO-DM PLANT (P&ID NO. B269-02-42-475-1111)

REV.	DATE	REVISIONS	BY	CHKD	APPD
3	07.03.03	REVISED AND ISSUED WITH TA-02	AB	SC	VS/PKG
2	23.08.21	REVISED AND REISSUED FOR TENDER	AB	SC	VS/PKG
1	27.05.21	REVISED AND REISSUED FOR TENDER	AB	SC	VS/PKG
0	29.04.20	ISSUED FOR TENDER	GSC	SC	VS/PKG

इंजीनियर्स इंडिया लिमिटेड
(भारत सरकार का उपक्रम)



**IOCL – PANIPAT REFINERY
EXPANSION PROJECT (P-25)
PANIPAT, HARYANA**

पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम

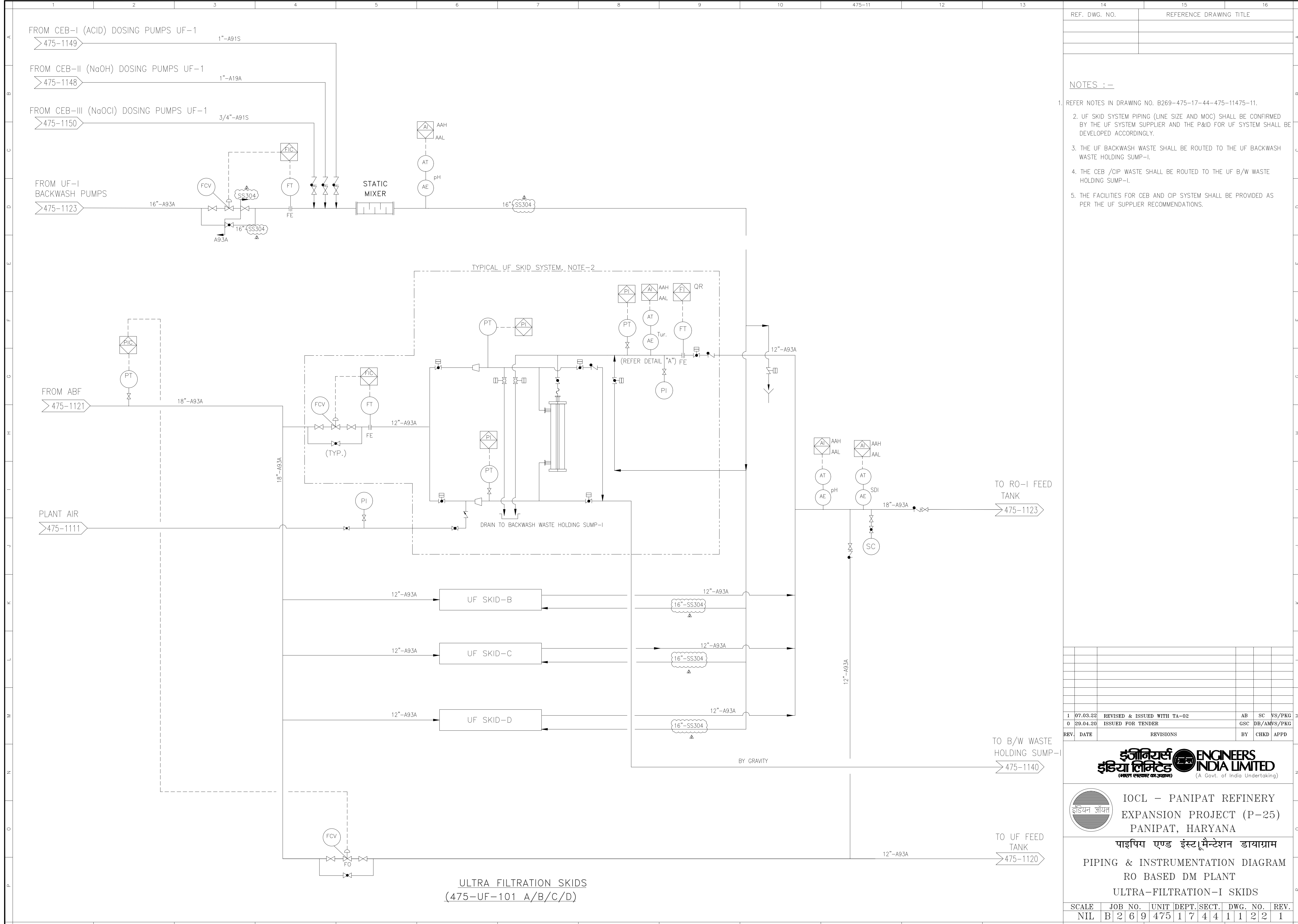
PIPING & INSTRUMENTATION DIAGRAM

RO BASED DM PLANT

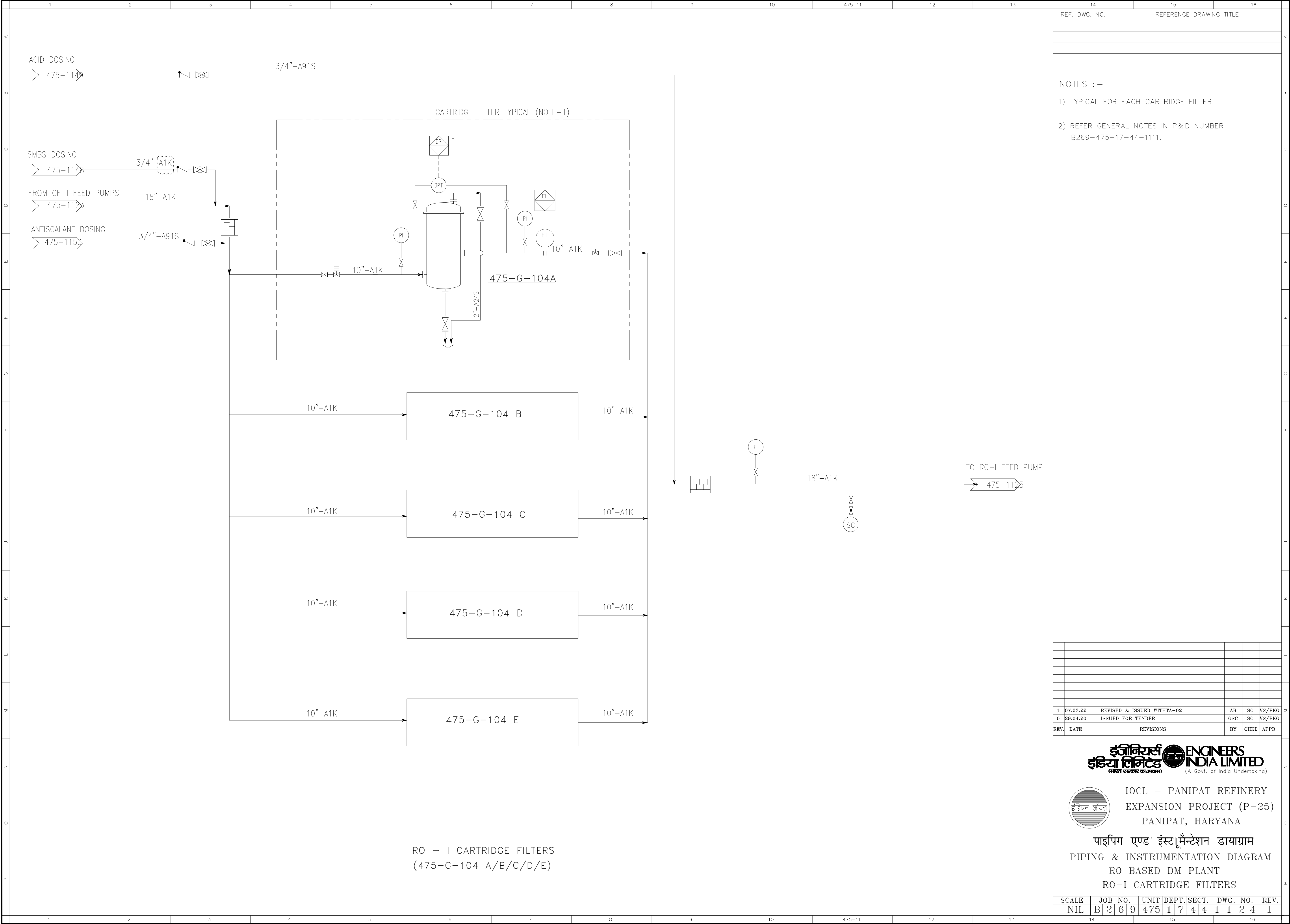
BATTERY LIMIT (SHEET 2 OF 2)

SCALE	JOB NO.	UNIT	DEPT.	SECT.	DWG. NO.	REV.
NIL	B 2	6	9	475	1 7 4 4	1 1 1 1 3

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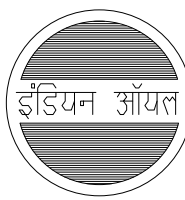
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- NOTES :-
- 1) TYPICAL FOR EACH CARTRIDGE FILTER
- 2) REFER GENERAL NOTES IN P&ID NUMBER B269-475-17-44-1111.

1	07.03.22	REVISED & ISSUED WITHTA-02	AB	SC	VS/PKG
0	29.04.20	ISSUED FOR TENDER	GSC	SC	VS/PKG

REV.	DATE	REVISIONS	BY	CHKD	APPD
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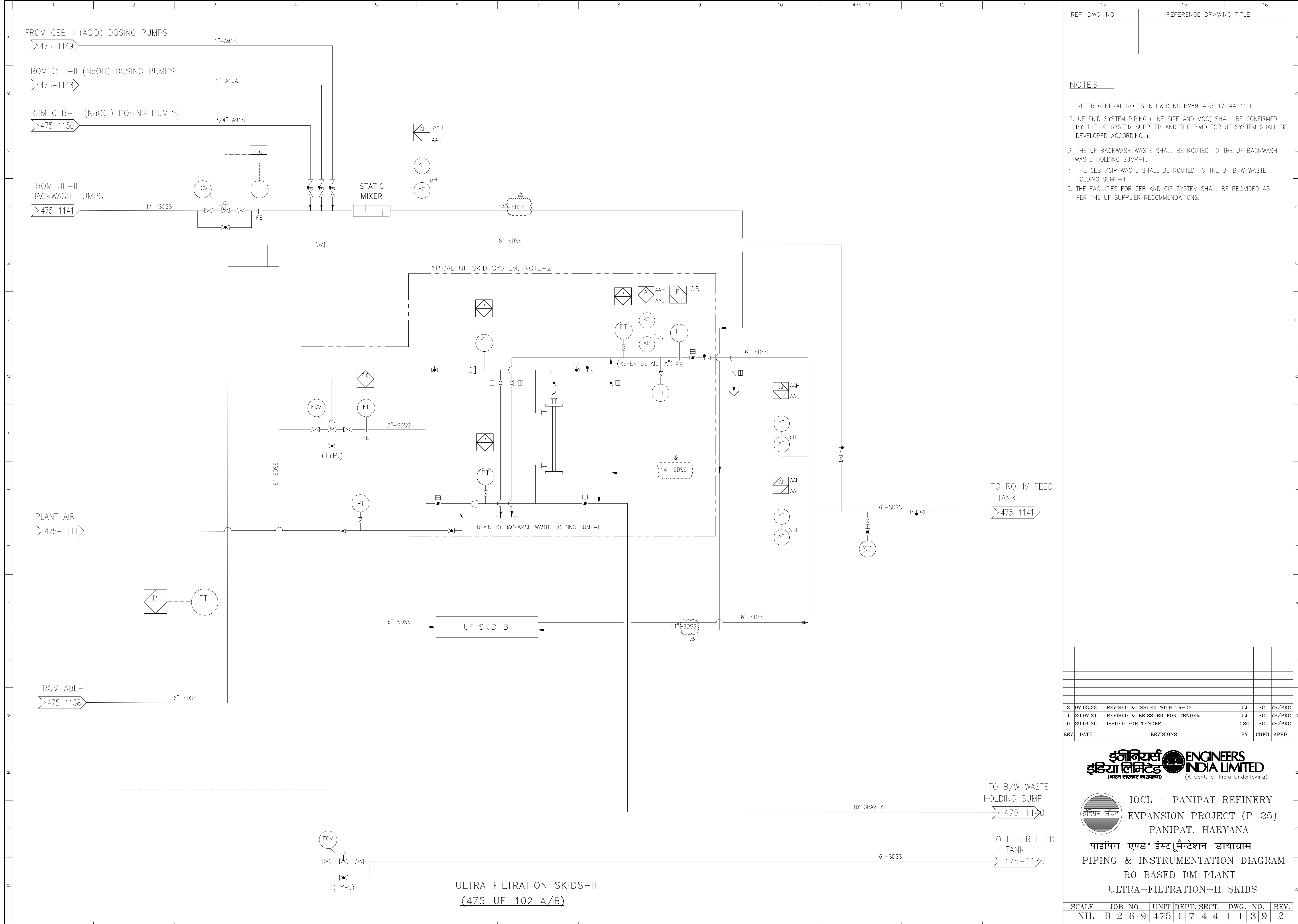


IOCL - PANIPAT REFINERY
EXPANSION PROJECT (P-25)
PANIPAT, HARYANA

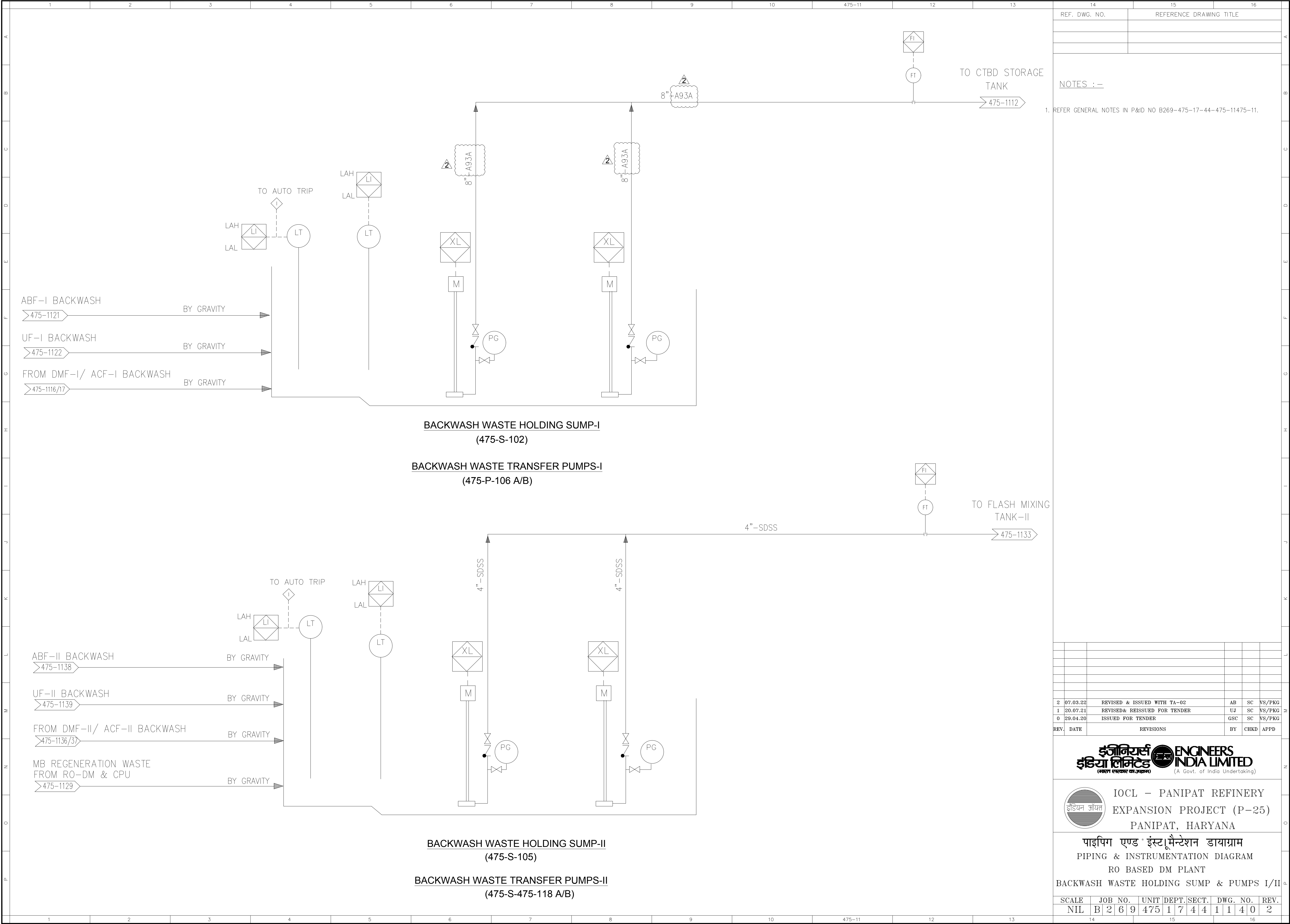
पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम
PIPING & INSTRUMENTATION DIAGRAM
RO BASED DM PLANT
RO-I CARTRIDGE FILTERS

SCALE	JOB NO.	UNIT	DEPT.	SECT.	DWG. NO.	REV.
NIL	B 2 6 9	475	1	7	4 4	1 1 2 4 1

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NOTES :-

1. REFER GENERAL NOTES IN P&ID NO B269-475-17-44-475-11475-11.

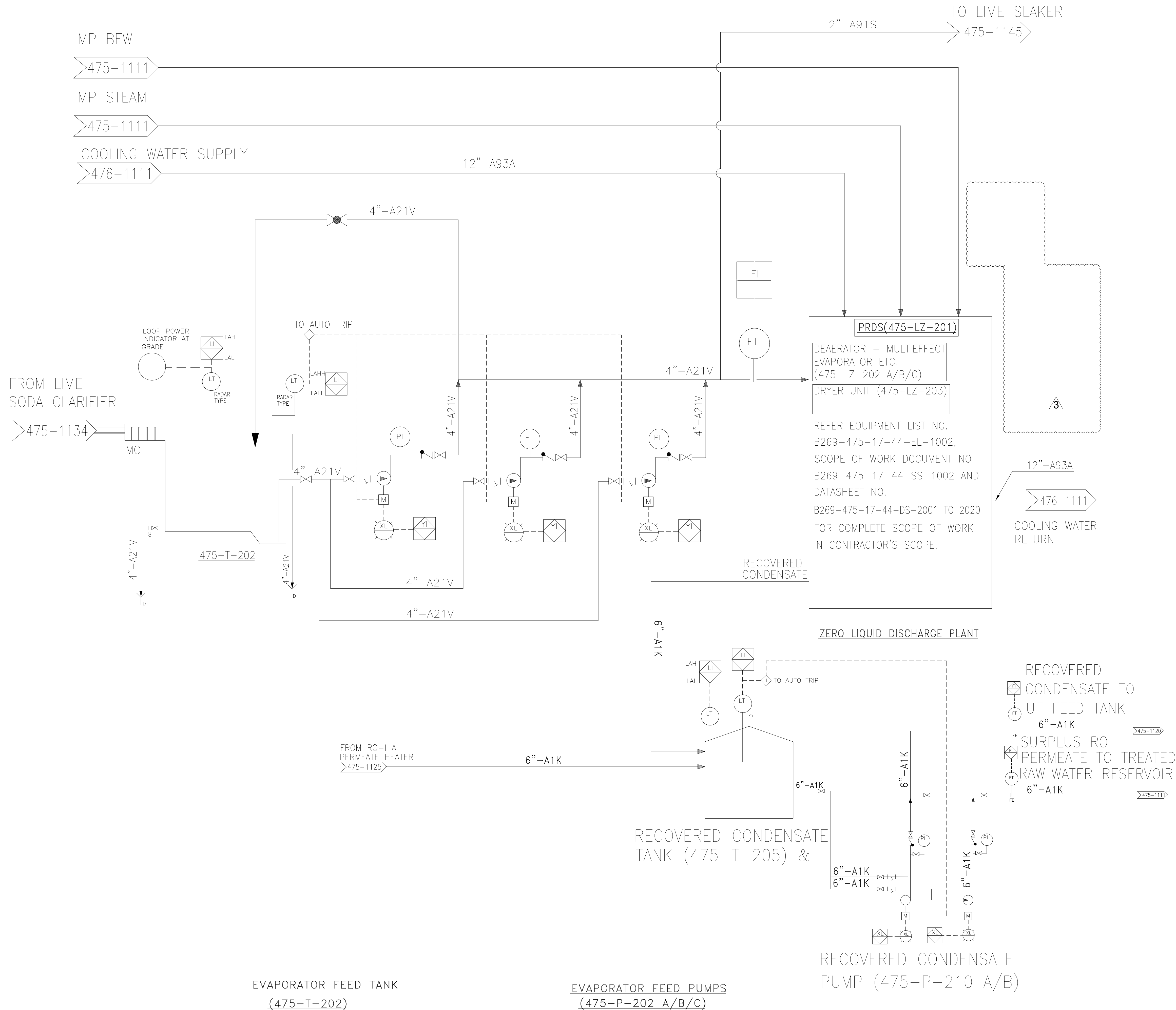


IOCL - PANIPAT REFINERY
EXPANSION PROJECT (P-25)
PANIPAT, HARYANA

पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम
PIPING & INSTRUMENTATION DIAGRAM
RO BASED DM PLANT
BACKWASH WASTE HOLDING SUMP & PUMPS I/II

SCALE	JOB NO.	UNIT	DEPT.	SECT.	DWG. NO.	REV.
NIL	B 2 6 9	475	1	7 4 4	1 1 4 0	2

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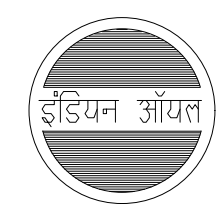
NOTES :—

1. REFER GENERAL NOTES IN P&ID NO B269-475-17-44-1111.

2. MC: MIXING CHANNEL

REV.	DATE	REVISIONS	BY	CHKD	APPD
3	07.03.22	REVISED AND ISSUED WITH TA-02	AB	SC	VS/PKG
2	25.08.21	REVISED AND REISSUED FOR TENDER	AB	SC	VS/PKG
1	27.05.21	REVISED AND REISSUED FOR TENDER	SC	VS	PKG
0	29.04.20	ISSUED FOR TENDER	GSC	SC	VS/PKG

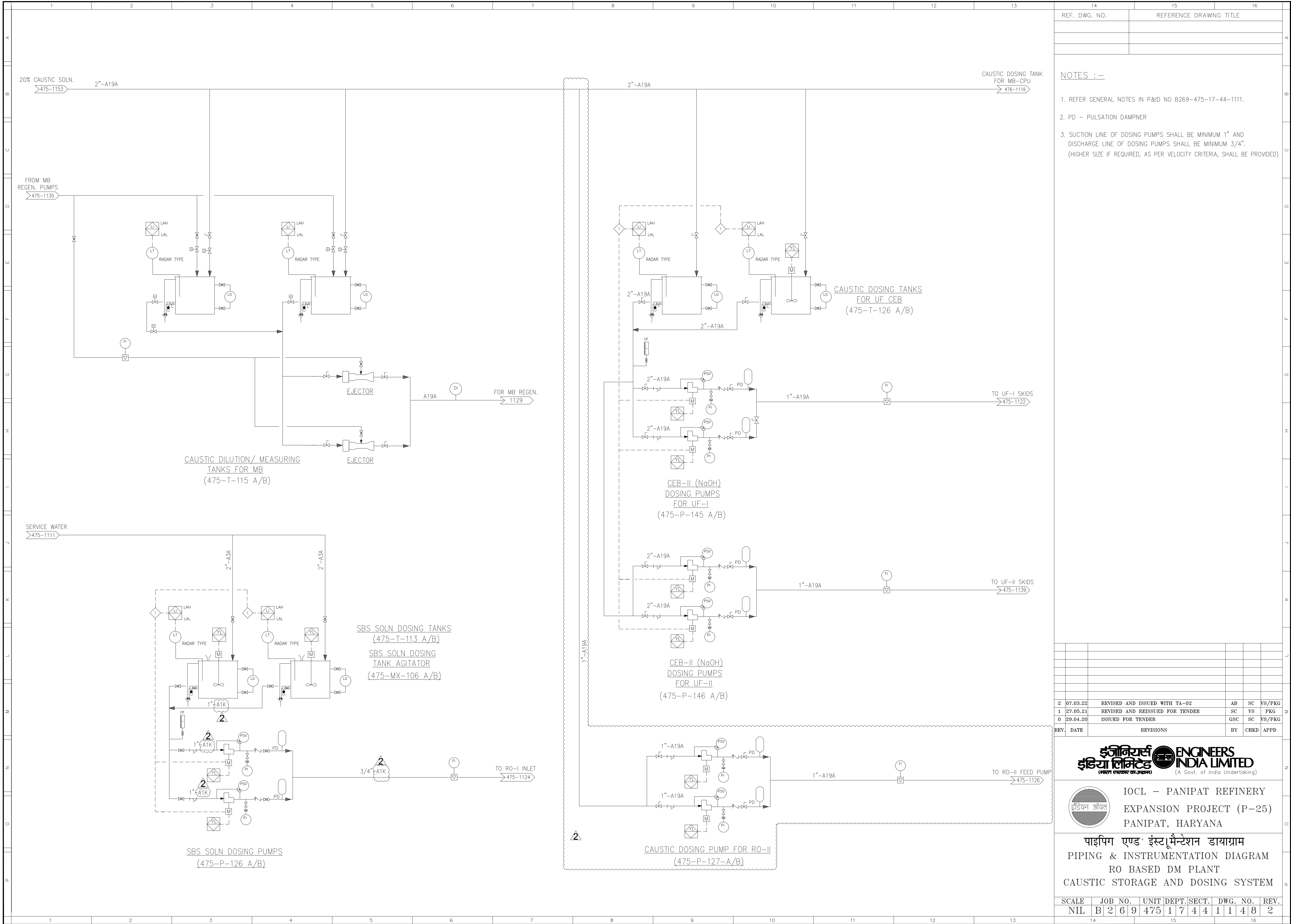
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**IOCL – PANIPAT REFINERY
EXPANSION PROJECT (P-25)
PANIPAT, HARYANA**

पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम
PIPING & INSTRUMENTATION DIAGRAM
RO BASED DM PLANT
ZERO LIQUID DISCHARGE PLANT

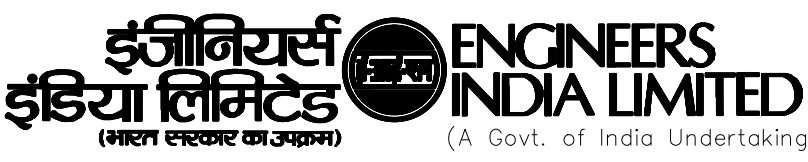
SCALE	JOB NO.	UNIT	DEPT.	SECT.	DWG. NO.	REV.
NIL	B 2 6 9	475	1	7	4 4	1 1 4 5 3

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- NOTES :-
1. REFER GENERAL NOTES IN P&ID NO B269-475-17-44-1111.
 2. PD - PULSATION DAMPNER
 3. SUCTION LINE OF DOSING PUMPS SHALL BE MINIMUM 1" AND DISCHARGE LINE OF DOSING PUMPS SHALL BE MINIMUM 3/4". (HIGHER SIZE IF REQUIRED, AS PER VELOCITY CRITERIA, SHALL BE PROVIDED)

REV.	DATE	REVISIONS	BY	CHKD	APPD
2	07.03.22	REVISED AND ISSUED WITH TA-02	AB	SC	VS/PKG
1	27.05.21	REVISED AND REISSUED FOR TENDER	SC	VS	PKG
0	29.04.20	ISSUED FOR TENDER	GSC	SC	VS/PKG



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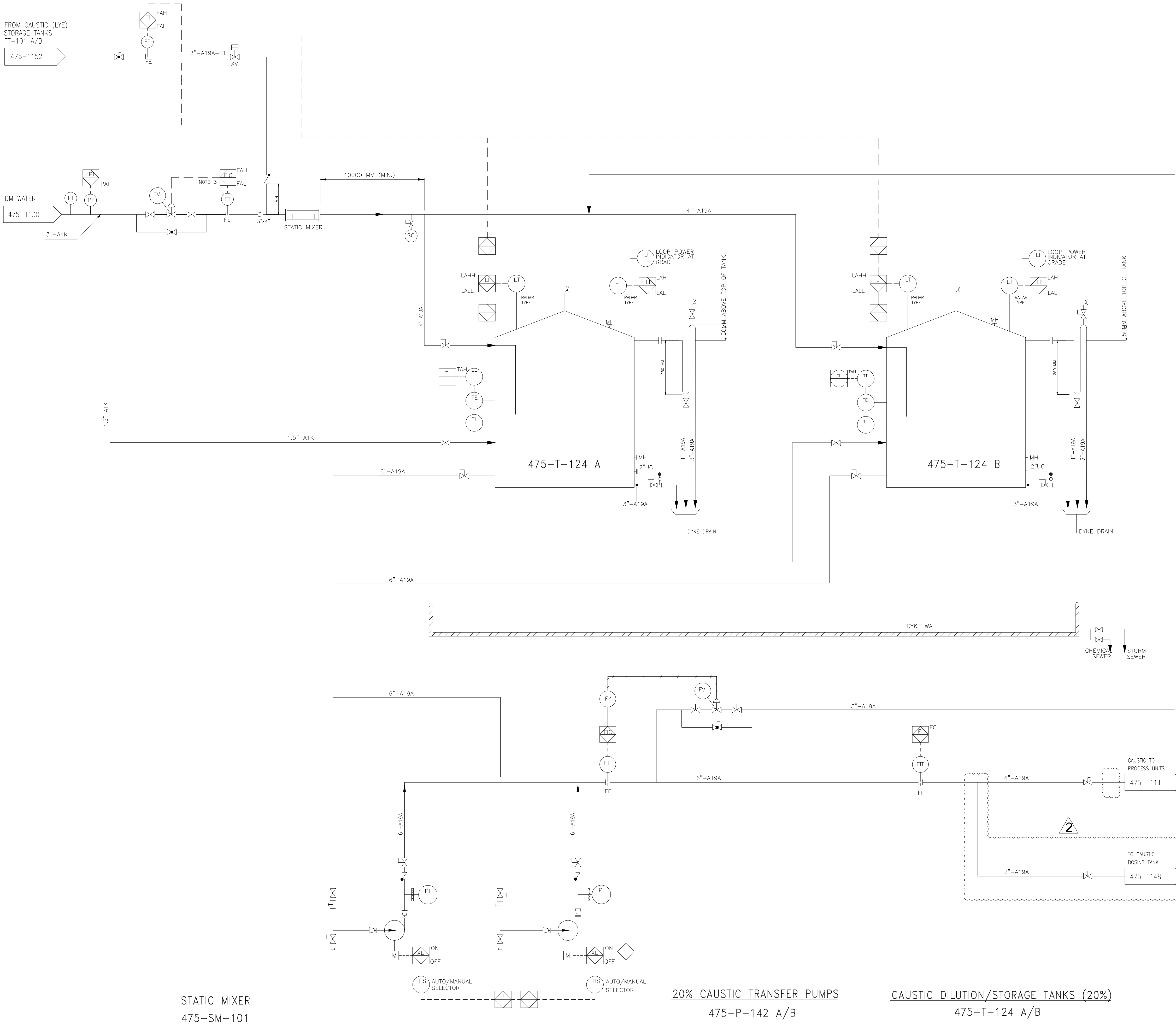


IOCL - PANIPAT REFINERY
EXPANSION PROJECT (P-25)
PANIPAT, HARYANA

पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम
PIPING & INSTRUMENTATION DIAGRAM
RO BASED DM PLANT
CAUSTIC STORAGE AND DOSING SYSTEM

SCALE	JOB NO.	UNIT	DEPT.	SECT.	DWG. NO.	REV.
NIL	B 2 6 9	475	1	7 4 4	1 1 4 8	2

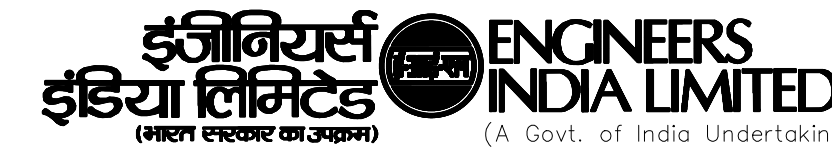
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NOTES :-

1. DYKE DRAIN TO BE ROUTED TO CHEMICAL SEWER UPTO B/L OF THE RODM PLANT.
2. REFER GENERAL NOTES IN P&ID NO B269-475-17-44-1111.
3. RATIO CONTROL ON FLOW SHALL BE PROVIDED IN THE DM WATER LINE FOR DILUTION AND PREPARATION OF 20% CAUSTIC SOLUTION IN THE TANKS

REV.	DATE	REVISIONS	BY	CHKD	APPD
2	07.03.22	REVISED AND ISSUED WITH TA-02	AB	SC	VS/PKG
1	27.05.21	REVISED AND REISSUED FOR TENDER	SC	VS	PKG
0	29.04.20	ISSUED FOR TENDER	GSC	SC	VS/PKG

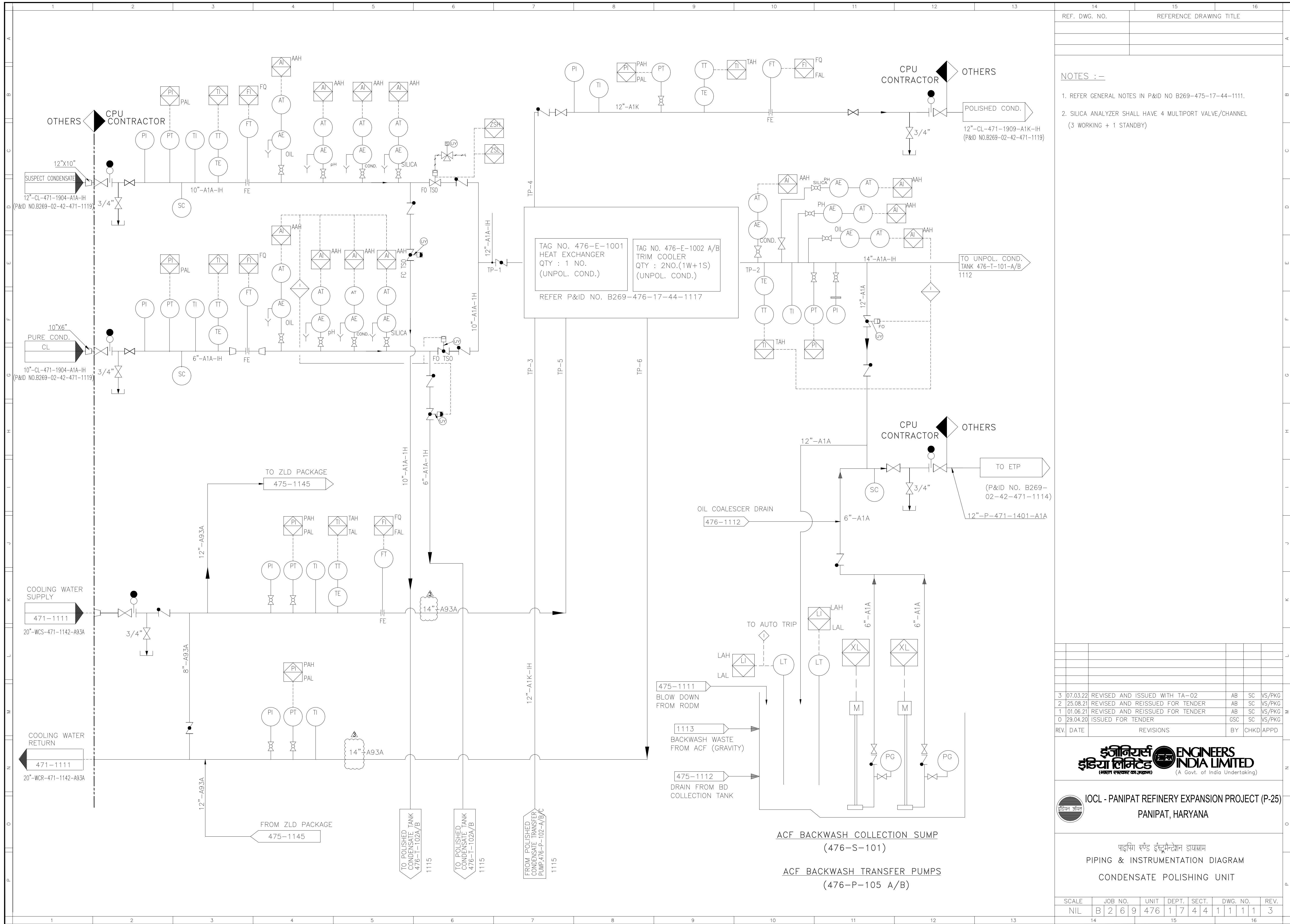


IOCL - PANIPAT REFINERY
EXPANSION PROJECT (P-25)
PANIPAT, HARYANA

पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम
PIPING & INSTRUMENTATION DIAGRAM
20% CAUSTIC STORAGE
AND TRANSFER SYSTEM

SCALE	JOB NO.	UNIT	DEPT.	SECT.	DWG. NO.	REV.
NIL	B 2 6 9	475	1 7	4 4	1 1 5 3	2

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- NOTES :—
1. REFER GENERAL NOTES IN P&ID NO B269-475-17-44-1111.
 2. SILICA ANALYZER SHALL HAVE 4 MULTIPOINT VALVE/CHANNEL (3 WORKING + 1 STANDBY)

REV.	DATE	REVISIONS	BY	CHKD	APPD
3	07.03.22	REVISED AND ISSUED WITH TA-02	AB	SC	VS/PKG
2	25.08.21	REVISED AND REISSUED FOR TENDER	AB	SC	VS/PKG
1	01.06.21	REVISED AND REISSUED FOR TENDER	AB	SC	VS/PKG
0	29.04.20	ISSUED FOR TENDER	GSC	SC	VS/PKG

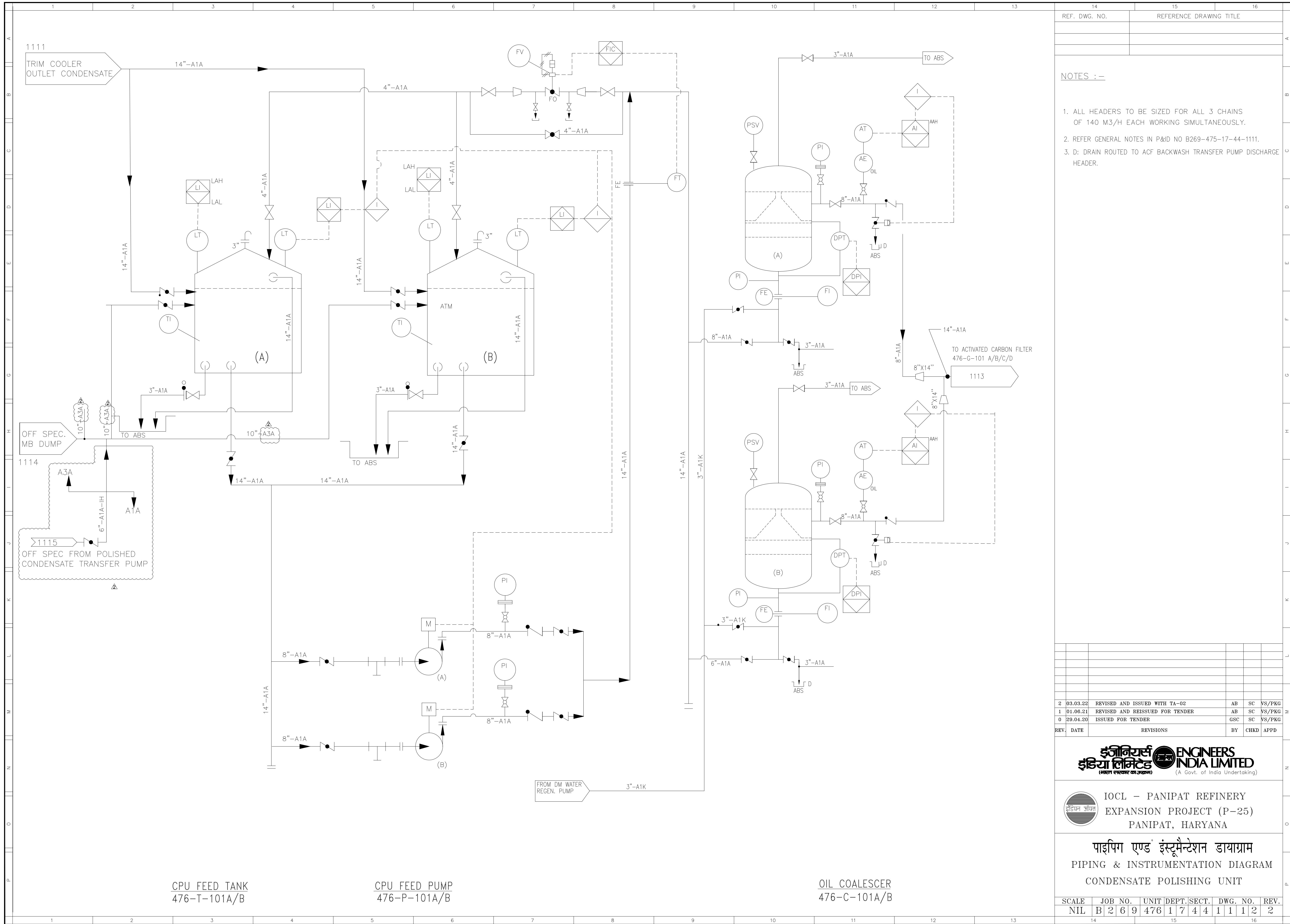


IOCL - PANIPAT REFINERY EXPANSION PROJECT (P-25)
PANIPAT, HARYANA

पाइपिंग रण्ड इंस्ट्रुमेंटेशन डायग्राम
PIPING & INSTRUMENTATION DIAGRAM
CONDENSATE POLISHING UNIT

SCALE	JOB NO.	UNIT	DEPT.	SECT.	DWG. NO.	REV.
NIL	B 2 6 9	476	1	7	4 4	1 1 1 1 3

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NOTES :-

1. ALL HEADERS TO BE SIZED FOR ALL 3 CHAINS OF 140 M3/H EACH WORKING SIMULTANEOUSLY.
2. REFER GENERAL NOTES IN P&ID NO B269-475-17-44-1111.
3. D: DRAIN ROUTED TO ACF BACKWASH TRANSFER PUMP DISCHARGE HEADER.

REV.	DATE	REVISIONS	BY	CHKD	APPD
2	03.03.22	REVISED AND ISSUED WITH TA-02	AB	SC	VS/PKG
1	01.06.21	REVISED AND REISSUED FOR TENDER	AB	SC	VS/PKG
0	29.04.20	ISSUED FOR TENDER	GSC	SC	VS/PKG



IOCL - PANIPAT REFINERY
EXPANSION PROJECT (P-25)
PANIPAT, HARYANA

पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम
PIPING & INSTRUMENTATION DIAGRAM
CONDENSATE POLISHING UNIT

SCALE	JOB NO.	UNIT	DEPT.	SECT.	DWG. NO.	REV.
NIL	B 2 6 9	476	1	7 4 4	1 1 1 2	2

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FROM ACID DILUTION
TANK (CPU)

TO POLISHED COND.
STORAGE TANK
476-T-102A/B
1115

OFF. SPEC.
COND. TO UNPOLISHED
COND.STORAGE TANK
1112

MIXED BED EXCHANGER
476-MB-101A/B

FROM ACTIVATED
CARBON FILTERS

1113

FROM ACF/MB
AIR SCOUR BLOWER

NOTES :-

1. REFER GENERAL NOTES IN P&ID NO B269-475-17-44-1111.

1	03.03.22	REVISED & ISSUED WITH TA-02	GSC	SC	VS/PKG
0	29.04.20	ISSUED FOR TENDER	GSC	SC	VS/PKG
EV.	DATE	REVISIONS	BY	CHKD	APPD



IOCL – PANIPAT REFINERY
EXPANSION PROJECT (P-25)
PANIPAT, HARYANA

पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम

PIPING & INSTRUMENTATION DIAGRAM

CONDENSATE POLISHING UNIT

SCALE	JOB NO.				UNIT	DEPT.	SECT.	DWG. NO.				REV.
NIL	B	2	6	9	476	1 7	4 4	1	1	1	4	1

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UNPOLISHED
CONDENSATE

476-1111
TP - 1

POLISHED
CONDENSATE

476-1111
TP - 3

COOLING WATER

476-1111
TP - 5

POLISHED
CONDENSATE

476-1111
TP - 4

COOLING WATER
RETURN

476-1111
TP - 6

1111

TO UNPOLISHED
COND. TANK

476-1111
TP - 2

HEAT EXCHANGER
UNPOLISHED CONDENSATE
476-E-1001
QTY. : 1 NO.

TRIM COOLERS
UNPOLISHED CONDENSATE
476-E-1002 A/B
QTY. : 1 NO.

NOTES :-

1. REFER GENERAL NOTES IN P&ID NO B269-475-17-44-1111.

REV.	DATE	REVISIONS	BY	CHKD	APPD
1	03.03.22	REVISED & ISSUED WITH TA-02	AB	SC	VS/PKG
0	29.04.20	ISSUED FOR TENDER	GSC	SC	VS/PKG

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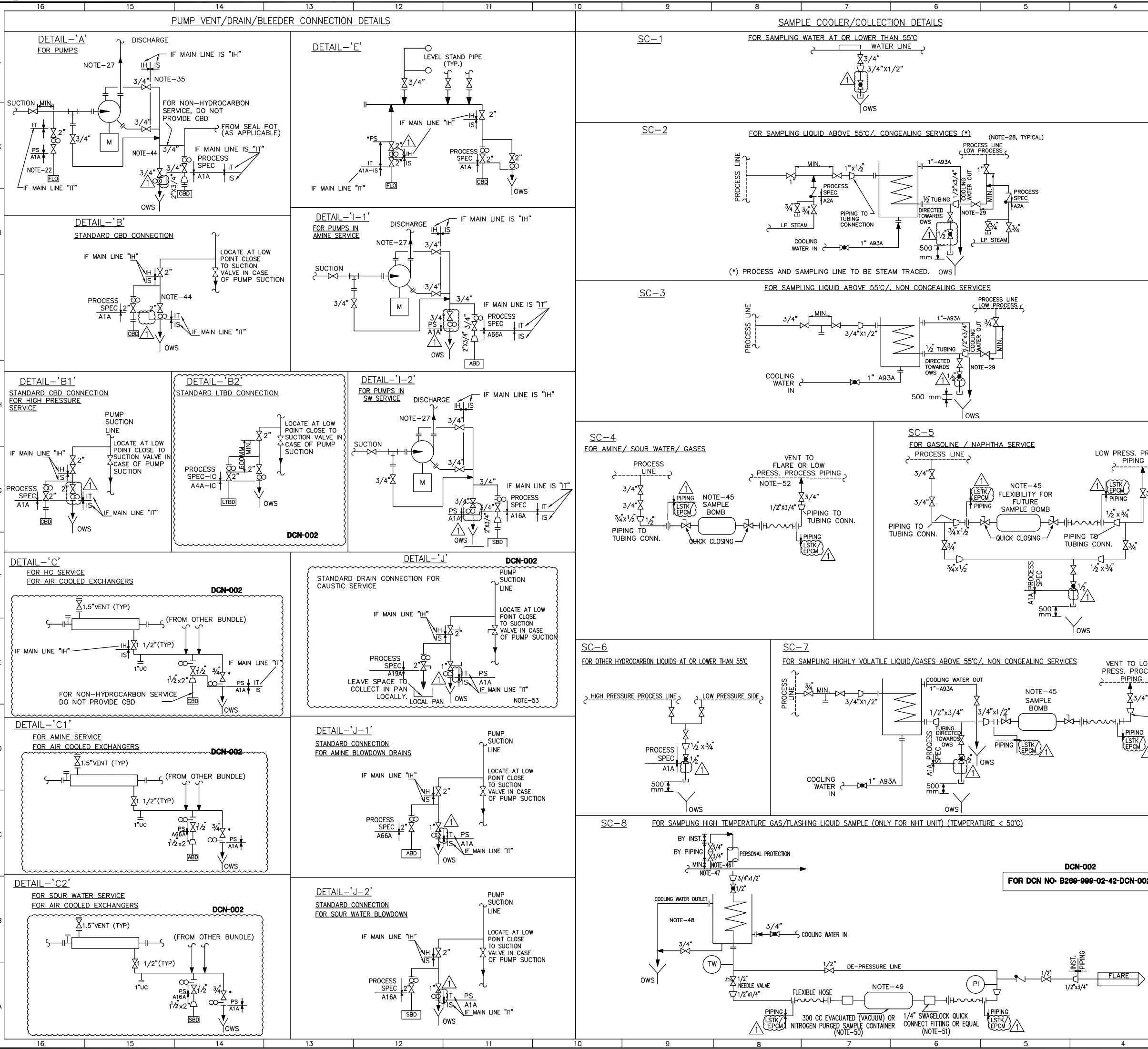


IOCL - PANIPAT REFINERY
EXPANSION PROJECT (P-25)
PANIPAT, HARYANA

पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम
PIPING & INSTRUMENTATION DIAGRAM
HEAT EXCHANGER & TRIM COOLER
CONDENSATE POLISHING UNIT


SCALE	JOB NO.	UNIT	DEPT.	SECT.	DWG. NO.	REV.
NIL	B 2 6 9	476	1	7	4 4	1 1 1 7 1


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- NOTES:-**
- INLET/OUTLET PIPING ON TUBE SIDE OF SHELL AND TUBE HEAT EXCHANGER SHALL BE DESIGNED TO HAVE REMOVABLE SPOOL PIECE FOR EASY MAINTENANCE.
 - IF CASING VENT IS NOT PROVIDED, TAPPING SHALL BE TAKEN FROM TOP OF DISCHARGE LINE.
 - FOR CLOSED SAMPLING IN CASE OF LP PROCESS LINE IS NOT AVAILABLE. IT CAN BE CONNECTED TO CBD/FLARE SPECIFICATION ON CASE TO CASE BASIS.
 - WHENEVER POSSIBLE CLOSED SAMPLING FACILITY TO BE CONSIDERED IN CASE NOT FEASIBLE THEN ONLY OPEN SAMPLING TO BE CONSIDERED.
 - THE FIRST ISOLATION VALVE ON ALL INSTRUMENT TAPPING SHALL BE GATE VALVE. (FOR LICENSED UNITS, LICENSOR SPECIFIC REQUIREMENTS FOR TYPE OF ISOLATION VALVE SHALL OVERRIDE).
 - ALL HEATER INLET CONTROL VALVE ASSEMBLY TO BE LOCATED AT GRADE.
 - INSTRUMENT IMPULSE LINES TO BE INSULATED/ TRACED FOR LINES PROVIDED WITH INSULATION/TRACING TO AVOID CONDENSATION/CONGEALING.
 - THE CW RETURN HEADER AT INDIVIDUAL UNIT B/L WILL BE PROVIDE WITH CP.
 - 3/4" BLEED VALVES WITH FLANGE WILL BE PROVIDED AT THE UPSTREAM AND DOWNSTREAM OF PSV'S (BETWEEN PSV'S AND ISOLATION VALVES).
 - FOR LPG UNSTABILIZED NAPHTHA GASOLINE & LIGHTER PUMPS. VENT/ DRAIN CONNECTION TO FLARE AS WELL AS CBD TO BE PROVIDED.
 - FOR INSTRUMENT DRAIN LINES TO BE ROUTED AWAY FROM HOT SURFACE.
 - HAMMER BLIND IS NOT TO BE USED.
 - UTILITY CONNECTION NOZZLES SHALL NOT BE FROM BOTTOM.
 - NRV ON STEAM EXHAUST FROM TURBINE SHALL NOT BE LOCATED IN A VERTICAL POSITION.
 - NRV TO BE PROVIDED ON ALL THE VENT LINE TO FLARE FROM CONTROL VALVES, LG/LTs AND PUMP SEAL FLUSHING POTS ETC. NRV SHALL BE LOCATED AT MIN. DISTANCE FROM FLARE HEADER.
 - OWS/CBD VENTS IN PROCESS UNITS SHOULD BE DISCHARGED AT MIN. ELEVATION OF 3m ABOVE GRADE OR HIGHER THAN THE TALLEST STRUCTURE WITHIN 15m RADIUS OF ITS LOCATION.
 - A 4" STUB WITH ISOLATION VALVE AT THE LOWEST POINT IN ALL DEAD END OF COOLING WATER HEADER SHALL BE PROVIDED FOR FLUSHING.
 - FOR STEAM OUT CONNECTION REFER BELOW DETAIL.
-
- DCN-002**
- ALL PROCESS OWS CONNECTIONS ALONG WITH BLOWDOWN (CBD/ABO/SBD/LTD) WILL BE HAVING SAME LINE NUMBER AS CORRESPONDING CBD/ABO/SBD/LTD NUMBER WITH OWS SERVICE CODE.
 - QUICK DISCONNECT CONNECTIONS SHALL BE USED AND SHALL BE CAPABLE OF SELF-SEALING WITH ABILITY TO WITHSTAND AT LEAST 10.5 kg/cm² INTERNAL PRESSURE WHEN DISCONNECTED FROM THE CYLINDER.
 - USE DOUBLE BLOCK FOR ANY CLASS 900 LINES OR HIGHER AND FOR H2/H2S SERVICES.
 - TAKE SAMPLE CONNECTION FORM TOP HORIZONTAL LINE.
 - A SUPPORT FOR THE CYLINDER "BOMB" SHALL BE FORESEEN.
 - FOR OPERATING PRESSURE UNDER 125 barg (125 Kg/cm², 1800 psiG). USE WITH 304L-HDF4-300. SAMPLE BOTTLE OR EQUAL. FOR OPERATING PRESSURE 125 barg (125 Kg/cm², 1800 psiG) ABOVE USE.
 - FOR OPERATING PRESSURE UNDER 125 barg (125 Kg/cm², 1800 psiG). USE SWAGELOCK QUICK CONNECTS. STEMS : SS-QTB-5-8PM. BODIES : SS-QTB-8-8PM. OR EQUAL.
 - FOR OPERATING PRESSURE UNDER 125 barg (125 Kg/cm², 1800 psiG). USE SWAGELOCK QUICK CONNECTS. STEMS : SS-QTB-5-8PM. BODIES : SS-QTB-8-8PM. OR EQUAL.
- DCN-002**
- NRV TO BE PROVIDED FOR VENT TO FLARE LINES.
 - FOR CAUSTIC SERVICE, USE PLUG VALVE INSTEAD OF GATE VALVES.


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संख्या	तिथि	संशोधन	ड्राफ्ट	जांच	अनुमोदन	
No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.

**इंजिनियर्स
इंडिया लिमिटेड**
(भारत सरकार का उपक्रम)

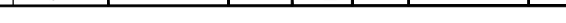
**ENGINEERS
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**इंडियन ऑयल कॉर्पोरेशन लिमिटेड
INDIAN OIL CORPORATION LTD.**
P-25 PROJECT

**पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम
PIPING AND INSTRUMENTATION DIAGRAM
GENERAL NOTES AND TYPICAL DETAILS**
(SHT. 2 OF 4)

अनुभाग SCALE	कार्य संख्या JOB NO.	विभाग DEPT.	अनुभाग SECTN.	इकाई UNIT	आवृत्ति संख्या DWG. No.	संशोधन REV.
	B269	02	42	00	1192	1

DCN-002



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LEVEL INSTRUMENT PIPING ASSEMBLIES VENT AND DRAIN SYSTEMS (NOTE-2,3,4)

NOTES:—

1. FOR P&ID LEGEND, ABBREVIATIONS AND DETAILS REFER DWG. NO. B269-02-42-00-1191/1192.
2. THIS IS A TYPICAL LEVEL INSTRUMENT/STAND PIPE. LG/LT MAY BE DIRECTLY MOUNTED OR VESSEL/COLUMN. STAND PIPE DIRECTLY MOUNTED ON VESSEL.
3. ACTUAL NO. OF INSTRUMENTS (LG/LT) AND STAND PIPE SHALL BE BASED ON INSTRUMENTATION INPUT (LEVEL SKETCHES).
4. PIPING TO GROUP AND ROUTE LEVEL INSTRUMENTS DRAIN SUITABLY.
5. CONNECTION FROM ALL DRAIN TO BE MADE FROM TOP OF MAIN BLOW DOWN HEADER.
6. LOCATE CHECK VALVE AT HIGHEST POINT IN HORIZONTAL RUN.
7. MAKE CONNECTION ON TOP OF THE PIPE AT 45° ANGLE IN DIRECTION OF FLOW.
8. REFER LEVEL SKETCH FOR LG/LT PMS.
9. FOR dp TYPE LEVEL INSTRUMENT ONE NUMBER OF VENT AND ONE NUMBER OF DRAIN CONNECTION TO BE PROVIDED FOR EACH LEG.
10. SLPOE OF 1:500 TO BE CONSIDERED FOR FREE DRAINING.
11. FOR 600# : DOUBLE ISOLATION TO BE PROVIDED FOR CONTROL VALVES, SAFETY VALVES (ALONG WITH VENT AND DRAIN) FOR STEAM SERVICE ONLY. APART FROM THAT, LICENSOR'S PROCESS PHILOSOPHY TO BE FOLLOWED.
12. FOR 900# AND ABOVE : DOUBLE ISOLATION TO BE PROVIDED FOR CONTROL VALVES, SAFETY VALVES (ALONG WITH VENT & DRAIN) FOR ALL SERVICES.

13. ALL VENTS TO BE CONNECTED TO TOP OF LTBD HEADER

DCN-002

DCN-002

FOR DCN NO. B269-999-02-42-DCN-002

0	28.09.19	ISSUED FOR ENGINEERING	NS	AR	RA	MSM
संख्या	तिथि	संशोधन	ड्राईन	द्वारा	जाँच	अनुमोदित
No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.

इंजिनियर्स
इंडिया लिमिटेड
(भारत सरकार का उपक्रम)

ENGINEERS
INDIA LIMITED
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इंडियन ऑयल कॉर्पोरेशन लिमिटेड
INDIAN OIL CORPORATION LTD.

P-25 PROJECT

पाइपिंग एण्ड इंस्ट्रुमेंटेशन डायग्राम
PIPING AND INSTRUMENTATION DIAGRAM

LEVEL INSTRUMENTS PIPING ASSEMBLIES VENT AND DRAIN SYSTEMS

(SHT. 4 OF 4)

अनुमाप	कार्य संख्या	विभाग	अनुभाग	इकाई	आरेख संख्या	संशोधन
SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV.
1	B269	02	42	00	1192	0

TECHNICAL AMENDMENT NO.; B269-475-02-42-TA-01
TO
TENDER NO.; SG/B269-475-PA-T-8701/23
FOR
RWTP, RO-DMP, CPU & ZLD Plant
(PROJECT: PANIPAT REFINERY EXPANSION PROJECT (P-25))

09-03-2022	Issued as amendment to tender	ANT	KV	KV
Date	Purpose	Prepared By	Reviewed By	Approved By

SUBJECT : TECHNICAL AMENDMENT
BID DOC NO. : SG/B269-475-PA-T-8701/23
SERVICE : RWTP, RO-DMP, CPU & ZLD Plant for Panipat Refinery Expansion Project (P25)

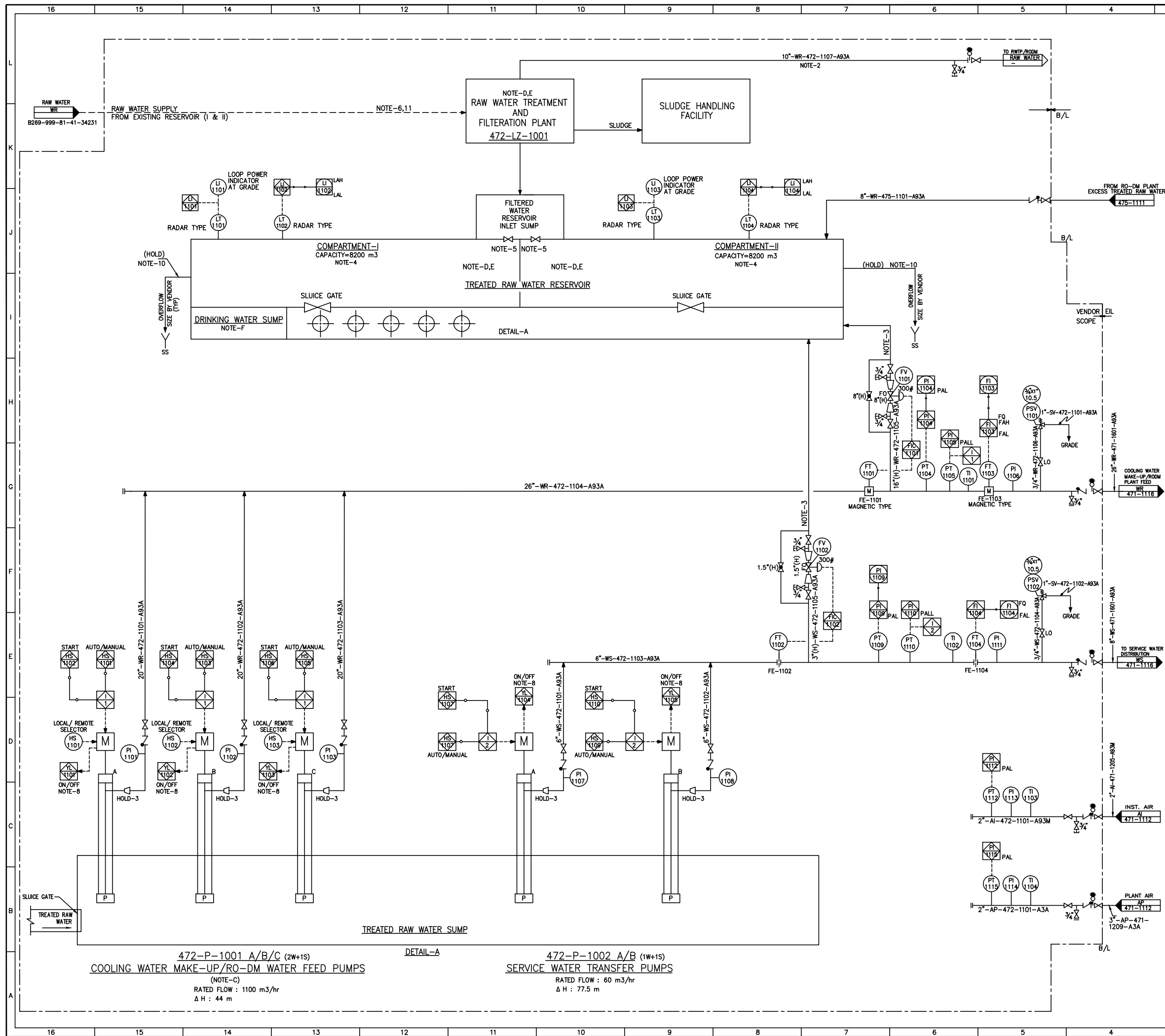
The terms& conditions of **Tender # SG/B269-475-PB-T-8701/23** stand modified to the extent indicated under column “MODIFICATIONS/ ADDITIONS/ DELETIONS”. All other terms & conditions etc. of Tender issued earlier shall remain unaltered.

Sl. No.	Section no.	Document no.	Page No.	Clause / Item No.	Modifications/Additions/Deletions
1.	Data sheets for RODM Plant	B269-475-02-42-1701	1987		<u>ADDITION</u> Inclusion of RODM Storage tank data sheet.
2.	characteristics of feed condensate	B269-476-02-DS-1901	2308		<u>MODIFICATION</u> Feed Condensate Quality updated and Note-20 updated in the CPU process data sheet
3.	characteristics of feed condensate & Operating Condn of Pure condensate	B269-081-02-DS-1901	2326		<u>MODIFICATION</u> Pure condensate operating & design conditions deleted and Note-14 updated in the CPU process data sheet
4.	Heat Exchanger process data sheet	B269-081-02-DS-1401 & B269-081-02-DS-1402	2329		<u>MODIFICATION</u> Suspect & Pure condensate inlet and outlet temp updated and Check case was deleted.
5.	RODM system P&ID	B269-02-42-475-1111	2518		<u>MODIFICATION</u> Treated effluent line size to RODM plant was updated & treated raw water line to RWTP reservoir deleted from the P&ID. Affected instrument data sheets and line schedule are updated.
6.	Raw water system P&ID	B269-02-42-472-1111	1983		<u>ADDITION</u> Inclusion of Raw water system P&ID

Enclosures:

1. New document Raw water P&ID B269-02-42-472-1111.
2. Updated RODM P&ID B269-02-42-475-1111.
3. Updated Exchanger data sheet - B269-081-02-DS-1401 & 1402.
4. Updated Condensate Polishing unit PDS - B269-476-02-DS-1901 & B269-081-02-DS-1901
5. Updated RODM storage tank data sheet - B269-475-02-42-1701
6. Updated RODM instrument data sheet – B269-475-02-DS-2011, B269-475-02-DS-2111, B269-475-02-DS-2311
7. Updated RODM Line schedule - B269-475-02-LS-1111

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GENERAL NOTES:

- UNIT NO. 472 TO BE PREFIXED TO ALL INSTRUMENTS TAG NOS.
- FOR STANDARD SYMBOLS & NOMENCLATURE REFER DWG. NO. B269-02-42-00-1191/1192.
- FOR DETAILS OF PUMP VENT & DRAIN REFER DWG. NO: B269-02-42-00-1192.
- DETAILS OF RAW WATER STORAGE & TREATMENT ARE COVERED SEPARATELY IN OTHER DOCUMENT.
- DETAILS SHOWN ARE PRELIMINARY AND TO BE DEVELOPED FURTHER BY CONTRACTOR.
- FOR DRINKING WATER PUMPING SYSTEM DETAILS, REFER VENDOR DOCUMENT.
- COMPLETE CONTROL, MONITORING AND INTERLOCK SHALL BE REALIZED IN PACKAGE VENDOR SUPPLIED DEDICATED PLC SYSTEM LOCATED AT CR-112A AND HOWEVER ALL THE SIGNALS SHALL BE MAPPED TO CENTRALIZED PURCHASER'S DCS SYSTEM.

NOTES:

- TAP OFF FOR SERVICE WATER HOSE STATIONS SHALL BE TAKEN INTERNALLY.
- PROVISION TO ROUTE FILTER BACKWASH, CLARIFIED WATER FROM SLUDGE TREATMENT SYSTEM AND OTHER RWTP DRAINS (AS SPECIFIED IN SCOPE OF WORK DOCUMENT) TO INLET RWTP/ROOM PLANT.
- PUMP MINIMUM FLOW CIRCULATION LINES MAY BE ROUTED TO TOP OF SUMP.
- TOTAL CAPACITY OF 8 HOURS FOR BOTH COMPARTMENTS I&II OF FILTERED WATER RESERVOIR SHALL BE NET CAPACITY EXCLUDING OF DEAD VOLUME (i.e. ON NET PUMPABLE BASIS).
- BOTH LINES TO BE SIZED FOR TOTAL FLOW FROM RAW WATER TREATMENT & FILTRATION PLANT. IF FILTERED WATER RESERVOIR IS CONNECTED WITH RAW WATER TREATMENT PLANT THROUGH CONCRETE CHANNEL, SLUICE GATE INSTEAD OF GATE VALVE SHALL BE PROVIDED.
- FLOW MEASUREMENT / INTEGRATION INDICATION ON RAW WATER FEED LINE TO RWTP SHALL ALSO BE REPEATED IN MASTER CONTROL ROOM.
- NO. AND LOCATION OF HOSE STATION TO BE FIRMED-UP DURING DETAIL ENGINEERING.
- RUNNING INDICATION SHALL BE PROVIDED IN PACKAGE SYSTEM.
- RAW WATER TREATMENT PLANT SHALL ALSO HAVE DRINKING WATER TREATMENT SECTIONS.
- NO. OF OVERFLOW CONNECTIONS IN EACH COMPARTMENT SHALL BE CONFIRMED DURING DETAIL ENGINEERING.
- TO MEET THE REQUIRED RAW WATER STORAGE CAPACITY FOR P-25 PROJECT EXISTING RESERVOIR'S (I&II) SHALL BE AUGMENTED.
- FIRE WATER MAKE UP LINE SHALL BE CONSIDERED FROM COOLING WATER MAKE UP HEADER IN OSBL.
- COMMON CHEMICAL SLUDGE HANDLING FACILITY SHALL BE CONSIDERED FOR THE WATER BLOCK PACKAGE.

HOLD LIST:

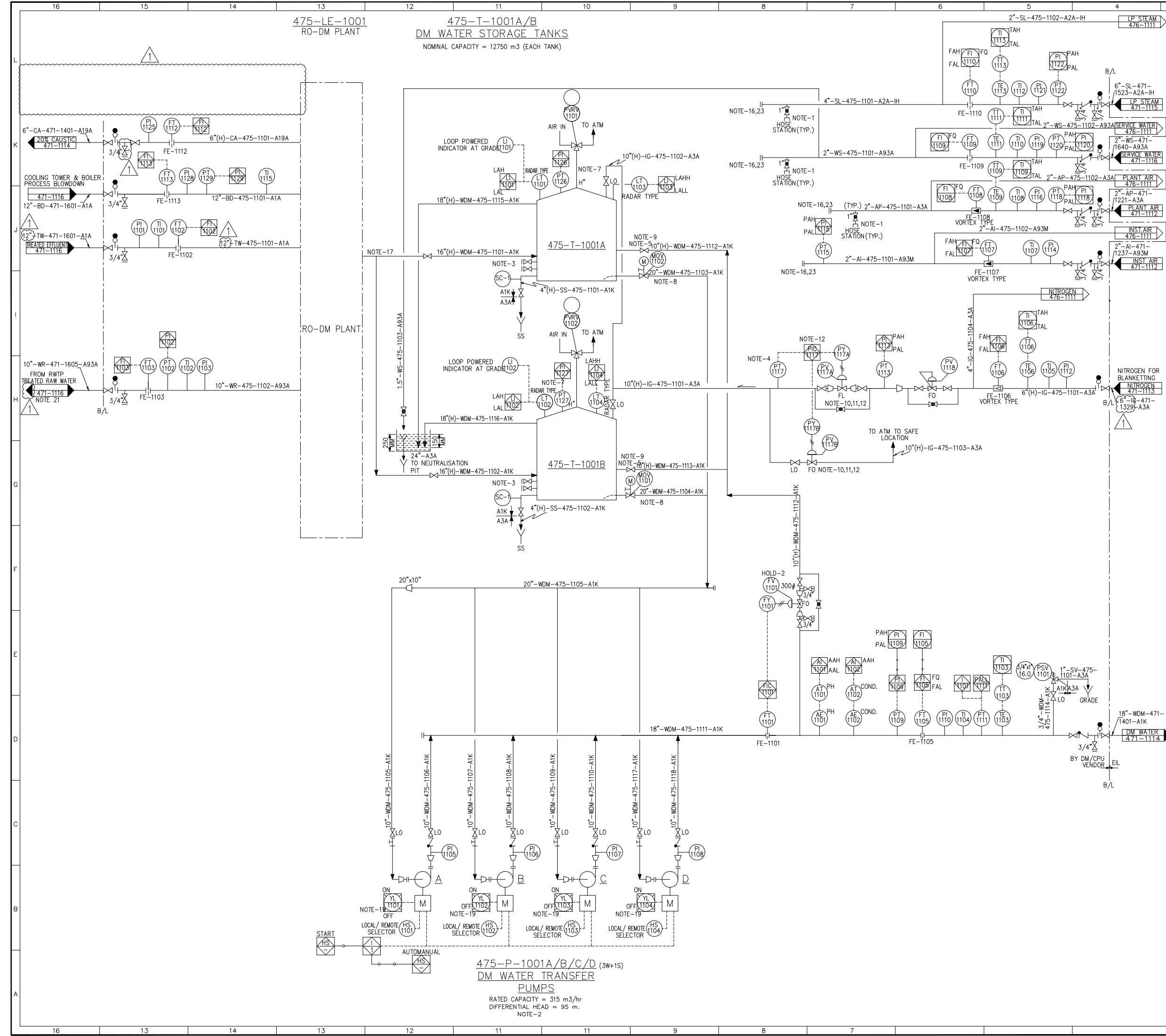
- DELETED.
- DELETED.
- PUMP NOZZLE SIZE.

O 15.04.21 ISSUED FOR ENGINEERING		OK	MS	ANT	KV	
C 26.08.20 REVISED FOR PACKAGE		BSR	ANT	KV	KV	
B 04.06.20 ISSUED FOR PACKAGE		NS	ANT	PV	KV	
A 20.03.20 ISSUED FOR COMMENTS		NS	ANT	PV	KV	
संख्या	तिथि	संशोधन	ड्राई	ड्राई	ड्राई	ड्राई
No.	DATE	REVISIONS	DRN	BY	CHKD	APPD.
<div>इंजिनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम)</div> <div>ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)</div> <div>इंडियन ऑयल कॉर्पोरेशन लिमिटेड INDIAN OIL CORPORATION LIMITED PANIPAT REFINERY EXPANSION (P-25) PROJECT</div> <div>पाइपिंग रण्ड इंस्ट्रुमेंटेशन डायग्राम PIPING AND INSTRUMENTATION DIAGRAM RAW WATER SYSTEM COOLING WATER MAKE-UP AND DM PLANT FEED PUMPS</div>						
अनुमान	कार्य संख्या	विभाग	अनुभाग	इकाई	आरेख संख्या	संशोध
SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV.
	B269	02	42	472	1111	0

EIL-0241-502-REV-0-A

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3		2		1					
GENERAL NOTES:									
A. UNIT NO-475 TO BE ADDED AS PREFIX TO ALL INSTRUMENT TAG NOS									
B. FOR STANDARD SYMBOLS & NOMENCLATURE REFER DWG. NO. B269-02-42-00-1191/1192.									
C. FOR DETAILS OF PUMP VENT & DRAIN REFER DWG. NO.-B269-02-42-00-1192.									
D. ** MARKED SIGNALS CONNECTION WITH RO-DM PACKAGE PLC SYSTEM WILL BE REPEATED ON OWNER'S DCS-SYSTEM THROUGH SOFT LINKS.									
NOTES:									
1. NO. AND LOCATION OF HOSE STATION TO BE FIRMED UP DURING DETAIL ENGINEERING.									
2. ALL DM WATER PUMPS SHALL HAVE PROVISION FOR EMERGENCY POWER, HOWEVER FOR LOAD ESTIMATION PURPOSE ONLY ONE PUMP LOAD SHALL BE CONSIDERED AT A TIME.									
3. DM WATER LINE FOR REGENERATION PURPOSE NOT SHOWN IN P&ID. VENDOR TO TAKE SUITABLE CONNECTION FROM TANK FOR REGENERATION.									
4. PT-1117 TO BE LOCATED CLOSE TO DM TANKS.									
5. LOCATE CLOSE TO TANK.									
6. MORPHOLINE DOSING FACILITY TO BE CONSIDERED BY VENDOR FOR EACH DM TANK IF REQUIRED.									
7. PRESSURE TRANSMITTER TO BE INSTALLED AWAY FROM THE NITROGEN INLET NOZZLE.									
8. ONE OF THE TWO VALVES SHALL BE KEPT OPEN AT ALL TIME.									
9. ISOLATION VALVE ON MINIMUM FLOW CIRCULATION CORRESPONDING TO ON LINE TANK SHALL BE KEPT OPEN WHEN THE PUMP IS TAKING SUCTION FROM SAME. ISOLATION VALVE ON MINIMUM FLOW LINE CORRESPONDING TO OTHER TANK SHALL BE KEPT CLOSED.									
10. CONTROL VALVE IN NITROGEN LINE SHALL BE FISHER CONTROL ASSEMBLY OR EQUIVALENT.									
11. PIPING DOWN STREAM OF N2 CONTROL VALVE SHALL BE FREE DRAINING TOWARDS BOTH TANK.									
12. PIC SPLIT CONTROL ACTION AS FOLLOWS.									
a. VENT VALVE WILL BE OPEN WHEN PRESSURE GOES BEYOND 80 mm WC IN THE TANK.									
b. NITROGEN INTAKE VALVE WILL BE OPEN WHEN PRESSURE FALLS BELOW 30 mm WC IN THE TANK.									
13. ALL ISOLATION VALVES IN CAUSTIC SERVICE TO BE PLUG VALVE TYPE.									
14. SAFETY SHOWER EYE WASH AND DRINKING WATER TO BE PROVIDED NEAR CAUSTIC/HCL HANDLING AREA.									
15. CAUSTIC/HCL REQUIREMENT FOR CPU SHALL BE MET FROM DM PLANT.									
16. VARIOUS UTILITIES FOR RO/DM PLANT.									
17. SILICA CONDUCTIVITY & PH ANALYSER WITH HIGH ALARM AND CONTROL ROOM INDICATION (FOR PH BOTH HIGH & LOW ALARM) SHALL BE PROVIDED IN THE COMMON HEADER LINE FROM RO-DM PLANT TO DM WATER STORAGE TANKS.									
18. UNLOADING/FITTING/INSTUMENT/HOSE CONNECTION FOR CHEMICAL HANDLING ARE IN VENDOR'S SCOPE OF SUPPLY.									
19. RUNNING INDICATION SHALL BE PROVIDE BOTH IN PLACES.									
20. ALL LINE SIZES SHOWN ARE MINIMUM REQUIREMENT. INCREASE IN LINE SIZE IS ACCEPTABLE. HOWEVER NO FURTHER DECREASE SHALL BE DONE.									
21. IN CASE OF START-UP/EFFLUENT FAILURE (OR) NON-AVAILABILITY, A BACKUP OF 514 (m3/hr) OF TREATED RAW WATER IS KEPT FOR DM WATER GENERATION.									
22. DM TANK WATER SEAL DRAIN TO BE ROUTED TO BACK WASH SUMP IN RO-DM PLANT.									
23. ALL UTILITY LINES SHOWN ARE PRELIMINARY. ROUTING INSIDE THE PACKAGE FOR ALL DESTINATION ARE BY PACKAGE VENDOR SCOPE.									
HOLD LIST:									
1. DELETED.									
2. CONTROL VALVE SIZE.									
3. PUMP NOZZLE SIZE.									
1									
1		09.03.22		RE-ISSUED FOR ENGINEERING		KS	ANT	KV	KV
O		06.05.21		ISSUED FOR ENGINEERING		DK	MS	ANT	KV
C		05.08.20		RE-ISSUED FOR PACKAGE		BSR	ANT	KV	KV
B		15.05.20		ISSUED FOR PACKAGE		NS	ANT	PV	KV
A		20.03.20		ISSUED FOR COMMENTS		NS	ANT	PV	KV
संख्या	तिथि	संशोधन				ड्रॉन	ड्राफ्ट	जॉय	अनुमोदित
No.	DATE	REVISIONS				DRN	BY	CHKD	APPD.
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ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)									
इंडियन ऑयल कॉर्पोरेशन लिमिटेड INDIAN OIL CORPORATION LIMITED PANIPAT REFINERY EXPANSION (P-25) PROJECT									
पाइपिंग रण्ड इंस्ट्रुमेंटेशन डायग्राम PIPING AND INSTRUMENTATION DIAGRAM									
RO-DM WATER STORAGE AND SUPPLY									
अनुमाप	कार्य संख्या	विभाग	अनुभाग	इकाई	आरेख संख्या	संशोधन			
SCALE	JOB NO.	DEPT.	SECTN.	UNIT	DWG. No.	REV.			
	B269	02	42	475	1111	1			


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				Rev. No. 0 Page 1 of 4	
PROJECT	P-25 PROJECT		CLIENT	IOCL PANIPAT	
UNIT	CONDENSATE POLISHING UNIT		JOB NO.	B269	UNIT NO. 476
ITEM NO.	476-LF-1001		SERVICE	CONDENSATE SYSTEM	
1	ITEM NO.	:	476-LF-1001		
2	SERVICE	:	POLISHING OF STEAM CONDENSATE RETURN FROM PROCESS UNITS.		
3	LOCATION	:	IN UTILITY AREA		
4	TYPE	:	ION EXCHANGE		
5	NO. OF CHAINS	:	THREE (ONE OPERATING + ONE IN REGENERATION + ONE OPERATING FOR FUTURE ALKYLATION)		
			ONE TRAIN FOR ALKYLATION UNIT TO BE INSTALLED IN FUTURE. (NOTE 26)		
6	CAPACITY OF EACH CHAIN :	140	M3/ HR (NET OUTPUT)		
	TURN DOWN	:	50%		
7	INLET CONDITION OF CONDENSATE @ CPU B/L :				
			SUSPECT	PURE	
	OPERATING PRESSURE	KG/CM2 G MIN/NOR	3.5	3.5	
	OPERATING TEMPERATURE	° C	90	90	
8	DESIGN CONDITION OF UNPOLISHED CONDENSATE :				
			SUSPECT	PURE	
	PRESSURE	KG/CM2 G	:	14.0	14.0
	TEMPERATURE	° C	:	150	150
9	OUTLET CONDITION OF POLISHED CONDENSATE @ PACKAGE B/L :				
	PRESSURE	KG/CM2 G	:	7	
	TEMPERATURE	° C	:	65	(NOTE-7)
10	DESIGN OUTLET CONDITION				
	PRESSURE	KG/CM2 G	:	16 (HOLD)	
	TEMPERATURE	° C	:	120	
11	REGENERATION CYCLE TIME	:	ONCE IN THREE DAYS FOR MB EXCHANGERS FOR A MAXIMUM PERIOD OF 4 HOURS		
12	TYPE OF TREATMENT	:	EACH CPU CHAIN TO HAVE OIL COALESCER, ACTIVATED CARBON FILTER AND ION EXCHANGE BED TO MAKE CONDENSATE SUITABLE FOR REPLACEMENT WITH DM WATER. (ONE SET OF OIL COALESCER AND ACTIVATED CARBON FILTER FOR ALKYLATION UNIT SHALL BE INSTALLED IN FUTURE ALONG WITH FUTURE ION EXCHANGE BED). (NOTE 26, 27)		
13	CHARACTERISTICS OF FEED CONDENSATE :				
	CONSTITUENTS		SPECIFICATIONS		
		NORMAL	DESIGN		
	p H	8.5-9.5	8.5-9.5		
	Ammonia as NH ₃ , ppm	0.06-1.3	0.06-1.3		
	Total dissolved solids, ppb	270	2175		
	Sodium as Na, ppb	40	295		
	Calcium as CaCO ₃ , ppb	55	560		
	Magnesium as CaCO ₃ , ppb	35	285		
	Chloride as Cl, ppb	35	255		
	Sulphate as SO ₄ , ppb	80	745		
	Silica (Total) as SiO ₂ , ppb	30	185		
	Colloidal Silica as SiO ₂ , ppm				
	Iron (Total) as Fe, ppb	20	20		
	Copper as Cu, ppm	0.1	0.1		
	Oil contents, ppm	10	10		
	Alkalinity, ppb	10-20	20(max)		
	KMnO ₄ value @ 100 deg.C, ppb	10000	15000(max)		
	Turbidity, NTU	NIL	1(max)		
	TSS, ppm	NIL	1(max)		
0	09-03-2022	ISSUED FOR ENGINEERING	ANT	KV	KV
B	08.05.2020	ISSUED FOR PACKAGE	PS	PV	KV
A	18.03.2020	ISSUED FOR COMMENTS	PS	PV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

 ENGINEERS INDIA LIMITED <small>(A Govt. of India Undertaking)</small>		CONDENSATE POLISHING UNIT PROCESS DATA SHEET		Document No. B269-476-02-DS-1901 Rev. No. 0 Page 2 of 4	
PROJECT	P-25 PROJECT		CLIENT	IOCL PANIPAT	
UNIT	CONDENSATE POLISHING UNIT		JOB NO.	B269	UNIT NO. 476
ITEM NO.	476-LF-1001		SERVICE	CONDENSATE SYSTEM	
14 CHARACTERISTICS OF POLISHED CONDENSATE					
	CONSTITUENTS		SPECIFICATIONS		
	pH		6.7-7.3		
	Conductivity at 20 oC, umho/cm		<0.2		
	Total Dissolved Solids (TDS), ppm		<0.1		
	Total hardness as CaCO ₃ , ppm		Nil		
	Total Reactive Silica as SiO ₂ , ppm		<0.02		
	Turbidity, NTU		Nil		
	Total Chlorides as Cl, ppm		Nil		
	Total Iron as Fe, ppm		<0.01		
	Total Copper as Cu, ppm		<0.003		
	Oil content, ppm		Nil		
	KMnO ₄ Consumption @ 100 °C, ppm		<1		
	Na + K as Na, ppm		<0.01		
	Total Suspended Solids, ppm		Nil		
15 MODE OF OPERATION: CPU SHALL HAVE PLC BASED AUTOMATIC CONTROL SYSTEM FOR REGENERATION. REGENERATION SYSTEM TO BE INITIATED MANUALLY BY PUSH BUTTON. PLANT SHALL HAVE PROVISION FOR MANUAL OPERATION.					
16 DESIGN SPECIFICATIONS : BROADLY, THE PLANT WILL CONSIST OF THE FOLLOWING :					
a) FEED CONDENSATE / POLISHED CONDENSATE EXCHANGER (NOTE-7,8)					
b) FEED CONDENSATE TRIM COOLER (NOTE-8)					
c) TWO FEED TANKS FOR UNPOLISHED CONDENSATE (UPSTREAM OF POLISHER) STORAGE EACH OF 5700 M3 NOMINAL CAPACITY TO BE PROVIDED. THIS IS BASED ON SUSPECT CONDENSATE + ONE LARGEST PURE CONDENSATE (IF CONTAMINATED) AT THE RATE OF 375 M3/HR (INCLUDING FUTURE ALKYLATION) FOR 12 HRS CONSIDERING ABOUT 80 % FILLING.					
d) TWO UNPOLISHED CONDENSATE FEED PUMPS (1 OPERATING + 1 STAND-BY) EACH OF 140 M3/HR RATED CAPACITY. ONE OPERATING PUMP OF SIMILAR CAPACITY TO BE INSTALLED FOR ALKYLATION UNIT IN FUTURE (NOTE-16, 26)					
e) EACH CHAIN SHALL COMPRISE OF OIL COALESCER (ONE PER CHAIN), ACTIVATED CARBON FILTER IN SERIES (PRIMARY AND SECONDARY- 2 OPERATING + 1 STANDBY), FOLLOWED BY MIXED BED (MB) (2 OPERATING + 1 STAND-BY) (NOTE 26)					
f) TWO TANKS FOR POLISHED CONDENSATE STORAGE EACH OF 6555 M3 NOMINAL CAPACITY.					
g) THREE POLISHED CONDENSATE PUMPS (2 OPERATING + 1 STANDBY) FOR TRANSFERING THE POLISHED CONDENSATE AS PER CONDITION GIVEN IN POINT NO. 9 ABOVE. RATED CAPACITY OF EACH PUMP SHALL BE 160 M3/HR. (ONE OPERATING PUMP OF SIMILAR CAPACITY SHALL BE INSTALLED FOR FUTURE ALKYLATION UNIT). (NOTE 26)					
17 REGENERATION CHEMICALS AND REGENERATION FACILITY :					
MB WILL BE REGENERATED WITH NaOH AS WELL AS WITH HCL. REGENERATION OF ACF SHALL BE DONE BY BACK WASHING WITH POLISHED CONDENSATE OR DM WATER. ALL FACILITIES REQUIRED FOR REGENERATION SHALL BE CONSIDERED. STORAGE CHEMICALS FOR REGENERATION SHALL BE COMMON WITH DM PLANT					
18 EFFLUENT TREATMENT :					
THE BACKWASH WASTE FROM ACF SHALL BE ROUTED TO BACKWASH WASTE SUMP IN RODM AND REGENERATION WASTE FROM MB SHALL BE ROUTED TO HRSCC-2 IN RODM PLANT FOR FURTHER PROCESSING.					
19 PROVISION SHALL BE PROVIDED FOR ROUTING OFFSPEC. CONDENSATE FROM CPU TO UNPOLISHED CONDENSATE TANKS AS WELL AS TO OWS.					
20 PACKAGE VENDOR TO PROVIDE THE MIN FLOW BYPASS LINE WITH CONTROL VALVE FOR BOTH UNPOLISHED AND POLISHED CONDENSATE PUMPS IN ORDER TO REGULATE THE FLOW OF CONDENSATE (TO DEAERATOR) BASED ON INCOMING FLOW OF UNPOLISHED CONDENSATE AND FOR PUMP PROTECTION. SUITABLE CONTROL TO BE PROVIDED FOR THE ABOVE.					
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
0	09-03-2022	ISSUED FOR ENGINEERING	ANT	KV	KV
B	08.05.2020	ISSUED FOR PACKAGE	PS	PV	KV
A	18.03.2020	ISSUED FOR COMMENTS	PS	PV	KV

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(A Govt. of India Undertaking)

CONDENSATE POLISHING UNIT

PROCESS DATA SHEET

Document No.

B269-81-02-DS-1901

Rev. No.

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of

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PROJECT	P-25 PROJECT		CLIENT	IOCL PANIPAT	
UNIT	NEW CPU (PNCP AREA)		JOB NO.	B269	UNIT NO. 81
ITEM NO.	81-LF-1001		SERVICE	CONDENSATE SYSTEM	
1	ITEM NO.	:	81-LF-1001		
2	SERVICE	:	POLISHING OF STEAM CONDENSATE RETURN FROM PROCESS UNITS.		
3	LOCATION	:	IN EXISTING PNCP UTILITY AREA		
4	TYPE	:	ION EXCHANGE		
5	NO. OF CHAINS	:	TWO		
6	CAPACITY OF EACH CHAIN :	50	M3/ HR (FEED INLET)		
	TURN DOWN	:	50%		
7	INLET CONDITION OF CONDENSATE @ CPU B/L :				
	SUSPECT				
	OPERATING PRESSURE	KG/CM2 G MIN/NOR	2.0		
	OPERATING TEMPERATURE	° C	90		
8	DESIGN CONDITION OF UNPOLISHED CONDENSATE :				
	SUSPECT				
	PRESSURE	KG/CM2 G	:	10	
	TEMPERATURE	° C	:	150	
9	OUTLET CONDITION OF POLISHED CONDENSATE @ PACKAGE B/L :				
	PR (NOR/MAX)	KG/CM2 G	:	8 /8	
	TEMP (NOR/MAX)	° C	:	'40-90 / 110	
10	DESIGN OUTLET CONDITION				
	PRESSURE	KG/CM2 G	:	15	
	TEMPERATURE	° C	:	150	
11	REGENERATION CYCLE TIME	:	ONCE IN THREE DAYS FOR MB EXCHANGERS FOR A MAXIMUM PERIOD OF 4 HOURS		
12	TYPE OF TREATMENT	:	EACH CPU CHAIN TO HAVE ACTIVATED CARBON FILTER (ACF) AND ION EXCHANGE BED TO MAKE CONDENSATE AS PER POLISHED CONDENSATE QUALITY		
13	CHARACTERISTICS OF FEED CONDENSATE :				
	CONSTITUENTS		SPECIFICATIONS		
		NORMAL		DESIGN	
	p H	8.5-9.5		8.5-9.5	
	Turbidity, NTU			1.0 (MAX.)	
	Ammonia as NH3, ppm	0.06-1.3		0.06-1.3	
	Total dissolved solids, ppb	270		2175	
	Sodium as Na , ppb	40		295	
	Calcium as CaCO3 , ppb	55		560	
	Magnesium as CaCO3, ppb	35		285	
	Chloride as Cl, ppb	35		255	
	Sulphate as SO4, ppb	80		745	
	Silica (Total) as SiO2, ppb	30		185 (REACTIVE SILICA)	
	Iron (Total) as Fe, ppb	20		20	
	Copper as Cu, ppm	0.1		0.1	
	Oil contents , ppm	2 TO 5		10	
	Alkalinity , ppm			3.0-7.0	
	KMnO4 value @ 100 deg.C, ppm			10(max)	
	TSS, ppm			1 (MAX)	
	M-alkalinity as CaCO3, ppm			3	
1	09-03-2022	RE-ISSUED FOR ENGINEERING	ANT	KV	KV
0	01.06.2021	ISSUED FOR ENGG	ANT	KV	KV
B	23.05.2021	RE-ISSUED FOR COMMENTS	ANT	KV	KV
A	17.04.2021	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

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PROJECT	P-25 PROJECT	CLIENT	IOCL PANIPAT	Page 6 of 6	
UNIT	NEW CPU (PNCP AREA)	JOB NO.	B269	UNIT NO.	81
ITEM NO.	81-LF-1001	SERVICE	CONDENSATE SYSTEM		
NOTES :					
1. THIS NEW CPU IS COMING UNDER EXISTING AREA AND EXISTING FACILITIES ARE TO BE UTILIZED, CPU VENDOR TO CHECK THE TIE-IN REQUIREMENT, ADEQUACY OF EXISTING FACILITIES .					
2. UTILITY CONSUMPTION TO BE PROVIDED BY CPU PACKAGE VENDOR.					
3. FOR HCL SERVICE ULTRA VIOLET RESISTANT PVC OR BETTER MATERIAL FOR PIPING TO BE USED.					
4. CPU PACKAGE VENDOR TO PROVIDE B/L ISOLATION VALVES ON ALL INCOMING / OUTGOING LINES.					
5. ALL CS MATERIAL IN CAUSTIC SERVICE SHALL BE PWHT.					
6. SINCE EXISTING FEED / POLISHED CONDENSATE EXCHANGER & TRIM COOLER ARE DESIGNED FOR MAXIMUM FLOW OF OF ABOUT 130 M3/HR. THE NEW FEED / POLISHED CONDENSATE & TRIM COOLER SHALL BE DESIGNED FOR FLOW 65 M3/HR (TO BE DISCUSSED WITH IOCL).					
7. EXCHANGER / COOLER DESIGN SHALL BE IN PACKAGE VENDOR SCOPE. HOWEVER FEED / POLISHED CONDENSATE EXCHANGER AND TRIM COOLER SHALL BE OF PLATE TYPE HEAT EXCHANGER AND MOC SHALL BE SS316.					
8. CPU PACKAGE VENDOR TO PROVIDE RECORDERS & ALARMS (ON DCS) FOR pH, OIL CONTENT, SILICA AND CONDUCTIVITY ON THE POLISHED CONDENSATE. THE DCS INSTRUMENTS SHALL BE CONNECTED TO MCR.					
9. POLISHED CONDENSATE PUMPS SHALL BE PROVIDED WITH AUTO-START FACILITY. PUMP SHALL START BASED ON ACTUATING INTERLOCKS THROUGH PRESSURE TRANSMITTERS. PUMP MOTORS TO BE SIZED FOR END OF THE CURVE.					
10. MOC FOR BOTH UNPOLISHED / POLISHED CONDENSATE TRANSFER PUMPS SHALL AS FOLLOWS:					
CASING & IMPELLER : SS-304L, SEAL TYPE : MECHANICAL.					
11. PRESSURE DROP IN COOLING WATER SIDE WITH IN VENDOR PACKAGE BATTERY LIMIT SHALL NOT EXCEED 1.5 KG/CM2 INCLUSIVE OF LINE LOSS, EXCHANGER LOSS, METERING LOSS ETC.					
12. IN CASE CPU TURNDOWN UPTO 50% IS NOT POSSIBLE, VENDOR MAY CONSIDER ARRANGEMENT FOR CONDENSATE RECYCLE TO ACHIEVE SPECIFIED TURNDOWN					
13. MIXED BED SHALL BE DESIGNED TO TOLERATE HYDROCARBON UPTO 0.5 PPM AS TOC.					
14. ONLINE OIL IN WATER ANALYSER (HC) , PH, CONDUCTIVITY AND SILICA ANALYZERS TO BE INSTALLED IN FEED CONDENSATE LINE.					
15. SYSTEM HYDRAULIC DESIGN FOR CPU WILL BE SUCH THAT IT IS POSSIBLE TO RUN BOTH THE CHAINS SIMULTANEOUSLY AT DESIGN CAPACITY.					
16 FACILITY WILL BE PROVIDED WITHIN CONDENSATE POLISHING UNIT FOR TRANSFERING OFF SPEC MATERIAL FROM POLISHED CONDENSATE TANKS BACK TO CPU FEED TANKS.					
17. NECESSARY DOSING TO MAINTAIN POLISHED CONDENSATE QUALITY TO BE PROVIDED					
18. BY-PASS PROVISION SHALL BE CONSIDERED IN TRIM COOLER IN CASE OF EXCESSIVE COOLING WATER.					
19. SUFFICIENT SAMPLING POINTS FOR SAMPLING UNPOLISHED AND POLISHED CONDENSATES SHALL BE PROVIDED.					
20. ACTIVATED CARBON FILTERS SHALL BE TWO NOS. IN SERIES PER CHAIN (PRIMARY AND SECONDARY ACF).					
I	09-03-2022	RE-ISSUED FOR ENGINEERING	ANT	KV	KV
O	01.06.2021	ISSUED FOR ENGG	ANT	KV	KV
B	23.05.2021	RE-ISSUED FOR COMMENTS	ANT	KV	KV
A	17.04.2021	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

 ENGINEERS INDIA LIMITED <small>(A Govt. of India Undertaking)</small>		STORAGE TANK PROCESS DATA SHEET		Document No. B269-475-02-42-DS-1701				
PROJECT P 25 PROJECT		CLIENT IOCL, PANIPAT		Rev. No. D				
UNIT DM WATER SYSTEM		JOB NO. B269		Page 1 of 3				
ITEM NO. 475-T-1001A/B		SERVICE DM WATER		UNIT NO. 475				
TYPE FIXED ROOF								
FLUID HANDLED DM WATER								
PROCESS DATA								
NOMINAL CAPACITY		M3	12750					
LIQUID STORED		M3	10800					
STORAGE TEMPERATURE		DEG C	AMB.					
STORAGE PRESSURE								
POSITIVE PRESSURE		KG/CM2G	FULL OF LIQUID + 50 MMWC					
VACUUM PRESSURE		MMWC	NIL					
FLUID PROPERTIES @OPERATING P & T								
LIQUID DENSITY		KG/M3	993					
VISCOSITY		CP	0.65-1.0					
FLASH POINT		DEG C						
POUR POINT		DEG C						
BLANKETING REQUIRED		YES						
IF YES, BLANKETING GAS		NITROGEN						
MECHANICAL DATA								
DIAMETER		MM	28500 (NOTE-5)					
HEIGHT		MM	20000(NOTE-5)					
DESIGN PRESSURE								
POSITIVE PRESSURE		KG/CM2G	FULL OF LIQUID + 150 MMWC					
VACUUM PRESSURE		MMWC	50					
DESIGN TEMPERATURE		DEG C	65					
AMBIENT TEMPERATURE								
DESIGN MINIMUM		DEG C	(-) 0.7					
DESIGN MAXIMUM		DEG C	46.6					
COIL REQUIRED		NO						
IF YES, PURPOSE OF COIL								
COIL DESIGN PRESSURE		KG/CM2G						
COIL DESIGN TEMPERATURE		DEG C						
COIL NOMINAL SIZE		INCH						
COIL AREA		M2						
FLUID CIRCULATED IN COIL								
COIL MATERIAL OF CONSTRUCTION								
INSULATION REQUIRED		NO						
IF YES, TYPE OF INSULATION								
INSULATION THICKNESS		MM						
BREATHING VALVE REQUIRED		YES						
VENT WITH/ WITHOUT FLAME ARRESTER		WITHOUT FLAME ARRESTOR						
SUCTION EXCHANGER REQUIRED		NO						
GAUGING & SAMPLING HATCH		NO						
MIXER REQUIRED		NO						
IF YES, MIXER DATA SHEET NO.								
CODE REQUIREMENT								
MATERIAL OF CONSTRUCTION								
		MATERIAL	CORROSION ALLOWANCE, MM					
SHELL BOTTOM COURSE		CS	1.0					
BOTTOM		CS	1.0					
ROOF		CS	0.5					
SHELL OTHER COURSE		CS	1.0					
NOZZLES AND CONNECTIONS		PIPING SPEC. FOR NOZZLES		AS PER P&ID				
MARK	NUMBER	SIZE (INCHES)	SERVICE	MARK	NUMBER	SIZE (INCHES)	SERVICE	
F	1	16(NOTE-7)	TANK INLET	PVRV	1	12 (NOTE-7)	BREATHING VALVE	
B	1	20	TANK OUTLET	R1-2	2	4 NOTE-4	REGENERATION NOZZLES	
C	1	10(NOTE-7)	CIRCULATION LINE	PI	1	2	PRESSURE INSTRUMENTS	
O	1	18(NOTE-7)	OVER FLOW					
D	1	4 (NOTE-7.9)	DRAIN					
LT	1	8 (NOTE-4)	LEVEL TRANSMITTERS					
LT	1	8 (NOTE-4)	LEVEL TRANSMITTERS					
N	1	10 (NOTE-7)	NITROGEN					
M1, M2	2	24	MANWAY, SHELL					
M3,M4	2	24	MANWAY, ROOF					
D	21-02-2022	ISSUED FOR PACKAGE				ANT	KV	KV
C	20-07-2021	REVISED AS MARKED				ANT	KV	KV
B	21-05-2020	REVISED AS MARKED				ANT	KV	KV
A	20-03-2020	ISSUED FOR COMMENTS				ANT	KV	KV
Rev. No.	DATE	PURPOSE				Prepared By	Reviewed By	Approved By

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PROJECT P25 PROJECT

UNIT DM WATER SYSTEM

ITEM NO. 475-T-1001A/B

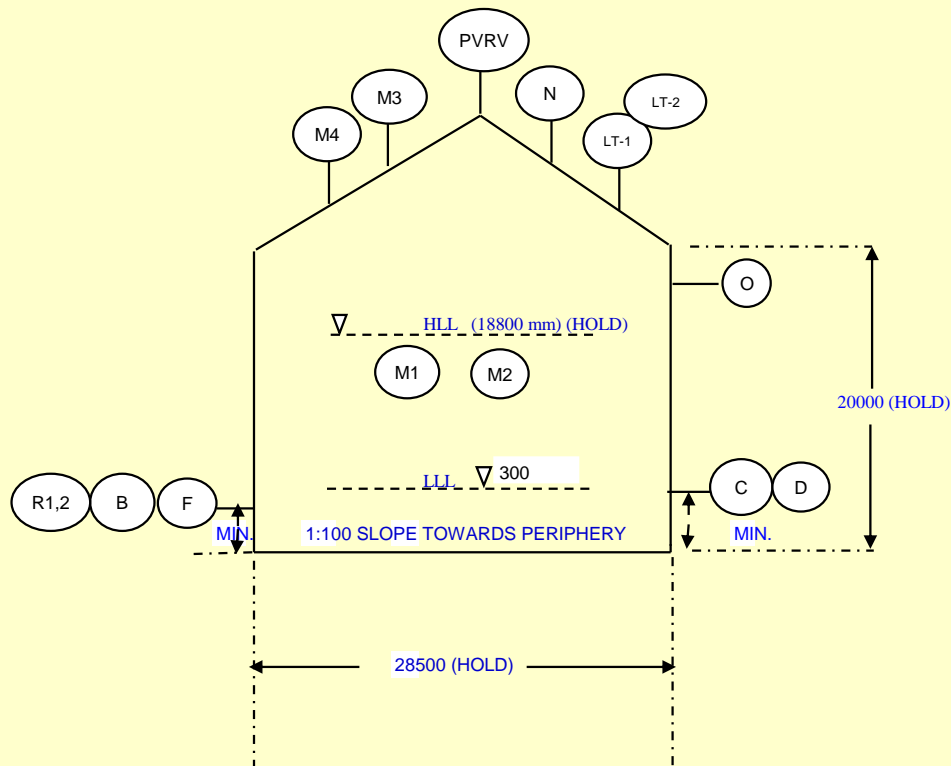
CLIENT IOCL, PANIPAT

JOB NO. B269

SERVICE **DM WATER**

UNIT NO. 475

SKETCH OF STORAGE TANK



ALL DIMENSIONS ARE IN MM

D	21-02-2022	ISSUED FOR ENGG	ANT	KV	KV
C	20-07-2021	REVISED AS MARKED	ANT	KV	KV
B	21-05-2020	REVISED AS MARKED	ANT	KV	KV
A	20-03-2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

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PROJECT P25 Project		CLIENT IOCL PANIPAT	
UNIT DM Water System		JOB NO. B269 UNIT NO. 475	

TAG NO.	475-PI-1101	Rev.	475-PT/PI-1102	Rev.	475-PI-1103	Rev.
SERVICE	TREATED EFFLUENT		TREATED RAW WATER		TREATED RAW WATER	
FLUID STATE	LIQUID		LIQUID		LIQUID	
LOCATION	12"-TW-475-1101-A1A	1	12"-WR-471-1102-A93A		12"-WR-471-1102-A93A	
OPERATING CONDITIONS						
OPERATING TEMPERATURE	DEG C	AMBIENT	AMBIENT		AMBIENT	
OPERATING PRESSURE	KG/CM2 G	2.5	2.5		2.5	
DESIGN CONDITIONS						
DESIGN TEMPERATURE	DEG C	65	65		65	
DESIGN PRESSURE	KG/CM2 G	18	10.5		10.5	
ALARM SET VALUES						
LOW	KG/CM2 G					
HIGH	KG/CM2 G					
LOW LOW	KG/CM2 G					
HIGH HIGH	KG/CM2 G					
REMARKS	NOTE-1		NOTE-1		NOTE-1	

TAG NO.	475-PI-1105	Rev.	475-PI-1106	Rev.	475-PI-1107	Rev.
SERVICE	DM WATER		DM WATER		DM WATER	
FLUID STATE	LIQUID		LIQUID		LIQUID	
LOCATION	10"-WDM-475-1106-A1K		10"-WDM-475-1108-A1K		10"-WDM-475-1110-A1K	
OPERATING CONDITIONS						
OPERATING TEMPERATURE	DEG C	AMBIENT	AMBIENT		AMBIENT	
OPERATING PRESSURE	KG/CM2 G	9.3	9.3		9.3	
DESIGN CONDITIONS						
DESIGN TEMPERATURE	DEG C	65	65		65	
DESIGN PRESSURE	KG/CM2 G	16	16		16	
ALARM SET VALUES						
LOW	KG/CM2 G					
HIGH	KG/CM2 G					
LOW LOW	KG/CM2 G					
HIGH HIGH	KG/CM2 G					
REMARKS	NOTE-1		NOTE-1		NOTE-1	

NOTES

- REFER P&ID NO. B269-02-42-475-1111
- DESIGN PRESSURE SHALL BE PROVIDED DURING DETAIL ENGINEERING.
- ALARM VALUE SHALL BE CONFIRMED DURING DETAIL ENGINEERING
- DESIGN PRESSURE SHALL BE PROVIDED BY RODM VENDOR

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

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PROJECT UNIT		P25 Project DM Water System		CLIENT JOB NO.		IOCL PANIPAT B269		UNIT NO. 475	
TAG NO.	475-PI-1108	Rev.	475-PT/PI/PAL/PAH-1109	Rev.	475-PI-1110	Rev.	475-PI-1110	Rev.	475-PI-1110
SERVICE	DM WATER		DM WATER		DM WATER		DM WATER		DM WATER
FLUID STATE	LIQUID		LIQUID		LIQUID		LIQUID		LIQUID
LOCATION	10"-WDM-475-1118-A1K		18"-WDM-475-1111-A1K		18"-WDM-475-1111-A1K		18"-WDM-475-1111-A1K		18"-WDM-475-1111-A1K
OPERATING CONDITIONS									
OPERATING TEMPERATURE	DEG C	AMBIENT	AMBIENT		AMBIENT		AMBIENT		AMBIENT
OPERATING PRESSURE	KG/CM2 G	9.3	9.0		8.7		8.7		8.7
DESIGN CONDITIONS									
DESIGN TEMPERATURE	DEG C	65	65		65		65		65
DESIGN PRESSURE	KG/CM2 G	16	16		16		16		16
ALARM SET VALUES									
LOW	KG/CM2 G		8.5						
HIGH	KG/CM2 G		9.6						
LOW LOW	KG/CM2 G								
HIGH HIGH	KG/CM2 G								
REMARKS	NOTE-1		NOTE-1,3		NOTE-1		NOTE-1		NOTE-1

TAG NO.	475-PT/PALL-1111	Rev.	475-PI-1112	Rev.	475-PT/PI/PAL/PAH-1113	Rev.	475-PT/PI/PAL/PAH-1113
SERVICE	DM WATER		NITROGEN		NITROGEN		NITROGEN
FLUID STATE	LIQUID		VAPOR		VAPOR		VAPOR
LOCATION	18"-WDM-475-1111-A1K		6"(H)-IG-475-1101-A3A		6"(H)-IG-475-1101-A3A		6"(H)-IG-475-1101-A3A
OPERATING CONDITIONS							
OPERATING TEMPERATURE	DEG C	AMBIENT	AMBIENT		AMBIENT		AMBIENT
OPERATING PRESSURE	KG/CM2 G	8.7	5		3		3
DESIGN CONDITIONS							
DESIGN TEMPERATURE	DEG C	65	65		65		65
DESIGN PRESSURE	KG/CM2 G	16	10.5		10.5		10.5
ALARM SET VALUES							
LOW	KG/CM2 G				2.5		2.5
HIGH	KG/CM2 G				3.1		3.1
LOW LOW	KG/CM2 G	7.9					
HIGH HIGH	KG/CM2 G						
REMARKS	NOTE-1,3		NOTE-1		NOTE-1,3		NOTE-1,3

NOTES

- 1. REFER P&ID NO. B269-02-42-475-1111
- 2. DESIGN PRESSURE SHALL BE PROVIDED DURING DETAIL ENGINEERING.
- 3. ALARM VALUE SHALL BE CONFIRMED DURING DETAIL ENGINEERING
- 4. DESIGN PRESSURE SHALL BE PROVIDED BY RODM VENDOR

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

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PROJECT P25 Project		CLIENT IOCL PANIPAT	
UNIT DM Water System		JOB NO. B269 UNIT NO. 475	

TAG NO.	475-PI-1114	Rev.	475-PT/PI/PAL/PAH-1115	Rev.	475-PI-1116	Rev.
SERVICE	INSTRUMENT AIR		INSTRUMENT AIR		PLANT AIR	
FLUID STATE	VAPOR		VAPOR		VAPOR	
LOCATION	2"-AI-475-1101-A93M		2"-AI-475-1101-A93M		2"-AP-475-1101-A3A	
OPERATING CONDITIONS						
OPERATING TEMPERATURE	DEG C	AMBIENT	AMBIENT		AMBIENT	
OPERATING PRESSURE	KG/CM2 G	6	6		6	
DESIGN CONDITIONS						
DESIGN TEMPERATURE	DEG C	65	65		65	
DESIGN PRESSURE	KG/CM2 G	10	10		10	
ALARM SET VALUES						
LOW	KG/CM2 G		5			
HIGH	KG/CM2 G		7			
LOW LOW	KG/CM2 G					
HIGH HIGH	KG/CM2 G					
REMARKS	NOTE-1		NOTE-1,3		NOTE-1	

TAG NO.	475-PT/PIC-1117	Rev.	475-PT/PI/PAL/PAH-1118	Rev.	475-PI-1119	Rev.
SERVICE	NITROGEN		PLANT AIR		SERVICE WATER	
FLUID STATE	VAPOR		VAPOR		LIQUID	
LOCATION	10"(H)-IG-475-1101-A3A		2"-AP-475-1101-A3A		2"-WS-475-1101-A93A	
OPERATING CONDITIONS						
OPERATING TEMPERATURE	DEG C	AMBIENT	AMBIENT		AMBIENT	
OPERATING PRESSURE	KG/CM2 G	50MM WCG	6		5	
DESIGN CONDITIONS						
DESIGN TEMPERATURE	DEG C	65	65		65	
DESIGN PRESSURE	KG/CM2 G	10.5	10		10.5	
ALARM SET VALUES						
LOW	KG/CM2 G		4			
HIGH	KG/CM2 G		8			
LOW LOW	KG/CM2 G					
HIGH HIGH	KG/CM2 G					
REMARKS	NOTE-1		NOTE-1,3		NOTE-1	

NOTES

- REFER P&ID NO. B269-02-42-475-1111
- DESIGN PRESSURE SHALL BE PROVIDED DURING DETAIL ENGINEERING.
- ALARM VALUE SHALL BE CONFIRMED DURING DETAIL ENGINEERING
- DESIGN PRESSURE SHALL BE PROVIDED BY RODM VENDOR

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

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PROJECT P25 Project		CLIENT IOCL PANIPAT	
UNIT DM Water System		JOB NO. B269 UNIT NO. 475	

TAG NO.	475-PT/PI/PAL/PAH-1120	Rev.	475-PI-1121	Rev.	475-PT/PI/PAL/PAH-1122	Rev.
SERVICE	SERVICE WATER		LP STEAM		LP STEAM	
FLUID STATE	LIQUID		VAPOR		VAPOR	
LOCATION	2"-WS-475-1101-A93A		4"-SL-475-1101-A2A-IH		4"-SL-475-1101-A2A-IH	
OPERATING CONDITIONS						
OPERATING TEMPERATURE	DEG C	AMBIENT	160		160	
OPERATING PRESSURE	KG/CM2 G	5	4		4	
DESIGN CONDITIONS						
DESIGN TEMPERATURE	DEG C	65	240		240	
DESIGN PRESSURE	KG/CM2 G	10.5	7/FV		7/FV	
ALARM SET VALUES						
LOW	KG/CM2 G	3			3	
HIGH	KG/CM2 G	6			5	
LOW LOW	KG/CM2 G					
HIGH HIGH	KG/CM2 G					
REMARKS	NOTE-1,3		NOTE-1		NOTE-1,3	

TAG NO.	475-PI-1125	Rev.	475-PT/PI-1126	Rev.	475-PT/PI-1127	Rev.
SERVICE	CAUSTIC		NITROGEN		NITROGEN	
FLUID STATE	LIQUID		VAPOR		VAPOR	
LOCATION	6"(H)-CA-475-1101-A19A		475-T-1001A		475-T-1001B	
OPERATING CONDITIONS						
OPERATING TEMPERATURE	DEG C	HOLD	AMBIENT		AMBIENT	
OPERATING PRESSURE	KG/CM2 G	HOLD	50MM WCG		50MM WCG	
DESIGN CONDITIONS						
DESIGN TEMPERATURE	DEG C	65	65		65	
DESIGN PRESSURE	KG/CM2 G	NOTE-4	3.5		3.5	
ALARM SET VALUES						
LOW	KG/CM2 G					
HIGH	KG/CM2 G					
LOW LOW	KG/CM2 G					
HIGH HIGH	KG/CM2 G					
REMARKS	NOTE-1,4		NOTE-1		NOTE-1	

NOTES

- REFER P&ID NO. B269-02-42-475-1111
- DESIGN PRESSURE SHALL BE PROVIDED DURING DETAIL ENGINEERING.
- ALARM VALUE SHALL BE CONFIRMED DURING DETAIL ENGINEERING
- DESIGN PRESSURE SHALL BE PROVIDED BY RODM VENDOR

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
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PROJECT	P25 Project		CLIENT	IOCL PANIPAT	
UNIT	DM Water System		JOB NO.	B269	
			UNIT NO.	475	
TAG NO.	475-PI-1128	Rev.	475-PT/PI-1129	Rev.	
SERVICE	BLOWDOWN		BLOWDOWN		
FLUID STATE	LIQUID		LIQUID		
LOCATION	12"-BD-475-1101-A1A		12"-BD-475-1101-A1A		
OPERATING CONDITIONS					
OPERATING TEMPERATURE	DEG C 33-45		33-45		
OPERATING PRESSURE	KG/CM2 G 2.5		2.5		
DESIGN CONDITIONS					
DESIGN TEMPERATURE	DEG C 65		65		
DESIGN PRESSURE	KG/CM2 G 8		8		
ALARM SET VALUES					
LOW	KG/CM2 G				
HIGH	KG/CM2 G				
LOW LOW	KG/CM2 G				
HIGH HIGH	KG/CM2 G				
REMARKS	NOTE-1		NOTE-1		

TAG NO.		Rev.		Rev.	
SERVICE					
FLUID STATE					
LOCATION					
OPERATING CONDITIONS					
OPERATING TEMPERATURE					
OPERATING PRESSURE					
DESIGN CONDITIONS					
DESIGN TEMPERATURE					
DESIGN PRESSURE					
ALARM SET VALUES					
LOW					
HIGH					
LOW LOW					
HIGH HIGH					
REMARKS					

NOTES

- REFER P&ID NO. B269-02-42-475-1111
- DESIGN PRESSURE SHALL BE PROVIDED DURING DETAIL ENGINEERING.
- ALARM VALUE SHALL BE CONFIRMED DURING DETAIL ENGINEERING
- DESIGN PRESSURE SHALL BE PROVIDED BY RODM VENDOR

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

TEMPERATURE INSTRUMENT

PROCESS DATA SHEET

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PROJECT	P25 Project	CLIENT	IOCL PANIPAT
UNIT	DM Water System	JOB NO.	B269
		UNIT NO.	475
TAG NO.	475-TI-1101	Rev.	475-TI-1102
SERVICE	TREATED EFFLUENT		TREATED RAW WATER
FLUID STATE	LIQUID		LIQUID
LOCATION	12"-TW-475-1101-A1A	1	10"-WR-475-1102-A93A
OPERATING CONDITIONS			
OPERATING TEMPERATURE	DEG C	AMBIENT	AMBIENT
OPERATING PRESSURE	KG/CM2 G	2.5	2.3
DESIGN CONDITIONS			
DESIGN TEMPERATURE	DEG C	65	65
DESIGN PRESSURE	KG/CM2 G	18	10.5
ALARM SET VALUES			
LOW	DEG C		
HIGH	DEG C		
LOW LOW	DEG C		
HIGH HIGH	DEG C		
REMARKS	NOTE-1		NOTE-1

TAG NO.	475-TI-1104	Rev.	475-TI-1105
SERVICE	DM WATER		NITROGEN
FLUID STATE	LIQUID		VAPOR
LOCATION	18"-WDM-475-1111-A1K		6"(H)-IG-475-1101-A3A
OPERATING CONDITIONS			
OPERATING TEMPERATURE	DEG C	AMBIENT	AMBIENT
OPERATING PRESSURE	KG/CM2 G	9.0	4-7
DESIGN CONDITIONS			
DESIGN TEMPERATURE	DEG C	65	65
DESIGN PRESSURE	KG/CM2 G	16	10.5
ALARM SET VALUES			
LOW	DEG C		NOTE-2
HIGH	DEG C		NOTE-2
LOW LOW	DEG C		
HIGH HIGH	DEG C		
REMARKS	NOTE-1		NOTE-1

NOTES

- REFER P&ID NO. B269-02-42-475-1111
- ALARM VALUE SHALL BE PROVIDED DURING DETAIL ENGG
- DESIGN PRESSURE SHALL BE PROVIDED BY RO-DM VENDOR
- 475-TI-1114 tag shall be deleted.

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

TEMPERATURE INSTRUMENT

PROCESS DATA SHEET

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PROJECT	P25 Project	CLIENT	IOCL PANIPAT
UNIT	DM Water System	JOB NO.	B269
		UNIT NO.	475
TAG NO.	475-TI-1107	Rev.	475-TI-1108
SERVICE	INSTRUMENT AIR		PLANT AIR
FLUID STATE	VAPOR		VAPOR
LOCATION	2"-AI-472-1101-A93M		2"-AP-475-1101-A3A
OPERATING CONDITIONS			
OPERATING TEMPERATURE	DEG C	AMBIENT	AMBIENT
OPERATING PRESSURE	KG/CM2 G	5-7	4-8
DESIGN CONDITIONS			
DESIGN TEMPERATURE	DEG C	65	65
DESIGN PRESSURE	KG/CM2 G	10	10
ALARM SET VALUES			
LOW	DEG C		NOTE-2
HIGH	DEG C		NOTE-2
LOW LOW	DEG C		
HIGH HIGH	DEG C		
REMARKS	NOTE-1		NOTE-1,2

TAG NO.	475-TI-1110	Rev.	475-TT/TE/TI/TAH/TAL-1111
SERVICE	SERVICE WATER		LP STEAM
FLUID STATE	LIQUID		VAPOR
LOCATION	2"-WS-475-1101-A93A		4"-SL-475-1101-A2A-IH
OPERATING CONDITIONS			
OPERATING TEMPERATURE	DEG C	AMBIENT	160
OPERATING PRESSURE	KG/CM2 G	3-6	4
DESIGN CONDITIONS			
DESIGN TEMPERATURE	DEG C	65	240
DESIGN PRESSURE	KG/CM2 G	10.5	7/FV
ALARM SET VALUES			
LOW	DEG C		NOTE-2
HIGH	DEG C		NOTE-2
LOW LOW	DEG C		
HIGH HIGH	DEG C		
REMARKS	NOTE-1		NOTE-1,2

NOTES

- REFER P&ID NO. B269-02-42-475-1111
- ALARM VALUE SHALL BE PROVIDED DURING DETAIL ENGG
- DESIGN PRESSURE SHALL BE PROVIDED BY RO-DM VENDOR
- 475-TI-1114 tag shall be deleted.

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

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PROJECT	P25 Project	CLIENT	IOCL PANIPAT
UNIT	DM Water System	JOB NO.	B269
		UNIT NO.	475
TAG NO.	475-TT/TE/TI/TAH/TAL-1113	Rev.	475-TI-1114
SERVICE	LP STEAM		TREATED RAW WATER
FLUID STATE	VAPOR		LIQUID
LOCATION	4"-SL-475-1101-A2A-IH		8"-WR-475-1101-A93A
OPERATING CONDITIONS			
OPERATING TEMPERATURE	DEG C 160		AMBIENT 33-45
OPERATING PRESSURE	KG/CM2 G 4		3.0 2.5
DESIGN CONDITIONS			
DESIGN TEMPERATURE	DEG C 240		65 65
DESIGN PRESSURE	KG/CM2 G 7/FV		NOTE-3 8
ALARM SET VALUES			
LOW	DEG C 143		
HIGH	DEG C 190		
LOW LOW	DEG C		
HIGH HIGH	DEG C		
REMARKS	NOTE-1		NOTE-1,3,4

TAG NO.		Rev.		Rev.	
SERVICE					
FLUID STATE					
LOCATION					
OPERATING CONDITIONS					
OPERATING TEMPERATURE					
OPERATING PRESSURE					
DESIGN CONDITIONS					
DESIGN TEMPERATURE					
DESIGN PRESSURE					
ALARM SET VALUES					
LOW					
HIGH					
LOW LOW					
HIGH HIGH					
REMARKS					

NOTES

1. REFER P&ID NO. B269-02-42-475-1111
2. ALARM VALUE SHALL BE PROVIDED DURING DETAIL ENGG
3. DESIGN PRESSURE SHALL BE PROVIDED BY RO-DM VENDOR
4. 475-TI-1114 tag shall be deleted.

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

PROJECT	P25 Project		CLIENT	IOCL PANIPAT		
UNIT	DM Water System		JOB NO.	B269		UNIT NO. 475
TAG NO.	475-FE/FT/FIC-1101	Rev.	475-FE/FT/FI-1102	Rev.	475-FE/FT/FI-1103	Rev.
SERVICE	DM WATER		TREATED EFFLUENT		TREATED RAW WATER	
LOCATION	18"-WDM-475-1111-A1K		12"-TW-475-1101-A1A	1	10"-WR-475-1102-A93A	
FLUID	DM WATER		TREATED EFFLUENT		TREATED RAW WATER	
FLUID STATE	LIQUID		LIQUID		LIQUID	
OPERATING CONDITIONS						
TEMPERATURE	DEG C	AMBIENT	AMBIENT		AMBIENT	
PRESSURE AT INLET	KG/CM2 G	9.3	2.5		2.5	
FLOW RATE @ P&T						
NORMAL	861	M3/HR	383	M3/HR	132	M3/HR
MINIMUM	126 (NOTE-2)	M3/HR	192 (NOTE-2)	M3/HR	66(NOTE-2)	M3/HR
MAXIMUM	945	M3/HR	475	M3/HR	514	M3/HR
ELEMENT PRESS. DROP	KG/CM2	0.25 (MAX)	0.25 (MAX)		0.25 (MAX)	
LIQUID PROPERTIES @ P&T						
DENSITY	KG/M3	993	992 -1000		992 -1000	
VISCOSITY	CP	0.69	0.8-1.0		0.83	
GAS & VAPOUR PROPERTIES @ P&T						
MOLECULAR WEIGHT						
COMPRESSIBILITY FACTOR						
VISCOSITY						
CP/CV						
TYPE OF FLOW METER	ORIFICE		ORIFICE		ORIFICE	
CORROSIVE CONSTITUENTS	NIL		NIL		NIL	
VAC POSSIBILITY	NA		NA		NA	
DESIGN CONDITIONS						
DESIGN TEMPERATURE	DEG C	65	65		65	
DESIGN PRESSURE	KG/CM2 G	16	18		10.5	
ALARM SET POINT VALUES						
LOW						
HIGH						
LOW LOW						
HIGH HIGH						
NOTE NO.	1,2		1,2		1,2	

NOTES:-

1. REFER P&ID NO. B269-02-42-475-1111
2. FLOW RATE SHALL BE PROVIDED DURING DETAIL ENGINEERING
3. DESIGN PRESSURE SHALL BE PROVIDED BY RO-DM VENDOR
4. FLOW RATE & ALARM VALUE SHALL BE PROVIDED DURING DETAIL ENGINEERING

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

PROJECT	P25 Project		CLIENT	IOCL PANIPAT	
UNIT	DM Water System		JOB NO.	B269	
			UNIT NO.	475	
TAG NO.	475-FE/FT/FI/FAL/FQ-1105	Rev.	475-FE/FT/FI/FAH/FAL-1106	Rev.	475-FE/FT/FI/FAH/FAL-1107
SERVICE	DM WATER		NITROGEN		INSTRUMENT AIR
LOCATION	18"-WDM-475-1111-A1K		6"(H)-IG-475-1101-A3A		2"-AI-475-1101-A93M
FLUID	DM WATER		NITROGEN		INSTRUMENT AIR
FLUID STATE	LIQUID		VAPOR		VAPOR
OPERATING CONDITIONS					
TEMPERATURE	DEG C	AMBIENT	AMBIENT		AMBIENT
PRESSURE AT INLET	KG/CM2 G	9.0	3		6
FLOW RATE @ P&T					
NORMAL	861	M3/HR	NOTE-4	NM3/HR	NOTE-2
MINIMUM	126 (NOTE-2)	M3/HR		NM3/HR	NOTE-2
MAXIMUM	945	M3/HR	NOTE-4	NM3/HR	NOTE-2
ELEMENT PRESS. DROP	KG/CM2	0.25 (MAX)	0.1(MAX)		0.1(MAX)
LIQUID PROPERTIES @ P&T					
DENSITY	KG/M3	993			
VISCOSITY	CP	0.69			
GAS & VAPOUR PROPERTIES @ P&T					
MOLECULAR WEIGHT			28		29
COMPRESSIBILITY FACTOR			1		1
VISCOSITY			0.01		0.01
CP/CV			1.4		1.4
TYPE OF FLOW METER	ORIFICE		VORTEX		VORTEX
CORROSIVE CONSTITUENTS	NIL		NIL		NIL
VAC POSSIBILITY	NA		NA		NA
DESIGN CONDITIONS					
DESIGN TEMPERATURE	DEG C	65	65		65
DESIGN PRESSURE	KG/CM2 G	16	10.5		10
ALARM SET POINT VALUES					
LOW			NOTE-4	NM3/HR	
HIGH			NOTE-4	NM3/HR	
LOW LOW					
HIGH HIGH					
NOTE NO.	1,2		1,4		1,2

NOTES:-

1. REFER P&ID NO. B269-02-42-475-1111
2. FLOW RATE SHALL BE PROVIDED DURING DETAIL ENGINEERING
3. DESIGN PRESSURE SHALL BE PROVIDED BY RO-DM VENDOR
4. FLOW RATE & ALARM VALUE SHALL BE PROVIDED DURING DETAIL ENGINEERING

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

PROJECT	P25 Project		CLIENT	IOCL PANIPAT	
UNIT	DM Water System		JOB NO.	B269	
			UNIT NO.	475	
TAG NO.	475-FE/FT/FI/FQ-1108	Rev.	475-FE/FT/FI/FQ-1109	Rev.	475-FE/FT/FI/FAH/FAL/FQ-1110
SERVICE	PLANT AIR		SERVICE WATER		LP STEAM
LOCATION	2"-AP-475-1101-A3A		2"-WS-475-1101-A93A		4"-SL-475-1101-A2A-IH
FLUID	PLANT AIR		SERVICE WATER		LP STEAM
FLUID STATE	VAPOR		LIQUID		VAPOR
OPERATING CONDITIONS					
TEMPERATURE	DEG C	AMBIENT	AMBIENT		160
PRESSURE AT INLET	KG/CM2 G	6	5		4
FLOW RATE @ P&T					
NORMAL	NOTE-2	NM3/HR	NOTE-2		NOTE-2 KG/HR
MINIMUM	NOTE-2	NM3/HR			NOTE-2 KG/HR
MAXIMUM	NOTE-2	NM3/HR	NOTE-2	M3/HR	NOTE-2 KG/HR
ELEMENT PRESS. DROP	KG/CM2	0.1(MAX)	0.25 (MAX)		0.1(MAX)
LIQUID PROPERTIES @ P&T					
DENSITY	KG/M3		992 -1000		
VISCOSITY			0.83		
GAS & VAPOUR PROPERTIES @ P&T					
MOLECULAR WEIGHT	29				18
COMPRESSIBILITY FACTOR	1				1
VISCOSITY	CP	0.01			0.01
CP/CV	1.4				
TYPE OF FLOW METER	VORTEX		VORTEX		ORIFICE
CORROSIVE CONSTITUENTS	NIL		NIL		NIL
VAC POSSIBILITY	NA		NA		
DESIGN CONDITIONS					
DESIGN TEMPERATURE	DEG C	65	65		240
DESIGN PRESSURE	KG/CM2 G	10	10.5		7/FV
ALARM SET POINT VALUES					
LOW					NOTE-3 KG/HR
HIGH					NOTE-3 KG/HR
LOW LOW					
HIGH HIGH					
NOTE NO.	1,2		1,2		1,2,3

NOTES:-

1. REFER P&ID NO. B269-02-42-475-1111
2. FLOW RATE SHALL BE PROVIDED DURING DETAIL ENGINEERING
3. DESIGN PRESSURE SHALL BE PROVIDED BY RO-DM VENDOR
4. FLOW RATE & ALARM VALUE SHALL BE PROVIDED DURING DETAIL ENGINEERING

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

PROJECT	P25 Project			CLIENT	IOCL PANIPAT			
UNIT	DM Water System			JOB NO.	B269		UNIT NO.	475
TAG NO.	475-FE/FT/FI-1112		Rev.	475-FE/FT/FI-1113		Rev.		Rev.
SERVICE	CAUSTIC			BLOWDOWN				
LOCATION	6"(H)-CA-475-1101-A19A			12"-BD-475-1101-A1A				
FLUID	20%CAUSTIC			BLOWDOWN				
FLUID STATE	LIQUID			LIQUID				
OPERATING CONDITIONS								
TEMPERATURE	DEG C	30		33-45				
PRESSURE AT INLET	KG/CM2 G	6(H)		2.5				
FLOW RATE @ P&T								
NORMAL		NOTE-2 M3/HR		287 M3/HR				
MINIMUM		NOTE-2 M3/HR		119 M3/HR				
MAXIMUM		NOTE-2 M3/HR		414 M3/HR				
ELEMENT PRESS. DROP	KG/CM2	0.25 (MAX)		0.25 (MAX)				
LIQUID PROPERTIES @ P&T								
DENSITY	KG/M3	1220		995 -1000				
VISCOSITY	CP	4.5		0.75				
GAS & VAPOUR PROPERTIES @ P&T								
MOLECULAR WEIGHT								
COMPRESSIBILTY FACTOR								
VISCOSITY								
CP/CV								
TYPE OF FLOW METER	ORIFICE			ORIFICE				
CORROSIVE CONSTITUENTS				NIL				
VAC POSSIBILITY				NA				
DESIGN CONDITIONS								
DESIGN TEMPERATURE	DEG C	65		65				
DESIGN PRESSURE	KG/CM2 G	NOTE-3		8				
ALARM SET POINT VALUES								
LOW								
HIGH								
LOW LOW								
HIGH HIGH								
NOTE NO.	1,2,4			1				

NOTES:-

1. REFER P&ID NO. B269-02-42-475-1111
2. FLOW RATE SHALL BE PROVIDED DURING DETAIL ENGINEERING
3. DESIGN PRESSURE SHALL BE PROVIDED BY RO-DM VENDOR
4. FLOW RATE & ALARM VALUE SHALL BE PROVIDED DURING DETAIL ENGINEERING

1	9/3/2022	ISSUED FOR ENGINEERING	ANT	KV	KV
0	18/9/2020	ISSUED FOR PACKAGE	ANT	KV	KV
B	5/6/2020	ISSUED FOR PACKAGE	ANT	KV	KV
A	7/4/2020	ISSUED FOR COMMENTS	ANT	KV	KV
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PROJECT **P25 Project**

Client **IOCL PANIPAT**

UNIT **DM Water System**

Job No. **B269**

UNIT NO. **475**

SNo	Line No.	Service	Fluid State	Size (Inch)	Class	Location		Oper. Conditions		Design Conditions		Testing		Tracing		Insulation		Note No.	Rev
						From	To	Temp (Deg C)	Presssure (kg/cm2g)	Temp (Deg C)	Presssure (kg/cm2g)	Mediu m	Press. (kg/cm2g)	Yes /No	Type	Type	Thick (mm)		
1	0.75"-WDM-475-1114-A1K	DM WATER	L	0.75	A1K	18"-WDM-475-1111-A1K	475-PSV-1101	AMBIENT	9.0	65	16	H		NO		NIL		1	
2	1"-SV-475-1101-A3A	DM WATER	L	1	A3A	PSV-1101	GRADE	AMBIENT	ATM	65	3.5	H						1	
3	10"(H)-IG-475-1102-A3A	NITROGEN	V	10 H	A3A	10"(H)-IG-475-1101-A3A	475-T-1001A	AMBIENT	50 MMWCG	65	10.5	P		NO		NIL		1	
4	10"(H)-IG-475-1103-A3A	NITROGEN	V	10 H	A3A	10"(H)-IG-475-1103-A3A	ATM	AMBIENT	50 MMWCG	65	10.5	P		NO		NIL		1	
5	10"(H)-WDM-475-1112-A1K	DM WATER	L	10 H	A1K	18"-WDM-475-1111-A1K	475-T-1001A	AMBIENT	2-9	65	16	H		NO		NIL		1	
6	10"(H)-WDM-475-1113-A1K	DM WATER	L	10 H	A1K	10"(H)-WDM-475-1112-A1K	475-T-1001B	AMBIENT	2-9	65	16	H		NO		NIL		1	
7	10"-WDM-475-1106-A1K	DM WATER	L	10	A1K	475-P-1001A	18"-WDM-475-1111-A1K	AMBIENT	9.3	65	16	H		NO		NIL		1	
8	10"-WDM-475-1108-A1K	DM WATER	L	10	A1K	475-P-1001B	18"-WDM-475-1111-A1K	AMBIENT	9.3	65	16	H		NO		NIL		1	
9	10"-WDM-475-1110-A1K	DM WATER	L	10	A1K	475-P-1001C	18"-WDM-475-1111-A1K	AMBIENT	9.3	65	16	H		NO		NIL		1	

1	09-MAR-2022	Re-Issued For Engineering	ANT	KV	ANT
0	18-SEP-2020	Issued For Package	ANT	KV	KV
B	31-MAY-2020	Issued For PACKAGE	ANT	ANT	ANT
A	09-APR-2020	Issued For Comments	ANT	ANT	ANT
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

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PROJECT **P25 Project**

Client **IOCL PANIPAT**

UNIT **DM Water System**

Job No. **B269**

UNIT NO. **475**

SNo	Line No.	Service	Fluid State	Size (Inch)	Class	Location		Oper. Conditions		Design Conditions		Testing		Tracing		Insulation		Note No.	Rev
						From	To	Temp (Deg C)	Presssure (kg/cm2g)	Temp (Deg C)	Presssure (kg/cm2g)	Mediu m	Press. (kg/cm2g)	Yes /No	Type	Type	Thick (mm)		
10	10"-WDM-475-1118-A1K	DM WATER	L	10	A1K	475-P-1001D	18"-WDM-475-1111-A1K	AMBIENT	9.3	65	16	H		NO		NIL		1	
11	10"-WR-475-1102-A93A	TREATED RAW WATER	L	10	A93A	10"-WR-471-1605-A93A	RO-DM PLANT	AMBIENT	2.5	65	10.5	H		NO		NIL		1,3	
12	12"-BD-475-1101-A1A	BLOWDOWN	L	12	A1A	12"-BD-471-1601-A1A	RODM PLANT	33-45	2.5	65	8	H		NO		NIL			
13	12"-TW-475-1101-A1A	TREATED EFFLUENT	L	12	A1A	12"-TW-471-1601-A1A	RO-DM PLANT	AMBIENT	2.5	65	18	H		NO		NIL		1	
14	16"(H)-WDM-475-1101-A1k	DM WATER	L	16 H	A1K	RO-DM PLANT	475-T-1001A	AMBIENT	2 (H)	65	3.5(H)	H		NO		NIL		1	
15	16"(H)-WDM-475-1102-A1k	DM WATER	L	16 H	A1K	16"(H)-WDM-475-1101-A1K	475-T-1001B	AMBIENT	2(H)	65	3.5(H)	H		NO		NIL		1	
16	18"(H)-WDM-475-1115-A1k	DM WATER	L	18 H	A1K	475-T-1001A	TO NEUTRALISATION PIT	AMBIENT	1	65	3.5	H		NO		NIL		1	
17	18"(H)-WDM-475-1116-A1k	DM WATER	L	18 H	A1K	475-T-1001B	TO NEUTRALISATION PIT	AMBIENT	1	65	3.5	H		NO		NIL		1	
18	18"-WDM-475-111-A1K	DM WATER	L	18	A1K	475-P-1001A/B/C/D	DM WATER DISTRIBUTION	AMBIENT	9.3	65	16	H		NO		NIL		1	

1	09-MAR-2022	Re-Issued For Engineering	ANT	KV	ANT
0	18-SEP-2020	Issued For Package	ANT	KV	KV
B	31-MAY-2020	Issued For PACKAGE	ANT	ANT	ANT
A	09-APR-2020	Issued For Comments	ANT	ANT	ANT
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

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PROJECT **P25 Project**

Client **IOCL PANIPAT**

UNIT **DM Water System**

Job No. **B269**

UNIT NO. **475**

SNo	Line No.	Service	Fluid State	Size (Inch)	Class	Location		Oper. Conditions		Design Conditions		Testing		Tracing		Insulation		Note No.	Rev
						From	To	Temp (Deg C)	Presssure (kg/cm2g)	Temp (Deg C)	Presssure (kg/cm2g)	Medium	Press. (kg/cm2g)	Yes /No	Type	Type	Thick (mm)		
19	2"-AI-475-1101-A93M	INSTRUMENT AIR	V	2	A93M	471-1112	INSIDE RODM DISTRIBUTION	AMBIENT	5-7	65	10	P		NO		NIL		1	
20	2"-AI-475-1102-A93M	INSTRUMENT AIR	V	2	A93M	2"-AI-475-1101-A93M	TO CPU UNIT	AMBIENT	5-7	65	10	P		NO		NIL		1	
21	2"-AP-475-1101-A3A	PLANT AIR	V	2	A3A	471-1112	INSIDE RODM DISTRIBUTION	AMBIENT	4-8	65	10	P		NO		NIL		1	
22	2"-AP-475-1102-A3A	PLANT AIR	V	2	A3A	2"-AP-475-1101-A3A	TO CPU UNIT	AMBIENT	4-8	65	10	P		NO		NIL		1	
23	2"-SL-475-1102-A2A-IH	LP STEAM	V	2	A2A	4"-SL-475-1101-A2A-IH	TO CPU UNIT	160	3-5	240	7/FV	P		NO		IH	40 40	1	
24	2"-WS-475-1101-A93A	SERVICE WATER	L	2	A93A	471-1116	INSIDE RODM DISTRIBUTION	AMBIENT	3-6	65	10.5	H		NO				1	
25	2"-WS-475-1102-A93A	SERVICE WATER	L	2	A93A	2"-WS-475-1101-A93A	TO CPU UNIT	AMBIENT	3-6	65	10.5	H		NO				1	
26	2"-WS-475-1103-A93A	SERVICE WATER	L	2	A93A	2"-WS-475-1101-A93A	TO NEUTRALISATION PIT	AMBIENT	3-6	65	10.5	H		NO				1	
27	20"-WDM-475-1103-A1K	DM WATER	L	20	A1K	475-T-1001A	20"-WDM-475-1105-A1K	AMBIENT	ATM	65	3.5	H		NO		NIL		1	
28	20"-WDM-475-1104-A1K	DM WATER	L	20	A1K	475-T-1001B	20"-WDM-475-1103-A1K	AMBIENT	ATM	65	3.5	H		NO		NIL		1	

1	09-MAR-2022	Re-Issued For Engineering	ANT	KV	ANT
0	18-SEP-2020	Issued For Package	ANT	KV	KV
B	31-MAY-2020	Issued For PACKAGE	ANT	ANT	ANT
A	09-APR-2020	Issued For Comments	ANT	ANT	ANT
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

LINE SCHEDULE

 Document No. **B269-475-02-LS-1111**

 Rev No. **1**

Page 4 of 5

 PROJECT **P25 Project**

 Client **IOCL PANIPAT**

 UNIT **DM Water System**

 Job No. **B269**

 UNIT NO. **475**

SNo	Line No.	Service	Fluid State	Size (Inch)	Class	Location		Oper. Conditions		Design Conditions		Testing		Tracing		Insulation		Note No.	Rev
						From	To	Temp (Deg C)	Presssure (kg/cm2g)	Temp (Deg C)	Presssure (kg/cm2g)	Medium	Press. (kg/cm2g)	Yes /No	Type	Type	Thick (mm)		
29	20"-WDM-475-1105-A1K	DM WATER	L	20 /10	A1K	20"-WDM-475-1103-A1K	475-P-1001A SUCTION	AMBIENT	ATM	65	3.5	H		NO		NIL		1	
30	20"-WDM-475-1107-A1K	DM WATER	L	10	A1K	20"-WDM-475-1103-A1K	475-P-1001B SUCTION	AMBIENT	ATM	65	3.5	H		NO		NIL		1	
31	20"-WDM-475-1109-A1K	DM WATER	L	10	A1K	20"-WDM-475-1103-A1K	475-P-1001C SUCTION	AMBIENT	ATM	65	3.5	H		NO		NIL		1	
32	20"-WDM-475-1117-A1K	DM WATER	L	10	A1K	20"-WDM-475-1103-A1K	475-P-1001D SUCTION	AMBIENT	ATM	65	3.5	H		NO		NIL		1	
33	3"(H) -CA-475-1101-A19A	CAUSTIC	L	3 H	A19A	RO-DM PLANT	TO DISTRIBUTION	30	6(H)	65	NOTE-2	H		NO		NIL		1,2	
34	4"-IG-475-1104-A3A	NITROGEN	V	4	A3A	6"(H) -IG-475-1101-A3A	TO CPU UNIT	AMBIENT	4-7	65	10.5	P		NO		NIL		1	
35	4"-SL-475-1101-A2A-IH	LP STEAM	V	4	A2A	471-1112	INSIDE RODM DISTRIBUTION	160	3-5	240	7/FV	P		NO		IH	40 40	1	
36	6"(H) -CA-475-1101-A19A	CAUSTIC	L	6 H	A19A	RO-DM PLANT	TO DISTRIBUTION	30	6(H)	65	NOTE-2	H		NO		NIL		1,2	
37	6"(H) -IG-475-1101-A3A	NITROGEN	V	6 /10 H	A3A	471-1112	475-T-1001B	AMBIENT	4-7	65	10.5	P		NO		NIL		1	

1	09-MAR-2022	Re-Issued For Engineering	ANT	KV	ANT
0	18-SEP-2020	Issued For Package	ANT	KV	KV
B	31-MAY-2020	Issued For PACKAGE	ANT	ANT	ANT
A	09-APR-2020	Issued For Comments	ANT	ANT	ANT
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

LINE SCHEDULE

Document No. **B269-475-02-LS-1111**

Rev No. **1**

Page 5 of 5

PROJECT **P25 Project**

Client **IOCL PANIPAT**

UNIT **DM Water System**

Job No. **B269**

UNIT NO. **475**

SNo	Line No.	Service	Fluid State	Size (Inch)	Class	Location		Oper. Conditions		Design Conditions		Testing		Tracing		Insulation		Note No.	Rev
						From	To	Temp (Deg C)	Presssure (kg/cm2g)	Temp (Deg C)	Presssure (kg/cm2g)	Mediu m	Press. (kg/cm2g)	Yes /No	Type	Type	Thick (mm)		

NOTES:

1. REFER P&ID NO B269-02-42-475-1111
2. DESIGN PRESSURE SHALL BE PROVIDED BY RO-DM VENDOR
3. TWO WAY LINE

1	09-MAR-2022	Re-Issued For Engineering	ANT	KV	ANT
0	18-SEP-2020	Issued For Package	ANT	KV	KV
B	31-MAY-2020	Issued For PACKAGE	ANT	ANT	ANT
A	09-APR-2020	Issued For Comments	ANT	ANT	ANT
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

**TECHNICAL AMENDMENT NO: 02 (ELECTRICAL)
TO
TENDER: B269-475-17-44-PA-T-8701 FOR RO/DM/RWTP/CPU/ZLD PACKAGE
(PROJECT: P-25, M/s IOCL-PANIPAT)**

08.03.2022	Issued as Technical Amendment-1	SNM	MK	HK
DATE	PURPOSE	BY	CHECKED	APPROVED

SUBJECT : Technical Amendment No.: 02
TENDER NO. : B269-475-17-44-PA-T-8701

The terms, conditions and specifications of Bidding Document stand modified to the extent indicated under column "MODIFICATIONS/ADDITION/DELETION". Corresponding implications of the same, else-where in the bid package shall be taken care appropriately. All other terms & conditions, stipulations and specifications of Bidding Document shall remain unaltered.

S. No	Section No./ Document No.	Clause No./ Item No.	Subject	Modifications / Additions/Deletions/ Clarification
1.	B269-475-16-50-SOW-8701 Rev C	Page 921 of 7166	SCOPE OF SUPPLY & WORK-ELECTRICAL	Modification: Scope of Supply & Work (Electrical) Doc. B269-475-16-50-SOW-8701 Rev C is replaced & superseded by B269-475-16-50-SOW-8701 Rev D and attached here.
2.	B269-475-16-50-SOW-8701 Rev C	Page 1378 of 7166	JOB SPECIFICATION - ELECTRICAL	Modification: Job Specification (Electrical) Doc. B269-475-16-50-SP-8701 Rev B is replaced & superseded by B269-475-16-50-SP-8701 Rev C and attached here.
3.	B269-475-16-50-0001 Rev B	Page 2566 of 7166	SINGLE LINE DIAGRAM – RODM, CPU, ZLD PACKAGE	Modification: Single Line Diagram – RODM/CPU/ZLD Doc. B269-475-16-50-0001 Rev B is replaced & superseded by B269-475-16-50-0001 Rev C and attached here.
4.	B269-475-16-50-0011 Rev A	Page 2567 of 7166	SINGLE LINE DIAGRAM – RWTP PACKAGE	Modification: Single Line Diagram – RWTP Doc. B269-475-16-50-0011 Rev A is replaced & superseded by B269-475-16-50-0001 Rev B and attached here.
5.	B269-475-16-50-3001 Rev B	Page 2574 of 7166	SCOPE BLOCK DIAGRAM – RODM/CPU/ZLD PACKAGE	Modification: Scope Block Diagram – RODM/CPU/ZLD Doc. B269-475-16-50-3001 Rev B is replaced & superseded by B269-475-16-50-3001 Rev C and attached here.
6.	B269-475-16-50-3011 Rev A	Page 2573 of 7166	SCOPE BLOCK DIAGRAM – RWTP PACKAGE	Modification: Scope Block Diagram – RWTP Doc. B269-475-16-50-3001 Rev A is replaced & superseded by B269-475-16-50-3001 Rev B and attached here.
7.	B269-475-16-50-SL-8701 Rev B	Page 2944 of 7166	LIST OF SPARE PARTS	Modification: List of Mandatory Spares Parts (Electrical) Doc. B269-475-16-50-SL-8701 Rev B is replaced & superseded by B269-475-16-50-SL-8701 Rev C and attached here.

8.	B269-475-16-50-VR-8701	5, 8, 10, 23 Page 2 to 4	VENDOR REQUIREMENTS DATA	<p>Modification: Cl. No. 5 is modified as below: Load Analysis, Transformer sizing, Capacitor sizing, HV Cable sizing.</p> <p>Cl. No. 8 is modified as below: Electrical Load Data: Tick Mark (√) against "WITH BID" at 1st Column also. (Electrical Load Data for PACKAGE (Individually for RWTP, RODM/ZLD/CPU and CPU-PNCP) including emergency process load & other loads such as UPS system load for Control Room & Substation, DC System load and emergency lighting load etc. shall be furnished at Bid Stage)</p> <p>Cl. No. 10 is modified as below: Purchase Requisitions for Critical custom built equipment (E.g. HV switchboards & Isolator Breaker Panels, HV Capacitors, MV Switchboards, Distribution Transformers, UPS Systems, HV cables, etc.)</p> <p>Cl. No. 23 is modified as below: Critical Vendor Drawings for custom built equipments (E.g.) GA,SLD, Data sheet (HV Switchgears & Isolator breaker panels, HV capacitor, MV Switchboard (PCC/EPMCC/MCC), Distribution Transformers, VFD/Soft Starter, UPS System, HV Motors etc.)</p>
9.	TABLE OF CONTENTS	Page 3, 13, 14, 16 of 7166	JOB SPECIFICATION, EIL SPECIFICATION, ITP (ELECTRICAL ATTACHMENTS)	<p>Deletion: Following DOCUMENTS are Deleted:-</p> <ul style="list-style-type: none"> (i) B269-999-16-50-SP-0022 (Job Spec. for Solar Rooftop Photo Voltaic System) (ii) B269-999-16-50-SP-0023 (Job Spec. for Online Moisture Removal System) (iii) 6-51-0021 Rev. 5 (Spec. for flameproof plugs, sockets & handlamps) (iv) 6-51-0022 Rev. 0 (Spec. for grid connected rooftop solar photovoltaic power system) (v) 6-51-0043 Rev. 7 (Spec. for Neutral Grounding Resistor) (vi) 6-51-0068 Rev. 0 (Spec. for EHV Power Transformer) (vii) 6-81-1021 Rev. 2 (ITP for flameproof plugs, sockets & handlamps) (viii) 6-81-1043 Rev. 4 (ITP for Neutral Grounding Resistor) (ix) 6-81-1061 Rev. 4 (ITP for hazardous area lighting fixture & junction boxes) (x) 6-81-1068 Rev. 0 (ITP for EHV Power Transformer)

10.	TABLE OF CONTENTS	Page 4, 5, 6, 7, of 7166	DATASHEETS(ELECTRICAL ATTACHMENTS)	(i) B269-999-16-50-DS-0001 Rev. A is replaced with Rev. B * (ii) B269-999-16-50-DS-0004 Rev. A is replaced with Rev. B * (iii) B269-999-16-50-DS-0005 Rev. A is replaced with Rev. B * (iv) B269-999-16-50-DS-0006 Rev. A is replaced with Rev. B * (v) B269-999-16-50-DS-0007 Rev. A is replaced with Rev. B * (vi) B269-999-16-50-DS-0008 Rev. A is replaced with Rev. B * (vii) B269-999-16-50-DS-0010 Rev. A is replaced with Rev. B * (viii) B269-999-16-50-DS-0012 Rev. A is replaced with Rev. B * (ix) B269-999-16-50-DS-0016 Rev. A is replaced with Rev. B * (x) B269-999-16-50-DS-0105 Rev. A is replaced with Rev. B * (xi) B269-999-16-50-DS-1001 Rev. A is replaced with Rev. B * *Copy of latest Datasheet is attached herewith .
11.	TABLE OF CONTENTS	Page 5, 6, 7 of 7166	DATASHEETS(ELECTRICAL ATTACHMENTS)	Deletion: Following Datasheets are Deleted:- (i) B269-999-16-50-DS-0002 Rev. A (HV Bus duct) (ii) B269-999-16-50-DS-0003 Rev. A (Hardware datasheet for incomer from Transformer) (iii) B269-999-16-50-DS-0304 Rev. A (Power Transformer) (iv) B269-999-16-50-DS-0351 Rev. A (NGR) (v) B269-999-16-50-DS-0922 Rev. A (EOT crane) (vi) B269-999-16-50-DS-0931 Rev. A (Solar Module) (vii) B269-999-16-50-DS-0932 Rev. A (Power Conditioning Unit) (viii) B269-999-16-50-DS-1016 Rev. A (Hardware datasheet Hydroblasting power panel)
12.	TABLE OF CONTENTS	Page 13, 14 of 7166	EIL SPECIFICATION(ELECTRICAL ATTACHMENTS)	(i) 6-51-0018 Rev. 5 is replaced with 6-51-0018 Rev. 6 * (ii) 6-51-0019 Rev. 5 is replaced with 6-51-0019 Rev. 6 * (iii) 6-51-0044 Rev. 5 is replaced with 6-51-0044 Rev. 6 * (iv) 6-51-0047 Rev. 3 is replaced with 6-51-0047 Rev. 4 * (v) 6-51-0048 Rev. 3 is replaced with 6-51-0048 Rev. 4 * (vi) 6-51-0072 Rev. 6 shall be read as 6-51-0072 Rev. 5 ** *Copy of latest standard specification is attached herewith . **Copy of latest standard specification is already attached with Tender .
13.	TABLE OF CONTENTS	Page 16 of 7166	ITP (ATTACHMENTS)	(i) 6-81-1020 Rev. 3 is replaced with 6-81-1020 Rev. 4 * (ii) 6-81-1071 Rev. 2 is replaced with 6-81-1071 Rev. 3 * *Copy of latest ITP is attached herewith .

14.	TABLE OF CONTENTS	Page 19, 20 of 7166	ELECTRICAL ATTACHMENTS	<p>(i) 7-51-0002 Rev. 5 is replaced with 7-51-0002 Rev. 6 *</p> <p>(ii) 7-51-0011 Rev. 5 is replaced with 7-51-0011 Rev. 6 *</p> <p>(iii) 7-51-0021 Rev. 5 is replaced with 7-51-0021 Rev. 6 *</p> <p>(iv) 7-51-0102 Rev. 7 is superseded by B269-999-16-50-4004 Rev. 0 **. Also 7-51-0101 Rev. 5 stands "Deleted".</p> <p>(v) 7-51-0103 Rev. 6 is replaced with 7-51-0103 Rev. 7 *</p> <p>(vi) 7-51-0104 Rev. 5 is replaced with 7-51-0104 Rev. 6 *</p> <p>(vii) 7-51-0105 Rev. 6 is replaced with 7-51-0105 Rev. 7 *</p> <p>(viii) 7-51-0106 Rev. 5 is replaced with 7-51-0106 Rev. 6 *</p> <p>(ix) 7-51-0107 Rev. 5 is replaced with 7-51-0107 Rev. 6 *</p> <p>(x) 7-51-0108 Rev. 6 is replaced with 7-51-0108 Rev. 7 *</p> <p>(xi) 7-51-0109 Rev. 5 is replaced with 7-51-0109 Rev. 6 *</p> <p>(xii) 7-51-0111 Rev. 5 is replaced with 7-51-0111 Rev. 6 *</p> <p>(xiii) 7-51-0115 Rev. 5 is replaced with 7-51-0115 Rev. 6 *</p> <p>(xiv) 7-51-0116 Rev. 7 is replaced with 7-51-0116 Rev. 8 *</p> <p>(xv) 7-51-0214 Rev. 5 is replaced with 7-51-0214 Rev. 6 *</p> <p>(xvi) 7-51-0224 Rev. 6 "Cable Termination for motors cable dropping along column (for HV/ MV Motors)" to be read as "Typical Installation of Weatherproof Light Fixture"</p> <p>**</p> <p>(xvii) 7-51-0332 Rev. 3 is replaced with 7-51-0332 Rev. 4 *</p> <p>(xviii) 7-51-0335 Rev. 3 is replaced with 7-51-0335 Rev. 4 *</p> <p>(xix) 7-51-0336 Rev. 3 is replaced with 7-51-0336 Rev. 4 *</p> <p>*Copy of latest standard is attached herewith.</p> <p>**Copy of Job specific standard is already attached with Tender.</p>
15.	TABLE OF CONTENTS	Page 24 of 7166	EIL STANDARD (ELECTRICAL ATTACHMENTS)	<p>Addition: Following EIL Standards are added:-</p> <p>(i) 7-51-0207 Rev. 6 (Typical installation of street light fixture) *</p> <p>(ii) 7-51-0208 Rev. 7 (Typical marshalling box details for lighting poles) *</p> <p>(iii) 7-51-0209 Rev. 6 (General arrangement for flood light mast) *</p> <p>(iv) 7-51-0223 Rev. 5 (Typical installation of flood light fixture) *</p> <p>(v) 7-51-0234 Rev. 1 (Typical installation for street lighting fixture with precast foundation) *</p> <p>(vi) 7-51-0324 Rev. 5 (Cable Termination for motors cable dropping along column - for HV/ MV Motors)</p> <p>(vii) 7-51-0327 Rev. 1 (Typical Details for cable crossing the dyke wall in tank farm area) *</p> <p>*Copy of latest standard specification is attached herewith.</p>

16.	TABLE OF CONTENTS	Page 24 of 7166	EIL SPECIFICATION (ELECTRICAL ATTACHMENTS)	Addition: Following EIL Specifications are added:- (i) 6-51-0088 Rev. 4 (Specification for electrical work as part of paving works) * (ii) 6-51-0093 Rev. 5 (Specification of electrics of package equipment) * *Copy of latest standard specification is attached herewith .
17.	TABLE OF CONTENTS	Page 24 of 7166	DATASHEETS (ELECTRICAL ATTACHMENTS)	Addition: Following Datasheets are added:- (i) B269-999-16-50-DS-0014 Rev. A (Hardware Datasheet – Tie feeder for VFD driven motor with bypass) * *Copy of latest datasheet is attached herewith .
18.	B269-999-16-50-DS-0104 Rev A	Page 2394 of 7166	DATASHEET FOR MV SWITCHBOARD COMPONENTS	Addition: Following sentences are added to NOTE-1 at the end For 240V 1-ph AC motors (except MOVs) rating less than < 0.18kW, DMPR is not applicable and suitable standard motor protection features shall be provided. However for motor rating $0.18 \leq kW \leq 55$, DMPR shall be provided.
19.	B269-999-16-50-3003 Rev A	Page 2571 of 7166	BLOCK DIAGRAM for NUMRICAL RELAY LAN & SUBSTATION AUTOMATION SYSTEM	Addition: Following New Note shall be added at the end:- Note-14: All Multi Function Meter (MFM) in HV & MV switchboards shall be communicable type. Complete data of MFM shall be accessible in the SAS (through switchboard level Ethernet Switches) & associated SAS Laptop/ HMI. The protocol for communication shall be over RS-485 or fibre optic cable, preferably with IEC protocol. Accordingly, protocol converters/ gateways at suitable locations as required shall be provided by CONTRACTOR for data integration on IEC 61850 protocol from Master Ethernet Switch to Owner's ECS system.
20.	B269-999-16-50-3003 Rev A	Page 2571 of 7166	BLOCK DIAGRAM for NUMRICAL RELAY LAN & SUBSTATION AUTOMATION SYSTEM	Deletion: Following shall be Deleted from the Block Diagram:- Solar Power System
21.	B269-475-16-50-3002 Rev B	Page 2572 of 7166	SCOPE DIVISION BLOCK DIAGRAM SYSTEM for ECS	Addition: Following New Note shall be added at the end:- Note-6: Size of ECS panels shall be as per ECS interface input to be provided by the CONTRACTOR during detailed engineering. Based on same, space requirement, heat load and power requirement shall be provided during detailed engineering.

(SIGNATURE AND STAMP OF BIDDER)

SCOPE OF SUPPLY & WORK **(ELECTRICAL)** **FOR** **RWTP / RODMP / ZLDP / CPU PACKAGE** **(TENDER NO. B269-475-17-44-PA-T-8701)**

CLIENT : INDIAN OIL CORPORATION LTD.

PROJECT : PANIPAT REFINERY EXPANSION PROJECT (P-25)

JOB NO. : B269

D	08.03.2022	REVISED AND REISSUED FOR BIDS	SNM	MK	HK
C	28.06.2021	REVISED AND REISSUED FOR BIDS	AKG	HK	HK
B	27.11.2020	REVISED AND REISSUED FOR BIDS	AKG	HK	HK
A	15.05.2020	ISSUED FOR BIDS	SK	HK	HK
REV. NO	DATE	PURPOSE	PREPARED BY	REVIEWER	APPROVER

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4. WORKS EXCLUDED.....	15

1. SCOPE OF SUPPLY & WORK

The electrical work shall include, but not be limited to, Design and Engineering, Detailed engineering, System Study, Relay setting and coordination using ETAP, Preparation of drawings and documents as specified, sizing, selection, procurement, transportation to site, storage at site, supply of all materials / equipment, all tools and tackles, installation, testing, commissioning including supply of Mandatory spares & commissioning spares as required and handing over of all electrical work complete in all respects as per data sheets, drawings, specifications, standards etc., specified in the bid package for the RWTP/ RODMP / ZLDP / CPU for Panipat Refinery Expansion Project (P-25), Panipat of M/s IOCL-PR. Major equipment and materials shall include but not be limited to the following:

Sr. No.	Description	Design & Engg.	Supply	Installation	Testing and Commissioning
1.	6.6kV, (Ampere rating by contractor), 40kA (1 Sec), Draw out type Switchboard with VCB.	✓	✓	✓	✓
2.	6.6kV, (kVAR rating by contractor), panel mounted Capacitor banks with APFC Panel, RVT & series reactor.	✓	✓	✓	✓
3.	6.6/0.433kV, (kVA rating by contractor) distribution transformers for Normal and Emergency power supply	✓	✓	✓	✓
4.	415V, (Ampere rating by contractor), 65 kA (1 Sec) Bus ducts (As required) from distribution transformers to switchboards.	✓	✓	✓	✓
5.	415V, (Ampere rating by contractor), 65 kA (1 sec.) single front, draw out Power & Motor Control Centre (PMCC)	✓	✓	✓	✓
6.	415V, (Ampere rating by contractor), 65 kA (1 sec.) single front, draw out Motor control centres (MCC)	✓	✓	✓	✓
7.	415V, (Ampere rating by contractor), 65 kA (1 sec.) single front, draw out Emergency Power Control Centre (EPMCC)	✓	✓	✓	✓
8.	415V, (Ampere rating by contractor), 65 kA (1 sec.) single front, draw out Auxiliary Service board (ASB)	✓	✓	✓	✓
9.	415V/ 415V, (kVA rating by contractor) Lighting Transformers for Normal Lighting	✓	✓	✓	✓

Sr. No.	Description	Design & Engg.	Supply	Installation	Testing and Commissioning
10.	415V/ 415V, (kVA rating by contractor) Lighting Transformers for Emergency Lighting	✓	✓	✓	✓
11.	415V, (Ampere rating by contractor), 25 kA (1 sec.) single front, draw out Lighting Distribution Board (LDB)	✓	✓	✓	✓
12.	415V, (Ampere rating by contractor), 25 kA (1 sec.) single front, draw out Emergency Lighting Distribution Board (ELDB)	✓	✓	✓	✓
13.	110V AC, Parallel redundant with individual bypass UPS system with associated Nickel Cadmium battery (2x100% configuration), ACDB, Cell Booster etc for DCS/PLC/Instrumentation loads as per Sketch attached with the Design Basis with Online Battery Monitoring System	✓	✓	✓	✓
14.	230V AC, Parallel redundant with individual bypass UPS system with associated Nickel Cadmium battery (2x100% configuration), ACDB, Cell Booster etc for providing Control supply to Thyristor Panel, VFD, ECS, LAN system etc. as per Sketch attached with the Design Basis.	✓	✓	✓	✓
15.	110V DC supply system comprising parallel redundant battery chargers, Nickel Cadmium battery (2x50% configuration), DCDB, cell booster for switchgear protection & control with Online Battery Monitoring System	✓	✓	✓	✓
16.	220V DC supply system comprising parallel redundant battery chargers, Nickel Cadmium battery (2x50% configuration), DCDB, cell booster for critical lighting	✓	✓	✓	✓
17.	Power system for the package including preparation of report, drawings and documents as required, implementation, collection of all data, documents	✓	✓	✓	✓

Sr. No.	Description	Design & Engg.	Supply	Installation	Testing and Commissioning
	and information from Owner and various packages.				
18.	Substation Automation system, HMI (Common operator station cum engineering station), GPS for substation complete with necessary cabling and interface with upstream system.	✓	✓	✓	✓
19.	Variable frequency drives systems complete with input transformer, switchboard/panels of required voltage rating with by pass as required for variable speed motors as specified elsewhere in the package. (For critical drives with VFD wherein only one drive is there for the service, hot standby redundant VFD shall be provided additionally as per the requirement given in design basis and elsewhere in the package)	✓	✓	✓	✓
20.	Soft starters (VFD based) complete with input transformer, switchboard/panels of required voltage rating with by pass for start-up of large rated motors.	✓	✓	✓	✓
21.	Local control stations for all equipments, emergency push buttons, dual push button in transformers bays etc., as required.	✓	✓	✓	✓
22.	Industrial type Weatherproof (min. IP-55) Power distribution boards (PDBs) for feeding MOVs inside unit battery limit.	✓	✓	✓	✓
23.	415V, (Ampere rating by contractor) Fixed type space heater power distribution boards (PDBs).	✓	✓	✓	✓
24.	DC & AC Junction boxes as required.	✓	✓	✓	✓
25.	All electrics for MOV Actuators.	✓	✓	✓	✓
26.	All HV & MV motors, as required with respective equipments along with associated canopies and other accessories	✓	✓	✓	✓

Sr. No.	Description	Design & Engg.	Supply	Installation	Testing and Commissioning
27.	Electrics of EOT Crane including local isolator, motors, controls, interlocks, safety devices, lighting etc.	✓	✓	✓	✓
28.	Plant communication system equipment such as central exchange, operator & field call stations, loud speakers, beacon lamps, acoustic hoods and associated power supply modules, amplifiers, power pack, marshalling rack for field call stations, amplifier rack etc.	✓	(Note-b)	✓	(Note-d)
29.	Public address junction box (PAJB) and plant communication system cables from PA System Central Exchange onwards to all field equipments within package battery limit	✓	✓	✓	✓
30.	All Cables, junction boxes, cable glands, lugs, cable terminations, installation materials, structural supports etc., required for installation of all owner supplied equipment for plant communication system within the package battery limit.	✓	✓	✓	✓
31.	Detailed engineering, block/speech diagram, layout drawings, cable schedule, interconnection diagram etc. for the plant communication system including owner supplied equipment within the package battery limit.	✓	✓	✓	✓
32.	Fire alarm system equipments such as DGFAP, Break glass type manual call points, Detectors, Exit Signs, Hooters, HAB, Input/output relay, CRM etc.	✓	(Note-c)	✓	(Note-d)
33.	Fire alarm system cables, Junction box, cables glands, lugs, cable terminations, installation materials, structural supports etc. Required for installation of all owner supplied equipments for Fire alarm system within the package battery limit.	✓	✓	✓	✓

Sr. No.	Description	Design & Engg.	Supply	Installation	Testing and Commissioning
34.	Detailed engineering, layout drawings, cable schedule, interconnection diagram etc. for the Fire Alarm system including owner-supplied equipment within the package battery limit.	✓	✓	✓	✓
35.	Interface of the Contractor supplied fire suppression system with Owner's FA system, including all cables, trays, trenches, supports etc.	✓	✓	✓	✓
36.	Main incoming telephone system junction box (TJB), Safe area telephone sets, telephone system cables from TJB onwards to safe area equipments, acoustic hoods within package battery limit.	✓	✓	✓	✓
37.	All cables, cable glands, cable termination and connection of cables from Main incoming junction box to junction boxes, field equipments within package battery limit.	✓	✓	✓	✓
38.	Detailed engineering, block diagrams, telephone layout drawings, cable schedule, interconnection diagram, and cable layout for the telephone system within the package battery limit.	✓	✓	✓	✓
39.	Termination of Main incoming Plant Communication system and telephone system cables to the Junction boxes of respective systems within the package battery limit.	✓	✓	✓	✓
40.	Termination of Main incoming Data highway OFC Fire alarm cable to DGFAP within the package battery limit including supply of OFC cable termination kit	✓	✓	✓	✓
41.	Power supply Feeders, cables, lighting fixtures etc. for beacon lamps, acoustic hoods, within package battery limit for plant communication and telephone system.	✓	✓	✓	✓

Sr. No.	Description	Design & Engg.	Supply	Installation	Testing and Commissioning
42.	Industrial type Weather proof 415V welding receptacles (63A and 100A), 240V convenience receptacles.	✓	✓	✓	✓
43.	Normal, emergency and critical lighting system within the package battery limit comprising of lighting system for the buildings and Plant including aviation lighting for tall structures, platform / floor lighting poles, lighting and power panels, fixtures with lamps, hand lamps (including flexible cables, hand-lamp sockets), exhaust fans etc., complete wiring and cabling.	✓	✓	✓	✓
44.	Termination of all Power cables, associated control cables and OFC cables terminating on Contractor's equipment and originating outside package battery limit	✓	✓	✓	✓
45.	6.6kV Power cables and associated control cables from Contractor's 6.6kV switchboard to loads within package battery limit	✓	✓	✓	✓
46.	6.6kV outgoing power cables and associated control cables from package contractor 6.6KV switchboard to Free-issued loads installed in the package battery limit.	✓	✓	✓	✓
47.	All I/O cabling from Contractor's equipments (Switchgears, Transformers, UPS System, DC System, VFD Panels etc.) to SAS and ECS Interface Panels.	✓	✓	✓	✓
48.	Serial link / LAN cables in between numerical relays, ECS RTU, HMI, other electrical equipment for serial connectivity.	✓	✓	✓	✓
49.	ECS Interface Panels (transducer panel, Dummy panel, Interposing relay panel) ECS RTU Panels etc.	✓	X	✓	X
50.	Control cables from/to CR/SRR for DCS/PLC interface for all loads installed within package	✓	✓	✓	✓

Sr. No.	Description	Design & Engg.	Supply	Installation	Testing and Commissioning
	battery limit including free issued items.				
51.	All 1.1kV XLPE insulated MV cables for power, control, lighting, for Contractor supplied equipments within the package battery limit including Fire Survival cables, as required	✓	✓	✓	✓
52.	All 1.1kV XLPE insulated MV cables for power, control, lighting, for Owner supplied equipments within the package battery limit including Fire Survival cables, as required.	✓	✓	✓	✓
53.	All cable trays, cable ducts, supports, RCC cable trenches, conduits, RCC Culvert, ERCs (Electrical Road Crossings) within the package battery limit for all cables being supplied by contractor and all cables being supplied/ installed by owner for power, control, fire alarm, communication, telephone, ECS data highway and other systems.	✓	✓	✓	✓
54.	Complete layout engineering for Owner supplied cables inside package battery limit	✓	✓	✓	✓
55.	Miscellaneous civil material like sand, stone dust, gravels, bricks, plain cement concrete, bitumen etc.	✓	✓	✓	✓
56.	Cable accessories / installation materials such as weatherproof / flameproof double compression cable glands, termination kits, straight through joints, adapters, tag numbers, cable markers, cable ferrules, lugs, supports, saddles, GI pipes for above ground cable protection, floor sleeves, supports and all other associated accessories.	✓	✓	✓	✓
57.	Complete earthing & lightning protection system within package battery limit including clean earth system, maintenance free chemical earth pits with copper electrode, earth strips, earth plates, earthing cables etc. for all	✓	✓	✓	✓

Sr. No.	Description	Design & Engg.	Supply	Installation	Testing and Commissioning
	equipments (Owner/Contractor's) installed within package battery limit and interconnection of earth grid of package with the owner's main plant grid.				
58.	3-D Modelling in PDMS	✓	-	-	-
59.	Safety equipment such as, shock hazard charts, first aid boxes, caution boards, apron, gas mask, eye shields, discharge rods, DCP portable CO ₂ fire extinguishers, sand buckets, insulating mats, 7.2 KV grade hand gloves and other equipment for safety of all electrical equipment and personnel as per statutory regulations.	✓	✓	✓	✓
60.	Epoxy based insulating paint on complete flooring of switchgear halls in substation floor	✓	✓	✓	✓
61.	Non-UPS electrical power supply for Instrumentation.	✓	✓	✓	✓
62.	Chequered plates for covering floor cutouts, cable trenches etc.	✓	✓	✓	✓
63.	Electrics for HVAC, Electric heat tracing, electric heater, lift/elevator etc.	✓	✓	✓	✓
64.	Electrics for fire suppression system, HVWS system as applicable.	✓	✓	✓	✓
65.	All Civil works required for installation of electrical equipment, supports for cables / cable trays for completion of electrical works.	✓	✓	✓	✓
66.	Commissioning spares required during commissioning.	✓	✓	✓	✓
67.	Mandatory spares as specified in mandatory spare parts list.	-	✓	-	-
68.	Painting of all structural steel supports provided for installation (for all electrical equipment, associated components, cables, earthing) and letter & tag painting on equipments, etc.	✓	✓	✓	✓
69.	Fire proofing of cables and fire sealing of opening in substation	✓	✓	✓	✓

Sr. No.	Description	Design & Engg.	Supply	Installation	Testing and Commissioning
	through fire barrier				
70.	Inspection and Factory Acceptance Tests including type tests for electrical equipment as defined elsewhere in the package.	✓	✓	✓	✓
71.	Special tools and tackles (as required).	-	✓	-	-
72.	All LAN System passive components such as CAT-6 cables LAN cabling, face plates, UTP Jacks, patch cords, LIUs, Rack panels, UPS power distribution panels within Control Room, substation and other buildings within package battery limit. (Connection with overall refinery LAN system shall be done by others.)	✓	✓	✓	✓
73.	All LAN System active components such as core/network switches, etc., within Control Room, substation and other buildings (Support for testing & commissioning shall be provided by Pkg. Vendor)	✓	-	✓	-
74.	CPU Package in PNCP : All electrical works (Note- j)	✓	✓	✓	✓
75.	All documents, layouts and calculations as listed in the vendor data requirements documents (B269-475-16-50-VR-8701)	✓			

Note:

- "TICK" denotes contractor's scope. Wherever in description substation number is mentioned, same is for clarity purpose only in line with the indicative SLD attached with the tender.
- Maximum number of Communication system equipments considered in OWNER's scope of supply shall be as listed below. Any additional requirement over and above the listed quantities shall be in contractor's scope. The make of these additional equipment's shall be of identical make, type & model no. as that of the free-issued equipment's. Make & model no. of free-issued plant communication equipment's and PA communication cable size shall be informed to the Contractor during detail engineering.

For RODM/ZLD/CPU Area

- PA Exchange – 1 no.
- Operator Call Station – 2 Nos.
- Master Call Station – 1 no.

- Field call station with weatherproof loudspeakers 25W (FCS + Ext loudspeaker) – 35 Nos.
- Accoustic hood – 5 Nos.
- Beacon Lamp – 5 Nos.

For RWTP Area

- Operator Call Station – 2 Nos.
- Master Call Station – 1 no.
- Field call station with weatherproof loudspeakers 25W (FCS + Ext loudspeaker) – 15 Nos.
- Accoustic hood – 5 Nos.
- Beacon Lamp – 5 Nos.

- c.) Maximum number of Fire Alarm system equipments considered in OWNER's scope of supply shall be as listed below. Any requirement over and above the listed quantities shall be in contractor's scope. The make of these additional equipment/devices shall be of identical make, type & model no. as that of the free-issued equipment/devices. Make & model no. of free-issued fire alarm equipment and fire alarm cable sizes shall be informed to the Contractor during detail engineering

For RODM/ZLD/CPU Area

- Data gathering cum fire alarm panel (DGFAP) – 1 no.
- Intelligent adressable multi sensor detector – 375 Nos.
- Intrinsic safe intelligent addressable heat detector – 150 Nos.
- Manual call point (MCP) safe area type – 28 Nos.
- Electronic hooters addressable – 10 Nos.
- Exit signs addressable (Single faced) – 10 Nos.
- Exit signs addressable (Double faced) – 4 Nos.
- Hooter Acknowledgement Box – 3 Nos.
- Relay Module – 10 Nos.
- Input module – 9 Nos.
- Fault Isolator Module – 18 Nos.

For RWTP Area

- Data gathering cum fire alarm panel (DGFAP) – 1 no.
- Intelligent adressable multi sensor detector – 345 Nos.
- Intrinsic safe intelligent addressable heat detector – 20 Nos.
- Manual call point (MCP) safe area type – 15 Nos.
- Electronic hooters addressable – 10 Nos.
- Exit signs addressable (Single faced) – 10 Nos.
- Exit signs addressable (Double faced) – 4 Nos.
- Hooter Acknowledgement Box – 3 Nos.
- Relay Module – 8 Nos.
- Input module – 7 Nos.
- Fault Isolator Module – 19 Nos.

- d.) Testing and commissioning of the Fire alarm System, Plant Communication system and Telephone system will be done by others (respective system vendors). However, necessary co-ordination, assistance & interface support to vendors of the Fire Alarm System, Plant Communication system, and Telephone system as required during testing & commissioning

such as connection / disconnection / re-connection of cables etc., including all manpower is included in the contractor's scope for successful commissioning and putting into operation of the system.

- e.) Any other equipment not specifically mentioned above but required for normal operation of the Package is included in the scope of CONTRACTOR
- f.) Contractor shall provide following set of spare feeders for Owner's use in the Contractor supplied various switchboards (located in Contractor's substation) :

In SS-112 in RODM/ZLD/CPU Area

Sr. No	Switchboard	Feeder Type/Rating	Quantity	Total Load to be considered for sizing
1.	PMCC	400A ACB	3	2 x 150kVA
2.	ASB	SFUC / 63A	4	3 x 30kVA
3.	ASB	SFUC / 160A	2	1 x 60kVA
4.	LDB	SFUC / 1x160A+4x63A (For Outdoor Lighting)	2	1 x 20kVA
5.	ELDB	SFUC / 1x160A+4x63A (For Outdoor Lighting)	1	1 x 10kVA
6.	EPCC	132kW Breaker DOL Motor Feeder	5	3 x 132kW

In SS-122 in RWTP Area

Sr. No	Switchboard	Feeder Type/Rating	Quantity	Load to be considered for sizing
1.	PMCC	400A ACB	3	3 x 150kVA
2.	ASB	SFUC / 63A	4	4 x 30kVA
3.	ASB	SFUC / 160A	2	2 x 60kVA
4.	ASB	SFU / 160A	2	2 x 60kVA
5.	LDB	SFUC / 1x160A+4x63A (For Outdoor Lighting)	2	2 x 20kVA
6.	ELDB	SFUC / 1x160A+4x63A (For Outdoor Lighting)	1	1 x 10kVA
7.	EPCC	SFU / 63A	2	1 x 30kVA
8.	EPCC	7.5kW FVNR DOL Motor Feeder	3	1 x 7.5kW
9.	EPCC	45kW FVNR DOL Motor Feeder	3	1 x 45kW
10.	HV SWBD	250kW Breaker DOL Motor Feeder	4	2 x 250kW
11.	MCC	15kW FVNR DOL Motor	4	2 x 15kW

Sr. No	Switchboard	Feeder Type/Rating	Quantity	Load to be considered for sizing
		Feeder		

- g.) In Substation-112, 6.6kV HV switchboard fed from plant feeder, HV capacitor banks, other electrical systems i.e. UPS system, DC system, ECS system, FA system, PA system & telephone system, Emergency switchboard (including 415V EPMCC), ASB, Lighting system (including LDB, ELDB) etc. shall be common for the package sub units i.e. RODMP, ZLDP & CPU.

However, distribution transformers and associated MV switchboards (PMCC & MCC) shall be separate for feeding the MV loads of the following sub units:

- RODMP+CPU
- ZLDP.

- h.) For RWTP, separate substation SS-122 shall be provided having 6.6kV HV switchboard fed from plant feeder, HV capacitor banks, distribution transformers, PMCC, MCC, EPMCC and other electrical systems i.e. UPS system, DC system, ECS system, FA system, PA system & telephone system, ASB, Lighting system (including LDB, ELDB) etc.
- i.) For RWTP & RODM/ZLD/CPU, Cable routing from Owner's Substation to Package Battery limit shall be as per Annexure-A attached with bid document. Contractor shall refer this for guidance purpose.
- j.) For CPU Package in PNCP complex area, refer Existing CPU Equipment Layout including Substation-10 enclosed elsewhere in the bid package. Contractor's supplied equipments shall be fed from this Substation-10. All required power supply feeders & lighting feeders including providing extension panels to existing 415V Switchboards in Substation-10 is included in Contractor's scope. Further, power supply & other associated electrical works including cabling, lighting, earthing etc. complete in all respect for feeding complete CPU package loads in PNCP complex shall be in Contractor's scope of supply & work. Contractor shall furnish the electrical load list along with their rating during bid submission and during detail engineering.

2. STATUTORY APPROVALS

The contractor shall obtain approvals from the concerned electrical inspectorate for installation drawings and engineering of the electrical system and equipment covered under the contractor's scope. Any modification or additional requirements of the electrical inspectorate shall have to be carried out by the contractor at his own cost without affecting time schedule. Arranging for any other approvals required for the complex, from agencies such as CCOE etc. are included in the contractor's scope. For electrical equipment to be installed in hazardous area statutory approval certificates shall be furnished by the contractor. Any additional testing, if required, shall be carried out by the contractor without affecting project time schedule at no extra cost to Owner.

3. TRAINING AT SITE

Training to owner's Engineers at P-25 site for various electrical systems based on the following requirements shall be included in contractor's scope:

Sr. No.	Package	Total Man days	Days	Person from Elect.
1	Variable frequency drive system	20	10	2
2	Numerical relay and SAS	10	5	2
3	DC System	20	10	2

Sr. No.	Package	Total Man days	Days	Person from Elect.
4	UPS System	20	10	2
5	Electric Heater	10	10	1
6	EOT/ HOT	5	5	1
7	HV Motors rated ≥ 2 MW	20	10	2

4. WORKS EXCLUDED

The following works / item are excluded from the scope of the contractor:

- 4.1. Supply and laying of Plant Communication system cables up to the Central Exchange originating from outside the package battery limit.
- 4.2. Supply and laying of telephone system cables up to the Junction box for cables originating from outside the package battery limit.
- 4.3. Supply and laying of Data highway OFC Cable up to DGFAP for Fire Alarm System.
- 4.4. Supply, testing and commissioning of the fire alarm system including Data Gathering Fire Alarm Panels (DGFAP), detectors, manual call points, exit signs, sirens, hooters, hooter acknowledge boxes, power supply modules etc. to be installed in the package battery limit as part of the system for the entire complex.
- 4.5. Supply, testing and commissioning of plant communication system including Central exchange, Operator Call Station, field call stations, loud speakers, beacon lamps, acoustic hoods, power supply modules etc. to be installed in the package battery limit as a part of the system for the entire complex.
- 4.6. Provision of required telephone lines in the plant EPABX for use in package battery limit.
- 4.7. Supply and laying of 6.6kV Power cables and associated Control Cables from Owner's 6.6 kV switchboard to Contractor's 6.6kV Switchboard for normal power supply located in SS-112 for RODM/ZLD/CPU.
- 4.8. Supply and laying of 6.6kV Power cables and associated Control Cables from Owner's 6.6 kV switchboard to Contractor's 6.6kV Switchboard for normal power supply located in SS-122 for RWTP.
- 4.9. Supply and laying of 1.1 kV Power cable and associated Control cables from Owner's 415V Emergency Switchboard at a single point to each of the Contractor's 415V Emergency Switchboard located in SS-112 and SS-122, for emergency power supply.
- 4.10. Supply and laying of OFC Cables for Feeder differential protection, Status/Intertrip from Owner's 6.6kV Switchboard to Contractor's 6.6kV Switchboards in SS-112 & SS-122.
- 4.11. Supply of ECS Interface Panels, RTU panels and HMI for ECS.
- 4.12. Supply, erection, termination and commissioning of data highway cables at ECS RTU panels.
- 4.13. Supply, testing and commissioning of LAN System active components such as core/network switches, etc., within package battery limit shall be in Owner/others scope. Installation of these devices in substation building and control room building as per approved layout including cabling is in scope of CONTRACTOR.

JOB SPECIFICATION (ELECTRICAL) FOR RWTP / RODMP / ZLDP / CPU PACKAGE (TENDER NO. B269-475-17-44-PA-T-8701)

CLIENT : INDIAN OIL CORPORATION LTD.

PROJECT : PANIPAT REFINERY EXPANSION PROJECT (P-25)

JOB NO. : B269

D	08.03.2022	REVISED AND REISSUED FOR BIDS	SNM	MK	HK
C	28.06.2021	REVISED AND REISSUED FOR BIDS	AKG	HK	HK
B	27.11.2020	REVISED AND REISSUED FOR BIDS	AKG	HK	HK
A	15.05.2020	ISSUED FOR BIDS	SK	HK	HK
REV. NO	DATE	PURPOSE	PREPARED BY	REVIEWER	APPROVER

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1 GENERAL

1.1 INTRODUCTION

- 1.1.1 This specification along scope of work, design basis, design philosophy, equipment datasheets, equipment specifications, standards, drawings/ documents and other codes/ standards attached or referred shall form the basis for detailed design and engineering, manufacturing, supply, erection, testing, pre-commissioning, commissioning of the electrics covered in this tender for RWTP / RODM / ZLD / CPU Package for Panipat Refinery Expansion Project (P-25), of M/s IOCL – Panipat Refinery.
- 1.1.2 The work shall be carried out to the best workmanship, in conformity with the specifications, approved drawings/ construction drawings and the instructions of the owner or Engineer-in-Charge from time to time.
- 1.1.3 The contract shall include clearing of temporary constructions, waste materials and loose earth, which might get collected in and nearby the work site during execution of work and after final completion.

1.2 STANDARDS

- 1.2.1 The work / equipment shall comply with these specifications and the requirements of latest revision of codes & standards attached or referred to in the tender document. In case of any conflict between the various documents, the most stringent one shall be followed and Owner's/ EIL decision in this regard shall be final and binding. It is the responsibility of the Contractor to highlight any contradictions between various documents at the bid stage itself.
- 1.2.2 In case of imported equipment, codes and standards of the country of origin may be followed, if these standards are equivalent or stringent than the applicable Indian standards and meet the statutory regulations of approving Indian statutory bodies.
- 1.2.3 In addition, the work shall also conform to the requirements of latest editions/ amendments of the following:
- The CEA guidelines and rules framed there under.
 - The fire insurance Regulations.
 - Indian Petroleum Rules.
 - The regulations laid down by the Factory Inspectorate
 - The regulations laid down by the Chief Controller of Explosives.
 - The regulations laid down by Oil Industries Safety Directorate (OISD).
 - Any other regulations laid down by the Central, State or Local Authorities from time to time during the execution of this contract.

1.3 GUARANTEE

- 1.3.1 The contractor shall guarantee the installation for satisfactory operation against any defects of workmanship and materials (supplied by the contractor) for a period as specified elsewhere. Any damage or defect connected with the erection of materials, equipments or fittings supplied by the contractor that may be discovered at the time of issue of the completion certificate, or arise or come to light thereafter, shall be rectified or replaced by the contractor at his own expense as deemed necessary and as per the instruction of Owner or Engineer-in-Charge within the time limit specified by the Owner or Engineer-in-Charge.
- 1.3.2 The above guarantee shall be applicable for the quality of the work executed as well as for all equipment/ cables/ fixtures/ fittings/ other materials supplied by the contractor.

1.4 POWER SYSTEM DESCRIPTION

Following power feeders shall be provided for the two substation SS-112 & SS-122 to be located within the package battery limits of the CONTRACTOR.

- Two 6.6kV feeders, each rated for 100% load from 6.6kV Switchboard located at Owner's substation SS-100, will supply power to RODM / CPU / ZLD substation SS-112 located within the package battery limit of the contractor.
- Two 6.6kV feeders, each rated for 100% load from 6.6kV Switchboard located at Owner's Substation SS-100, will supply power to RWTP substation SS-122 located within the package battery limit of the contractor.

At SS-112, power will be received at 6.6kV switchboard (having two Incomers and bus sections interconnected by means of two bus couplers having fast bus transfer) via 6.6kV cables, for feeding the 6.6kV loads.

At SS-122, power will be received at the 6.6kV switchboard (having two Incomers and bus sections interconnected by means of two bus couplers having fast bus transfer) via 6.6kV cables, for feeding the 6.6kV loads.

All HV DOL Motors rated above 160kW shall be fed from 6.6kV Switchboard. 6.6kV power shall be stepped down to 415 V using 6.6/0.433 kV distribution transformers for feeding 415V loads of unit through power control centers, motor control centers and auxiliary service boards.

MV motors up to 55 kW will be fed from MCC whereas, motors rated above 55 kW and up to 160 kW will be fed from PMCC. Auto/Manual changeover facility shall be provided in PMCC & MCC while mechanical interlock shall be provided in incomers for ASB/LDB.

Auxiliary service board (ASB) shall have two incomers, one from normal PMCC and other from emergency EPMCC. Normally bus coupler in auxiliary switchboard shall remain closed while Incomer from emergency EPMCC shall remain open. During normal supply failure, normal supply incomer shall be opened and Emergency supply Incomer shall be closed. Auxiliary service board shall feed miscellaneous loads like welding receptacles, power panels, space heater panels, etc.

415 V systems is solidly earthed, whereas, 6.6 kV system is resistance earthed.

Emergency power shall be received at 415V level at a single point (at Contractor's 415V Emergency Switchboard i.e. 1 No. Incomer of EPMCC) individually in both SS-112 and SS-122. Other Incomer of EPMCC shall be fed from Contractor's 415V Normal Switchboard for normal power supply. Emergency loads such as Motors, Lighting, UPS System, DC System etc. shall be fed through emergency switchboards.

EPMCC will have two sections interconnected by a normally open bus-coupler. EPMCC shall be provided with auto transfer facility.

Plant normal lighting loads will be fed through normal lighting distribution board having two incoming supplies fed through 415V/415V lighting transformers fed from each bus section of normal PMCC.

25% of building and plant lighting will be on emergency. Emergency lighting load will be fed through an emergency lighting distribution board having both incoming supplies fed through 415V/415V lighting transformers from each bus section of EPMCC.

110AC UPS system shall be provided for Instrumentation process loads. UPS shall be located in separate UPS room in CR/SRR.

230V AC UPS system shall be provided for Control supply of VFD, Heater Control thyristor panels, LAN system, ECS system etc. This UPS shall be located in a separate room/partition in switchgear hall of substation.

110V DC System shall be provided for Switchgear protection and control circuits and shall be located in Substation building.

220V DC system shall be provided to feed critical DC lighting and shall be located in the substation building.

ECS system shall be procured & supplied by Owner. All equipments shall be connected to ECS for monitoring and control as per ECS IO list.

Typical key single line diagram drawing (B269-475-16-50-0001 & B269-475-16-50-0011) & scope block diagram (B269-475-16-50-3001) illustrates the typical power distribution scheme.

For CPU Package in PNCP complex area, refer Existing CPU Equipment Layout including Substation-10 enclosed elsewhere in the bid package. Contractor's supplied equipments shall be fed from this Substation-10. All required power supply feeders & lighting feeders including providing extension panels to existing 415V Switchboards in Substation-10 is included in Contractor's scope. Further, power supply & other associated electrical works including cabling, lighting, earthing etc. complete in all respect for feeding complete CPU package loads in PNCP complex shall be in Contractor's scope of supply & work. Contractor shall furnish the electrical load list along with their rating during bid submission and during detail engineering.

1.5 SITE CONDITION

For site conditions refer the clause 5.1 of Electrical Design Basis document B269-999-16-50-EDB-1001 enclosed with the package.

1.6 UTILIZATION VOLTAGE

For details of the utilization voltage refer the electrical design basis document B269-999-16-50-EDB-1001 enclosed with the package.

1.7 ADDITIONS / DELETIONS / MODIFICATIONS TO STANDARD SPECIFICATION

1.7.1 Specification for Medium and High Voltage cables & accessories (6-51-0051 Rev.8)

1.7.1.1 Clause No. 5.1.6 (b) shall be read as below:

"Temperature index as per ASTM-D-2863 i.e. to determine at what temperature normal oxygen content of 21% in air will support combustion of FRLS sheath will remain as 250°C".

1.7.1.2 Refer Cl. 6.3.1 and note that standard cable drum lengths for below mentioned cable sizes stands revised as mentioned below:

- Multi core power cables up to 50 sq.mm. – 2000 m
- Control cable of size up to 7x2.5 sq.mm. – 2000 m

1.7.1.3 The following point is added at the end of specification:

"For screen sizing calculations, final temperature to be considered shall be 200 °C under adiabatic conditions".

1.7.2 Specification for Communication and Fire Alarm Cables (6-51-0052 Rev. 7)

The following clauses of 6-51-0052 stands modified as below:

- 1.7.2.1 Cl. 4.4.3 – For XLPE insulated PA/FA/Telephone/Paired Control Cables, insulation thickness (nominal values) shall be as per IS-7098 (Part-1).
- 1.7.2.2 Cl. No. 6.3 (d) - Temperature index as per ASTM-D-2863 i.e. to determine at what temperature normal oxygen content of 21% in air will support combustion of FRLS sheath shall remain as 250°C.
- 1.7.2.3 Cl. No. 7.3 – Standard cable drum lengths for below mentioned cable sizes stands revised as mentioned below:
- PA/FA/Signal cable having size up to 6 pair 1.5 & 2.5 sq.mm. – 2000 m
 - PA/FA/Signal cable having size up to 10 pair 0.9 mm dia. – 2000 m
- 1.7.3 Specification for Uninterrupted Power Supply System (6-51-0017 Rev. 7)
- 1.7.3.1 The following is added at the end of Cl. No. 5.3.9 of specification:
- “The efficiency of DC-DC Converter / Buck Boost Amplifier shall be considered in battery sizing calculations as well as rectifier sizing calculations and capacity of battery and rectifier shall be accordingly sized”.
- 1.7.4 Specification for Battery Charger (6-51-0019 Rev. 6)
- 1.7.4.1 The following is added at the end of Note-2 on Page 14 & 15 of specification:
- “Battery isolator (MCCB/Switch Fuse) shall be provided with three pole version to ensure positive isolation of all the three connections of battery”.
- 1.7.4.2 The following is added to Cl. no. 5.2.1.8 Battery Charger:
- “Perforated sheet/Wire Mesh shall not be provided at the bottom of the charger as over a period of time these gets corroded / damaged resulting in easy access of vermin’s. Heat transfer system inside the charger shall be designed considering this aspect”
- 1.7.4.3 The following is added to Cl. no. 5.2.2.7 Printed Circuit Board :
- “Battery charger PCB electronic cards shall have conformal coating as per grade 3C3 (harsh environment) of IEC 60721-3-3 and certification for batch of supplied items shall be submitted by vendor for the same.
- 1.7.4.4 Clauses no. 5.3.1 “Construction of Chargers / Distribution Board” stands modified as below :
- “Each Battery Charger and DC distribution board shall be housed in a separate free standing cubicle with minimum IP-41 degree of protection, with common items for charger-1 & 2 housed in a separate vertical panel....”
- 1.7.5 Electrical Installation Standards 7-51-0201 Rev. 6, 7-51-0202 Rev. 6, 7-51-0221 Rev. 5 & 7-51-0233 Rev. 1
- 50 Dia. GI Pipe and 100 Dia. GI Pipe mentioned wherever in the standards shall be read as 50 NB (Medium Grade) GI Pipe and 100 NB (Medium Grade) GI Pipe respectively.

1.8 ENGINEERING AND JOB SPECIFIC REQUIREMENTS

- 1.8.1 Various equipment (to be supplied by CONTRACTOR) covered in this tender, shall be in compliance with the requirements defined in design philosophy, equipment datasheets and standards specifications attached/ referred. Besides these, the requirements as defined in respective clauses for individual equipment, referred elsewhere in this document shall also be considered/ complied with.
- 1.8.2 CONTRACTOR shall ensure that all electrical equipment shall comply with the site and system conditions, ratings and other technical requirement specified elsewhere with the documents attached with the tender.

- 1.8.3 CONTRACTOR shall use this specification, datasheet, design philosophy document and OWNER/ Consultant's standard specifications for various equipments. For equipments, where OWNER/Consultant standard specifications are not available, have not been attached, CONTRACTOR/ SUPPLIER shall use their own specification, developed based on project specific requirement and good engineering practices prevalent in petroleum industry, so as to ensure satisfactory operation and maintenance conditions. CONTRACTOR to however check from OWNER/ EIL with respect to availability of EIL standard/ specification, before use of their own specification
- 1.8.4 CONTRACTOR shall note that data sheets for some of the equipment are not enclosed separately. Equipment data sheets for such equipments shall be prepared by the CONTRACTOR/ SUPPLIER based on relevant codes and specifications and the data sheet shall contain all technical data and information which is essential for the purpose of review and technical acceptability, detailed engineering, installation, testing, repair and maintenance, replacement, etc. of the equipments. CONTRACTOR to however check from OWNER/ EIL with respect to availability of standard datasheet, before use of their own datasheet
- 1.8.5 The CONTRACTOR shall also prepare data sheets mentioned in OWNER/ Consultant standard specifications, but not enclosed with the package.
- 1.8.6 The equipment shall in general conform to latest revision of statutory regulations, Indian Standards, IEC/ Other international standards applicable for the country of origin of the equipment
- 1.8.7 All equipment shall be subjected to routine and acceptance tests as per applicable specifications. In addition, equipment shall be subjected to type tests if specified elsewhere
- 1.8.8 CONTRACTOR shall clearly specify in their purchase specifications, the requirement of conducting other special tests/ type tests, envisaged for various electrical equipment. Same shall be conducted without any time/ cost implication to OWNER/ Consultant.
- 1.8.9 Epoxy based insulating coating/paint for the required breakdown voltage on complete flooring of switchgear hall in Substations Switchgear floors shall be provided. Thickness of this coating shall be uniform and shall be for the maximum voltage in the substation.
- 1.8.10 Fire-proof sealing system and fire protection coating system shall be provided to prevent the spreading of fire from one place to another (or one zone to another) through the openings in wall / floor, along cables laid in trays / racks and through openings below floor-mounted Electrical Switchgear, MCC, Distribution Boards, Junction boxes, Cabinets and Panels. The systems shall be installed in the specified locations in consultation with the purchaser's engineer after all cables have been laid and terminated. For further requirements/details refer Specification for Fire Proof Sealing System (Doc No. B269-999-16-50-SP-0021) attached with the tender

2 EQUIPMENT SIZING AND SELECTION CRITERIA

2.1 ELECTRICAL DESIGN BASIS

- 2.1.1 Engineering design basis for electrical (B269-999-16-50-EDB-1001) & standard design philosophy for electrical facilities (6-51-0099) along with details indicates in this specification shall form the basis for basic design and developing detailed design and engineering for electrical facilities including electrical power system, electrical equipment and electrical installation etc.

2.2 FAULT LEVEL SELECTION

- 2.2.1 The fault level for various voltage levels of Electrical system for this complex shall be limited and provided as under. Accordingly the associated electrical equipment shall be selected suitable for same:

- i). 40 kA (RMS) (1sec.) / 100kA (Peak) for 6.6 kV systems.
- ii). 65 kA (RMS) (1sec.) / 143kA (Peak) for 415 V System for PMCC /EPMCC /MCC/ ASB
- iii). 25kA (RMS) (1 sec.) / 62.5 kA (Peak) for 415V System for LDB/ ELDB

2.2.2 Equipment with higher short circuit rating shall be selected based on short circuit studies.

2.2.3 Min. fault level to be considered for system study at Input of 6.6kV Switchboard for normal supply and 6.6kV Emergency supply shall be informed during detail engineering.

2.2.4 Various equipments in CONTRACTOR's scope of supply shall be sized considering all loads for the package and Owner's feeder requirement covered under this package

2.3 EQUIPMENT SIZING

2.3.1 Sizing of various equipment in CONTRACTOR's scope of supply i.e. 6.6 kV switchboards, HV Capacitors, 6.6/0.433kV distribution transformers, PMCC, EPMCC, MCC, MV bus ducts, ASB, LDB, ELDB, lighting transformers, DC systems, UPS systems, VFD systems, HV power cables, MV power and control cabling etc. is included in CONTRACTOR's scope of work. All equipment shall be sized subject to load analysis to be carried out by the CONTRACTOR. Besides these, feeders required for Owner's use, as indicated elsewhere in the bid package, shall also be taken into account in equipment sizing

2.3.2 CONTRACTOR to note that during sizing and selection of the equipments (i.e. oil filled and dry type transformers, DC system, UPS System, 415V switchboard, Ethernet switches, etc.), 20% spare feeders and 20% spare capacity (25% in case of DC System) shall be provided. This shall be over and above design margin.

2.3.3 CONTRACTOR to consider Owner's load as indicated in the scope of works document against each feeder required for Owner's use, for sizing of 6.6kV HV Switchboard, distribution transformer & 415V PMCC/EPMCC/MCC/ASB/LDB/ELDB. This does not include any spare capacity or design margin.

2.3.4 In Substation-112, 6.6kV HV switchboard shall be provided fed from plant feeder, capacitor banks, other electrical systems i.e. UPS system, DC system, ECS system, FA system, PA system & telephone system, Emergency switchboard (including 415V EPMCC), ASB, Lighting system (including LDB, ELDB) etc., shall be common for the package sub units i.e. RODMP, ZLDP & CPU. However, distribution transformers and associated MV switchboards (PMCC & MCC) shall be separate for feeding the MV loads of the following sub units:

a) RODM+CPU Part

b) ZLD Part

2.3.5 For RWTP separate substation SS-122 shall be provided having 6.6kV HV switchboard fed from plant feeder, distribution transformers, PMCC, MCC, EPMCC and other electrical systems i.e. UPS system, DC system, ECS system, FA system, PA system & telephone system, ASB, Lighting system (including LDB, ELDB) etc.

2.3.6 CONTRACTOR to consider the total derating factor on ground rating at 30°C specified in cable catalogue for cable as per design requirements. However, if the calculated value is above 0.5, then Contractor to follow derating factor as 0.5 and if the value is below 0.5, then contractor shall follow the value which is below 0.5 for sizing of cables in under ground. This shall be considered for all underground cables.

2.3.7 CONTRACTOR to consider sizing factor for normal, standby and intermittent loads as per EIL Spec. 6-51-0099. Contractor to consider 10% design margin and 20% spare capacity for future. However, wherever process requirements calls for higher factors to be considered, the same shall be taken into account

2.3.8 CONTRACTOR to note that each switchboard/ transformer shall be loaded upto maximum 80% of its bus bar/ transformer capacity.

- 2.3.9 Lightning protection of building shall be designed for LPS level as per IS/IEC-62305 based on the geographical location of the package. Lightning strip size shall be minimum 25 x 3 mm.
- 2.3.10 Earth Resistivity Value shall be measured by CONTRACTOR before earthing system design calculation. For earthing conductor sizing, duration of earth fault current duration to be considered, shall be minimum one second.
- 2.3.11 For lighting system design, overall maintenance factor shall not be more than 0.63

2.4 SUBSTATION BUILDING

- 2.4.1 Construction of substation building is included in the scope of CONTRACTOR. For detailed scope refer Civil/ Structural scope of work. Substation building shall have cable cellar and battery room on ground floor and Switchgear hall, UPS Room, Operator Room and Maintenance room on first floor. Refer typical architectural layout for detail wherein the minimum substation sizing requirements are indicated.
- 2.4.2 Cut-outs shall be provided along the complete length of switchgear hall. Beams in between cut-outs shall be provided with PVC sleeves of 150 mm dia. Opening of 200 x 100 mm shall be provided in all under slab beams of switchgear hall slab for FA cable laying. Cut-out of 1200 x 200 mm shall be provided in slab along columns on switchgear floor for cabling to wall mounted panels. Base frame work for all switchgear hall cut-outs is in scope of Contractor. All unused cut-outs shall be covered with 6 mm thick chequered plate after installation of all equipments. Cut outs provided for switchboards shall be covered with 6mm thick chequered plate during construction to prevent falling of people through cut outs.
- 2.4.3 All door/ gates in substation shall be provided with facility to padlocking the doors. Monorail shall be provided for equipment loading/ unloading.
- 2.4.4 All switchboards shall be installed considering provision for installation of two future panels on each side of switchboard.
- 2.4.5 CONTRACTOR to keep space for installation of Owner's ECS System panels in the switchgear hall. Exact dimension of same shall be finalized during detailed engineering based on input from CONTRACTOR.
- 2.4.6 Structural support for Owner's supplied panels is also in the scope of CONTRACTOR. In addition to the base frame of panel, additional framework base channels for embedding in the concrete/ welding to the insert plates on concrete surface shall be supplied and erected by the CONTRACTOR.
- 2.4.7 Additional protection shall be provided for transformers from rain, carried at angle to the vertical by the winds.
- 2.4.8 Fire wall between two adjacent transformers shall be extended at least 1 meter above the top most point of the Transformers. Fire wall shall also be designed to withstand the explosion of transformer bushing. Firewall thickness shall be minimum 355 mm in case of brick construction or 230 mm in case of RCC construction.
- 2.4.9 Battery room shall be well ventilated along with necessary exhaust system and water connection with sink. Battery room shall be provided with minimum two exhaust fans and louvered opening in the opposite wall/door. Floor of the battery room and walls up to 1.5 M height shall have acid/alkaline (as applicable) resistant protective material coating. Maintenance platform and wash basin/sink shall be provided in the battery room. Neutralisation pit for battery room shall be considered, which shall be connected to plant drain.
- 2.4.10 Switchgear/ control room shall have fire-fighting equipment, first aid boxes, insulating floor mats all around the switchboards, hand-gloves and other safety equipment as per statutory requirements. Flooring of switchgear hall shall be painted with insulation paint.

- 2.4.11 Epoxy based insulation coating with breakdown voltage as per IS, suitable for installation on concrete flooring shall be applied on switchgear hall & other rooms of substation in air-conditioned/ non-air-conditioned area. Rubber mats shall also be provided around switchboards as per CEA safety regulations.
- 2.4.12 The fire-proof sealing system and fire protection coating system are required to prevent the spreading of fire from one place to another (or one zone to another) through the openings in wall / floor, along cables laid in trays / racks and through openings below floor-mounted Electrical Switchgear, PMCC, Distribution Boards, Junction boxes, Cabinets and Panels. The systems shall be installed in the specified locations in consultation with the purchaser's engineer after all cables have been laid and terminated.
- 2.4.13 Emergency escape route is mandatory to be maintained and marked from all locations in the cable cellar of substation.
- 2.4.14 Even though standard specification 7-51-0340 is applicable for 16m hall however same shall be followed for 15m switchgear hall also by adjusting the spacing accordingly.
- 2.4.15 Separate room or enclosed area for sensitive electronic equipment (i.e. VFD, Charger etc.) shall be provided in substation.

2.5 SINGLE LINE DIAGRAM

It is the responsibility of the contractor to provide number of outgoing feeders in each switchboard as per actual loads, other electrical system requirements plus spare feeders in each switchboard in line with engineering design basis.

Key single line diagram attached with tender shows the Philosophy of distribution of electrical power and is indicative only. Quantity of equipment shown in SLD is minimum and shall have no bearing on the actual quantity and rating of equipment required during detail engineering. CONTRACTOR shall detail out the single line diagram based on loads finalized during engineering and licensor's requirements (i.e. alternate power source requirement etc.) and size all electrical equipment and shall furnish same for the review of Owner/EIL

Equipments as required, as per the bid package to cater the load demand of package and owner's load shall be supplied without any price and time impact to Owner/ Consultant.

3 EQUIPMENT SPECIFICATIONS

3.1 DISTRIBUTION TRANSFORMER

- 3.1.1 Maximum rating of distribution transformer shall be limited to 2500kVA however the transformer rating shall be finalized based on load analysis, considering 10% design margin and 20% capacity for future load. Each transformer shall be sized to feed the complete load independently.
- 3.1.2 Transformers with 80% loading shall be equal to Peak Demand (including 10% design margin) & does not include 20% spare capacity for future.
- 3.1.3 Transformers shall be provided with emergency trip pushbutton station in the transformer bay. Push button station shall have Dual pushbutton with logic to press both for transformer trip.
- 3.1.4 The transformers impedances shall be chosen to suit switchgear fault withstand capabilities and large motor start-up (if any).
- 3.1.5 Distribution Transformer shall be as per the enclosed distribution transformer datasheet and shall comply with EIL Specification 6-51-0041 and Distribution transformer shall comply to latest IS-1180 (Part-1): 2014 and its amendments including but not limited to amendment-4 and latest Gazette of India Order. Accordingly, efficiency of transformer at 50% and 100% load shall be considered with total losses at 50% and 100% loading not exceeding maximum losses values specified in Table-6 of IS-1180 (Part-1) for Energy Efficiency Level-2.

- 3.1.6 The transformer shall bear standard mark of Bureau of Indian Standards in line with Gazette of India. Copy of license obtained from Bureau of Indian Standards in compliance with IS 1180(Part-1) shall be furnished by the contractor along with transformer vendor drawings post order.
- 3.1.7 Temperature rise for winding and oil shall be as per Gazette of India Order dated 16-Dec-2016.
- 3.1.8 The overall dimensions of the transformers shall be limited in accordance with 7-51-0337 enclosed with the package.
- 3.1.9 Bucholz relay, OTI & WTI shall be provided with reed type switches in place of mercury switches.
- 3.1.10 Firefighting system is generally not envisaged for distribution transformers, accordingly, oil quantity for distribution transformer shall be restricted up to 2000 liters. In case, oil quantity is more than 2000 liter, HVWS system shall be provided by contractor.
- 3.1.11 CT for 51G shall be class 5P10 and CT for 64R shall be class PS for all the transformers. Technical details of class PS CT (Vk, Imag and RCT) shall be submitted by contractor for EIL review.
- 3.1.12 All transformers shall have WTI/ OTI transducer for interfacing with ECS.
- 3.1.13 All contacts including “spare contacts” and “contacts for owner’s interface” shall be duly wired and terminated upto the terminal block.
- 3.1.14 Contractor to ensure that valid type test certificates of offered design of transformer are available for Heat run test, short circuit test and impulse test. In case of non-availability of short circuit test reports and impulse test reports, same shall be conducted without any cost and time implication to Owner/ EIL.
- 3.1.15 As per clause no. 12.3.1 of standard specification 6-51-0041, oil leakage test shall be conducted at vendor’s works on all tanks and oil filled compartments. In case of discrepancy, most stringent testing conditions of EIL spec. 6-51-0041 and IS:1180 (Part-1):2014 shall be followed.
- 3.1.16 Heat run test shall be done on one distribution transformer of each rating, even if type test report for same is available with the vendor. Pressure test and vacuum test shall be done on one transformer tank of each size In case of of discrepancy, more stringent requirement of EIL spec. 6-51-0041 and IS-1180 (Part-1): 2014 shall be followed.
- 3.1.17 All signals as per ECS IO List shall be provided for interface with the Electrical control system.
- 3.1.18 As per Ministry of Environment, Forest and Climate Change (MoEF&CC), Regulation of Polychlorinated Biphenyls Order, 2016, manufacture and import of the Polychlorinated Biphenyls (PCBs) and PCBs containing equipment is banned and hence compliance of same in transformer oil shall be ensured.
- 3.1.19 Vendor to ensure that valid type test certificates for offered design of transformer are available for heat run test, short circuit test and impulse test. The same shall also be furnished for Owner’s/EIL’s record during detail engineering. In case the valid type test certificates are not available, Vendor shall carryout the type tests without any additional cost and time implication to Owner/EIL. In case of non-availability of short circuit test reports, manufacturer certified comparative statement in line with IEC-60076 part 5 / IS 2026 part 5 shall be furnished.

3.2 HV CAPACITOR

- 3.2.1 HV Capacitor shall be as per the enclosed HV capacitor datasheets and EIL standard specification 6-51-0020 attached with the tender.

- 3.2.2 Capacitor banks along with APFCR shall be indoor panel mounted type, installed in switchgear hall. Dry type series reactor, RVT installed inside panel shall be provided with the capacitor banks.
- 3.2.3 Capacitor bank and associated equipments shall be sized to maintain min. 0.98 power factor at the 6.6kV HV Switchboard.
- 3.2.4 As per Ministry of Environment, Forest and Climate Change (MoEF&CC), Regulation of Polychlorinated Biphenyls Order, 2016, manufacture and import of the Polychlorinated Biphenyls (PCBs) and PCBs containing equipment is banned and hence compliance of same in oil filled reactor shall be ensured.

3.3 MV BUSDUCT

- 3.3.1 Bus duct shall be provided for connection between the distribution transformer secondary & PMCC/EPMCC where the MV board rating is more than 1250A.
- 3.3.2 Note-4 of EDB doc. No. B269-999-16-50-1001 rev-0 (page 39 of 49) stands deleted and is replaced by following:
“Non segregated phase air insulated type MV bus duct shall be provided in place of sandwich type busduct.”
- 3.3.3 Bus-duct layout drawings shall be prepared by the CONTRACTOR based on substation equipment layout and Structural & Architectural drawings of substation and transformer drawings at the time of detail engineering.
- 3.3.4 It is CONTRACTOR's responsibility to close the gap between the bus-duct and the cut-out left for bus-duct routing. Closing of gap shall be done with material suitable for minimum 2 hours fire rating.
- 3.3.5 All other requirements for MV Bus duct shall be as per EIL Specification 6-51-0054 and MV bus duct datasheet attached with the tender.
- 3.3.6 All the offered MV bus duct shall be type tested. CONTRACTOR to ensure at the time of order placement that copies of valid type test certificates for the following tests conducted on identical design of offered bus ducts are available.
- Short time current withstand test
 - Heat run test.
 - Ingress Protection test.

- 3.3.7 Contractor shall furnish details of type test certificate in attached format for Type test certificates Doc no. B269-999-16-50-DS-1030 during detailed engineering for review.
- 3.3.8 The busduct bus bar material shall be same as that used for switchgear busbar. In case different material are provided for busbar of switchboards/transformers and busducts, bimetallic washer/plates shall be provided.

3.4 GENERAL REQUIREMENTS FOR HV & MV SWITCHBOARDS

- 3.4.1 Selection, sizing and suitability of all components shall be the CONTRACTOR's responsibility. The equipment as required for safe and satisfactory operation shall be considered included in CONTRACTOR's scope even if not specifically mentioned.
- 3.4.2 Only major relays, meters and controls are indicated in the hardware data sheets. Any auxiliary relays, timers, switches, etc, as required while developing the control schematic and felt necessary for safe operation, even if these are not specifically included, shall be supplied by the CONTRACTOR. All logic shall be implemented in the relay itself and not externally. Provision of adequate I/O count in the relays shall be ensured.
- 3.4.3 The CONTRACTOR's shall be solely responsible to coordinate the relay characteristics with relay supplier for the proper selection of all CTs with special care to select class PS CTs. The

VA burden, knee-point voltage, CT resistance and magnetizing current shall be calculated by the vendor for Owner/ EIL's review before proceeding with manufacturing.

- 3.4.4 Following sizing calculation for Class PS CT's shall be submitted by CONTRACTOR's during drawing review stage.
- Knee point voltage V_k
 - Metrosil
 - Stabilizing resistor.
- 3.4.5 CT ratios/ details, load details, cable sizes, feeder nos., name plate details etc., for all feeders at switchboards shall be finalized at the time of review of vendor drawings which shall be taken care by the CONTRACTOR without any impact on cost and time to Owner.
- 3.4.6 The size of bus-bar from horizontal bus to breaker and breaker to outgoing shall be designed based on breaker rating and not on CT/feeder rating.
- 3.4.7 Relay Setting
- 3.4.7.1 Relay settings for switchboards in CONTRACTOR's scope shall be undertaken by the CONTRACTOR/ Vendor and CONTRACTOR/ Vendor shall furnish the relay setting chart and relay coordination curves. During drawing review stage, vendor shall furnish numerical relay selection chart showing complete model no. of numerical relay and various functionalities offered meeting all requirements specified in tender.
- 3.4.7.2 Any other data required for relay setting to be done by the CONTRACTOR's shall be provided during engineering stage.
- 3.4.7.3 Design calculations for selection of relay setting and relay parameterization, relay coordination, providing relay-setting table & relay parameterization, etc. for all feeders is included in the CONTRACTOR's scope. Relay parameterization for all relays shall be provided and implemented by vendor.
- 3.4.8 Dummy panels and rear extensions, as required, to avoid fouling with beam/ column, adequacy of space for cable terminations, bus trunking, mounting of relays, meters, control components etc. shall be supplied as required without time & cost implication to owner.
- 3.4.9 Breaker control switches shall be hardwired type. All TNC and Trip Switch shall be lockable type.
- 3.4.10 Spring charging motors shall be suitable for 110V DC supply.
- 3.4.11 All switchboards shall have provision for positive LOTO implementation. Photographs of LOTO provision in each type of panels shall be submitted during drawing review for approval.
- 3.4.12 All transformer incipient faults signals shall be wired through interposing contactors in the panel to avoid nuisance tripping.
- 3.4.13 Suitable rating stabilizing resistance to be provided in earth fault protection of motor to prevent mal-operation on account of spill currents.
- 3.4.14 Transformer SEF should go to 86 of downstream and direct trip of upstream.
- 3.4.15 Load shedding scheme based on under frequency shall be finalised during detail engineering.
- 3.4.16 4-Pole MCB shall be considered in all the PT panels. 4th pole contact of the MCB shall be used for blocking under voltage protection function. Bi-stable relays shall be considered in PT panels for multiplication of the contact for under voltage blocking function in each feeder.
- 3.4.17 In Control logics / schemes, contacts of vacuum/ SF6 circuit breaker shall be utilized. In case, same is not available, then Bi-stable relays shall be considered for multiplication of Circuit breaker contacts.

- 3.4.18 Wherever failsafe contact concept is used, it shall use mechanical contacts. In case mechanical contacts cannot be provided, failsafe concept shall not be used.
- 3.4.19 The details of all Instrument transformers comprising their full name plate and connection diagram shall be displayed with stickers at an easily accessible location (In addition to Instrument transformer itself), during normal operation.
- 3.4.20 All the CT & PT connection should be through ring type reliable connection/terminations only.
- 3.4.21 Terminal connectors of all other control terminals shall be screwed type only. Separate terminal block shall be provided for further wiring to ECS/ upstream breaker/ Transformer, etc. for tripping/ interlock/ annunciation, etc.
- 3.4.22 All the NO, NC contacts of breaker, Relay DI/DO, RTD inputs, etc. shall be wired upto terminal block, even if the contacts are not used in the scheme.
- 3.4.23 Terminal multiplication to be done, wherever double control cable termination is done, i.e. only one control cable wire shall be connected to one terminal.
- 3.4.24 Additional 2 set of spare CT and PT terminals shall be provided for tapping CT and PT supply for future purpose in Incomers/ bus couplers/ Line PT and Bus PT of all switchboards.
- 3.4.25 It is required to interface HV and MV switchgears with the ECS Panel for control, monitoring and annunciation purpose. For ECS Interface, typical ECS IO list is attached.
- 3.4.26 In addition to above, terminals as required for interface with upstream and downstream switchgear needs to be provided to fulfil the operational requirements.
- 3.4.27 Hardware, as required, including selector switches, auxiliary relays, etc. during detail engineering to meet the operation requirement shall be supplied by vendor without any time and cost implication.
- 3.4.28 Vendor to note that the control cables used shall be 2.5 sq. mm. twisted pair shielded cables.
- 3.4.29 All signals as per ECS IO List shall be provided for interface with the Electrical control system.
- 3.4.30 DC and AC control supply scheme for switchboards shall be in line with hardware data sheet attached for switchboards.
- 3.4.31 For the DC Control supply to the various breaker panels in HV & MV Switchboards, there shall be one common control switch for all control supply to a particular breaker panel. Separate fuses for following branch circuit shall be provided:
 - 3.4.31.1 Spring charging circuit
 - 3.4.31.2 Closing circuit
 - 3.4.31.3 Tripping, contact multiplier & digital input circuit
 - 3.4.31.4 Indication circuit
 - 3.4.31.5 Each Numerical relay supply (incoming of numerical relay supply fuse shall be tapped before the control supply switch)
- 3.4.32 Separate control supply switch shall be provided for differential protection relays.
- 3.4.33 Bus differential scheme shall have dedicated supply from the same bus section.
- 3.4.34 CT Bypassing relay shall be latched type.
- 3.4.35 Bus differential multiplier relay shall be VAJH type only.
- 3.4.36 Common lock key shall be provided for breakers in place of individual lock key for each breaker.

3.5 HV SWITCHBOARDS

- 3.5.1 All requirements shall be considered while sizing the switchboards, and feeders, as required, including feeder for free-issues material based on final approved single line diagram, shall be provided with no cost and time implication to owner. 20% spare capacity shall be considered for sizing of Switchboard.
- 3.5.2 HV Switchboards shall be provided with two incomers and two bus coupler. Second bus coupler shall be without any kind of numerical relay and shall be provided with Electro-mechanical type Trip circuit supervision relay. Status of second bus coupler shall be used in interlock of Auto changeover logic, which shall be implemented in the first bus coupler with numerical relay. There shall not be any feeder in between two bus couplers.
- 3.5.3 All HV Switchgear shall be provided with online wireless temperature monitoring facility. The passive sensor should be wireless, battery less, dielectrically safe, robust to high voltage, high electromagnetic field, and harsh environment. It should take direct measurement on critical point. This facility shall be interfaced with ECS.
- 3.5.4 Feeder differential relay (87F) of same make/ model as installed in the Owner's Upstream 6.6kV Switchboard at SS-100 shall be free-issued to CONTRACTOR for installation and wiring in 6.6kV Switchboard incomer panels in SS-112. Testing and commissioning of loose supply relay is included in scope of CONTRACTOR. Optical fiber cable along with HDPE duct (Green conduit with white strip) shall be provided by others, however end termination of OFC including all accessories for receiving end shall be in the scope of this tender.
- 3.5.5 Feeder differential relay (87F) of same make/ model as installed in the Owner's Upstream 6.6kV Switchboard at SS-100 shall be free-issued to CONTRACTOR for installation and wiring in 6.6kV incomer panels in SS-122. Testing and commissioning of loose supply relay is included in scope of CONTRACTOR. Optical fiber cable along with HDPE duct (Green conduit with white strip) shall be provided by others, however end termination of OFC including all accessories for receiving end shall be in the scope of this tender
- 3.5.6 Auto changeover between incomers and bus coupler for 6.6 kV system shall be provided. Additionally manual change over through synchro-check relay with momentary paralleling shall also be provided. All necessary hardware shall be included to achieve auto, independent and manual operation of incomers and bus coupler.
- 3.5.7 Only major relays, meters and controls are indicated in the hardware data sheets. Any auxiliary relays, timers, switches, etc, as required while developing the control schematic and felt necessary for safe operation, even if these are not specifically included, shall be supplied by the CONTRACTOR. All logic shall be implemented in the relay itself and not externally. Provision of adequate I/O count in the relays shall be ensured
- 3.5.8 All relays, metering and control components shall be mounted on the panel front only. Dummy panel and rear extension, as required, for bus trunking / cable terminations shall be provided.
- 3.5.9 Microprocessor based Fast bus transfer system shall be provided between Incomer-1, bus coupler-1 and incomer-2 for applicable switchboards.

Auto/Manual Changeover with fast bus transfer scheme for switchboard with two incomers and one bus-coupler breakers shall comply with the logic described briefly as follows. Safety interlocks as deemed necessary shall however be considered during detailed engineering.

Auto/Manual Fast Bus Transfer

The auto/ manual fast bus transfer scheme is described in brief as follows:

Facility to be provided

- a) Auto fast bus changeover between the two incomers and one bus-coupler shall be in such a way that two incomer breakers are 'ON' at a time and bus-coupler breaker is normally open.

- b) Bus-coupler breaker is made 'ON' automatically in case the incoming supply at incomer breaker no. 1 or 2 fails in following modes:
 - i. Fast Transfer
 - ii. Delayed In phase transfer
 - iii. Residual voltage transfer (slow changeovers)
- c) Interlocks shall be continuously checked not limited to the following
 - i. Transfer system healthiness
 - ii. Breaker in service
 - iii. Breaker status & breaker contact integrity
 - iv. Master trip relay lockout condition (86)
 - v. Breaker coil healthiness and breaker configuration
 - vi. PT in service and PT MCB condition
 - vii. Other source voltage healthiness
- d) Blocking of auto transfer (i.e., closing of bus-coupler) if any incomer breaker trips due to a fault.
- e) Tripping of incomer on under voltage shall be blocked, if both the incomers simultaneously experience an under voltage.
- f) The auto-change over shall be blocked during load shedding.

Normal operating condition

Incomer no. 1 and 2 breakers are 'ON'. Bus-coupler breaker is 'OFF'.

Fast Transfer

The bus voltage and incoming source voltage shall be monitored on a continuous basis for magnitude and phase angle and it shall be ensured that the same are within the specified limit values at the moment of initiation to ensure that transfer operation is carried out under conditions conducive to fast bus transfer as per high speed sync-check supervision. The open and close commands to the circuit breaker from the high speed transfer device shall be issued synchronously.

In-Phase Transfer

If the synchronized conditions are not present the fast transfer shall be blocked. The supply breaker feeding to the bus opened and the bus-coupler is closed in the first minimum of the difference of healthy and bus bar voltage. The transfer system is able to determine the course of the difference voltage and the point in time of the 1st phase coincidence (first slip cycle synchronization). In order to compensate for the installation specific processing time like system response time, circuit breaker opening time etc. the close command is issued accordingly before the actual first minimum difference voltage occurs.

Residual voltage transfer

When the criteria for a fast transfer operation are not met and in phase transfer is not feasible, the closing of breaker in fast transfer and in phase transfer is not possible, the residual voltage transfer shall be utilized. The closing of the bus coupler shall take place when the voltage of the bus bar has subsided to a preset, permissible safe value (20-30% of rated voltage).

Manual transfer

- a) It is possible to trip incomer no. 1 or 2 after closing the bus-coupler to facilitate maintenance as required.
- b) When supply is again available at incomer breaker after auto changeover has already taken place, it is possible to restore the system to normal operating condition by operating selector switch (meant for tripping incomer no. 1 or 2 or bus-coupler) and by setting auto/ manual switch in 'Manual' mode.
- c) In manual transfer the closing circuit shall be checked through contacts of check synchronizing function during momentary paralleling.
- d) In manual transfer after momentary paralleling if desired breaker does not trip after preset time delay, breaker last closed shall trip.

Independent mode

In addition to the transfer modes, all the incomer and bus-coupler breaker shall be desired to operate independently (ON-OFF operation) on independent mode for dead bus charging & other maintenance requirement of switchboard. Paralleling of sources shall not be permitted in this mode.

Auto-Manual-independent (A-I-M) selector switch shall be provided in the switchboard for selection of different modes for operation.

Number of binary and analog inputs / outputs shall be adequate for the required system configuration.

FBT (Fast bus transfer) RELAY shall be physically located in Bus coupler panel or in any panel placed in the panel line-up only. All signal interchange between FBT relay & other panels shall be through inter-panel wiring only.

- 3.5.10 CT and PT burden mentioned in data sheets are indicative. CONTRACTOR shall provide the same as required including the burden for transducers provided at transducer panel. CONTRACTOR may consider 1.5 VA per phase per transducer for CT burden and 1.5 VA per phase per transducer for PT burden for analogue input for ECS interface.
- 3.5.11 All HV motor feeders schematics shall have provision for auto start and auto re-acceleration with feature to inhibit irrespective of process/licensor's requirement.
- 3.5.12 All requirements as specified above including ECS interface, shall be applicable for switchboard. Line PT and protection & metering requirements shall be as per Design data sheets and hardware data sheets as applicable.
- 3.5.13 For interfacing with DCS system, separate Standalone Marshalling panel shall be provided in Substation. Hardwired signals (with minimum requirement specified below) from various feeders of a bus section required for DCS interface shall be wired and terminated in the standalone marshalling panel.
 - i) Breaker/Contactor 'ON' indication
 - ii) Breaker/Contactor 'OFF' indication
 - iii) Local/Remote selection indication
 - iv) Process Trip indication
 - v) Process Start command
 - vi) Process Stop command
 - vii) Process Start permissive command
 - viii) Ammeter (0-1A/4-20mA)
 - ix) Ready to Start signal from feeder

- 3.5.14 Terminals for DCS input & DCS output shall be segregated & separate terminal block shall be provided. While wiring these signals from respective feeder module to marshalling, it shall be ensured that separate cables are used for status & commands & same shall be segregated.
- 3.5.15 Current rating for interface contacts shall be 2A, 110V DC.
- 3.5.16 All the signals available in Numerical relays shall be made available in Laptop & HMI through serial communication.
- 3.5.17 Number of analogue / digital IOs shall be worked out by the CONTRACTOR as per the ECS I/Os list attached with the bid package
- 3.5.18 All trip contact should be preferably “NO” contact. Separate NO contact of each such trip should be routed to relay also for event logging or redundant tripping.
- 3.5.19 Control supply of each BUS PT of HV switchboard shall have independent control supply switch and sets of fuses tapped from Main DC bus.
- 3.5.20 Installation of surge arrestors to be done after the CTs towards cable termination side.
- 3.5.21 Hard contacts of the breaker shall be used for providing interlocks in the schemes mainly for auto change over, tripping, feedback, closing and process interlocks. In the absence of sufficient hard contacts, latched contactors/ relays to be used for contact multiplication.
- 3.5.22 Critical contacts used for providing process interlocks should be direct hard contacts and these shall not be taken from the multiplying contactors / auxiliary relays, if feasible.
- 3.5.23 Wherever two NO contacts available in Emergency push button & LCS STOP PB of all breaker fed HV Motors, one NO contact shall be wired to trip breaker directly & other shall be wired to binary input of numerical motor protection relay.
- 3.5.24 All rear panel doors of HV panels shall have handle for ease of maintenance.
- 3.5.25 The validity requirements for the type test reports for HV switchboards , breakers etc. shall be as below :-

S. No	Type Test	Equipment	Validity
1	Short Circuit Withstand Capacity	Panel	Up to 5 years from the final bid opening date or design change which is earlier
2	Temperature Rise	Panel and breaker	Up to 5 years from the final bid opening date or design change which is earlier
3	Impulse and power frequency withstand	Panel	Till any design change
4	Internal Arc Fault	Panel	Till any design change
5	Degree of protection for panels	Panel	Till any design change
6	Breaker short circuit duty cycle test	Breaker	Till any design change

In case the valid type tests on the offered design of Equipment is not available, all type tests shall be conducted by the successful vendor on the offered design after order finalization without any extra cost and delivery impact.

- 3.5.26 Contractor shall furnish details of type test certificate in attached format for Type test certificates Doc no. B269-999-16-50-DS-1030 during detailed engineering for review

3.6 MV SWITCHBOARD

- 3.6.1 Refer enclosed hardware data sheets for the details of relay and metering facilities to be provided for each feeder. Only major relays, meters and controls are indicated in the data sheets. Any auxiliary relays, timers, switches, etc., as required while developing the control schematic and felt necessary for safe operation, even if these are not specifically included, shall be supplied by the contractor. All relays, metering and control components shall be mounted on the panel front only. All logic shall be implemented in the relay itself and not externally. Adequate I/O count shall be ensured.
- 3.6.2 The Contractor shall be solely responsible to coordinate the relay characteristics with relay supplier for the proper selection of all CTs with special care to select class PS CTs. The VA burden, knee-point voltage, CT resistance and magnetizing current shall be calculated by the contractor for Owner/ Consultant's review before proceeding with manufacturing.
- 3.6.3 Dummy panels and rear extensions, as required, for cable terminations, mounting of relays, meters, control components etc. shall be supplied as required and dummy/adopter panel for beam shall be considered for as per site requirements. Rear cable chamber provided for the switchboard shall be of height similar to other vertical panels.
- 3.6.4 All MV switchboards (PMCC/EPMCC/MCC/ASB/LDB/ELDB etc.) in contractor scope shall be of the same make.
- 3.6.5 Limiting maximum rating of PMCC/EPMCC shall be 4000A and fault level limited to 65kA for 1 sec.
- 3.6.6 The rating of MCC & ASB shall be limited to maximum 1250A.
- 3.6.7 All Incomers, Bus couplers and ACB power/motor feeders in MV Switchgear (PCC/PMCC/EPC/EPMCC) shall be provided with online wireless temperature monitoring facility. The passive sensor should be wireless, battery less, dielectrically safe, robust to high voltage, high electromagnetic field, and harsh environment. It should take direct measurement on critical point. This facility shall be interfaced with ECS.
- 3.6.8 For PCC/PMCC/EPC/EPMCC internal arc protection system shall be provided to sense internal arc and to isolate the fault.
- 3.6.9 For MV Switchboards rated up to 4000A, forced cooling for any of the components e.g. bus bars, air circuit breakers etc. is not acceptable. To achieve the continuous current rating under site conditions at design ambient temperature inside the panel / cubicle, the required de-rating as / if applicable shall be considered by switchboard vendor.
- 3.6.10 No. of outgoing feeders shall be decided based on system requirement, spare feeders and feeders for Owner's use as defined elsewhere. However, feeders, as required, based on final approved single line diagram, shall be provided with no cost and time implication to owner. 20% spare outgoing feeder or minimum one of each type, whichever is higher shall be provided in each switchboard.
- 3.6.11 Air circuit breaker/Isolator provided in incomers of PMCC /EPMCC /MCC /ASB /LDB /ELDB shall be of 4-pole type. Isolating links shall be provided in the neutral circuit of all the TPN outgoing feeders
- 3.6.12 All the switchgears shall have rating at least equal to the maximum demand plus a provision for 10% future load growth and 20% spare capacity (i.e. Max. Demand x 1.1 x 1.2). Incomers of switchgear shall be designed to cater to the complete load including 10% margin for future load growth and 20% spare capacity as specified above. Service breaking capacities for all breakers shall be equal to or higher than the maximum value of the short circuit at the point of installation.
- 3.6.13 **Changeover scheme for two incomers and one bus-coupler**
PMCC shall be provided with Auto/ Manual Changeover facility. Auto/Manual Changeover scheme for switchboard with two incomers and one bus-coupler breakers shall comply with

the logic described briefly as follows. Safety interlocks as deemed necessary shall however be considered during detailed engineering.

3.6.13.1 Auto Changeover

- i) Auto changeover between the two incomers and one bus-coupler shall be in such a way that the two-incomer breakers are 'ON' at a time and bus-coupler breaker is normally open.
- ii) Bus-coupler breaker is made 'ON' automatically in case the incoming supply at either of the incomer breaker fails and the respective breaker trips on under voltage.
- iii) Blocking of auto transfer (i.e., closing of bus-coupler) if any incomer breaker trips due to a fault or in case of standby earth fault (51G). Trip due to 64R, 63TX shall allow the transfer.
- iv) Tripping of incomer on under voltage shall be blocked, if both the incomers simultaneously experience an under voltage.

3.6.13.2 Manual Changeover

- i) Both the Incomer breakers are 'ON'. Bus-coupler breaker is 'OFF' Manual closing of bus-coupler with momentary paralleling (interlocked with check synchronizing relay) of the incoming supplies to facilitate taking out any of the incomer breakers for maintenance.
- ii) Trip any of the incomer breakers (pre-selected) after closing of any of the Incomer or coupler to avoid continuous paralleling of incomers.

3.6.13.3 Initiation of auto changeover:

- i) When the incoming supply to any of the breakers fails, the respective incomer is tripped through under voltage relays and a timer. The time delay is in the range of 0.5 to 5 sec. Breaker trip on under voltage is blocked in case of power failure on both the incomers.
- ii) The voltage on healthy bus section has been above the set value of normal voltage for a specified duration (settable through an off delay timer of range 0.5 to 5 sec) and the incomer breaker of healthy bus is closed in service position.
- iii) Bus-coupler is open and in-service position.
- iv) Auto / Manual switch is set for 'AUTO' operation.

3.6.13.4 Closing of bus coupler breaker under auto operation:

- i) One of the incomer breakers has tripped on under voltage.
- ii) The residual voltage on the bus that has lost supply is less than 40% of normal voltage.
- iii) Incoming voltage of healthy incomer has been above 80% of normal voltage for a specific duration (Through timer 0.5 sec to 5.0 sec)
- iv) Auto/ Manual switch is set for 'AUTO' operation.

3.6.13.5 Manual transfer after auto changeover:

- i) When supply is again available at incomer breaker after auto changeover has already taken place, it is possible to restore the system to normal operating condition by operating selector switch (meant for tripping incomer no. 1 or 2 or bus-coupler) and by setting auto/ manual switch in 'Manual' mode.
- ii) In manual transfer the closing circuit shall be interlocked through check synchronizing relay.

- 3.6.14 For interfacing with OWNER system, separate Standalone Marshalling panel shall be provided in Substation. Hardwired signals (with minimum requirement specified below) from various feeders required for ECS / DCS interface shall be wired and terminated in the standalone marshalling panel.
- i) Breaker/Contactor 'ON' indication
 - ii) Breaker/Contactor 'OFF' indication
 - iii) Local/Remote selection indication
 - iv) Process Trip indication
 - v) Process Start command
 - vi) Process Stop command
 - vii) Process Start permissive command
 - viii) Ammeter (0-1A/4-20mA)
 - ix) Ready to Start signal from feeder
- 3.6.15 Terminals for DCS & ECS, input & output shall be segregated & separate terminal block shall be provided. While wiring these signals from respective feeder module to marshalling, it shall be ensured that separate cables are used for status & commands & same shall be segregated
- 3.6.16 Current rating for interface contacts shall be 2A, 110V DC or 240V AC.
- 3.6.17 Number of analogue / digital IOs shall be worked out by the Contractor as per the ECS I/Os list attached with the tender.
- 3.6.18 Indicating lamps shall employ LEDs. LEDs provided for indication shall be cluster type with adequate brightness and minimum 2Nos LEDs chips per light. LEDs shall be connected in parallel and each LED chip having diameter not less than 3mm.
- 3.6.19 Two numbers ACB breaker handling trolleys shall be provided for the substation.
- 3.6.20 Earth fault relay operated through CBCT provided in PMCC & LDB feeders shall be mounted on draw-out part of the switchboard and shall be suitable for operation at 110V DC or 240V AC supply as available in the respective switchboard.
- 3.6.21 Timer provided in LDB shall be astronomical type smart timer i.e. to take care of weather condition & shall be programmable for full year.
- 3.6.22 For motor feeder rated up to 55kW, following shall be provided :
- R-C circuit shall be provided across the power contactor for all DOL motor starter feeders in PMCC.
 - Low burden auxiliary contactors shall be provided in all DOL motor starter feeders for receiving start/ stop commands from field.
- 3.6.23 All trip contact should be preferably "NO" contact. Separate NO contact of each such trip should be routed to relay also for event logging or redundant tripping.
- 3.6.24 Control supply of each BUS PT of PCC/EPCC/PMCC/EPMCC shall have independent control supply switch and sets of fuses tapped from Main DC bus.
- 3.6.25 Hard contacts of the breaker shall be used for providing interlocks in the schemes mainly for auto change over, tripping, feedback, closing and process interlocks. In the absence of sufficient hard contacts, latched contactors/ relays to be used for contact multiplication.
- 3.6.26 Critical contacts used for providing process interlocks should be direct hard contacts and these shall not be taken from the multiplying contactors / auxiliary relays, if feasible.

- 3.6.27 Wherever two NO contacts available in Emergency push button & LCS STOP PB of all breaker fed MV Motors, one NO contact shall be wired to trip breaker directly & other shall be wired to binary input of numeric motor protection relay.
- 3.6.28 All rear panel doors of MV panels shall have handle for ease of maintenance
- 3.6.29 Rear cable chamber provided for the switchboard shall be of height similar to other vertical panels and shall have handle for ease of maintenance.
- 3.6.30 All the offered switchboards and breakers shall be type tested. Copies of valid type test certificates for the following tests conducted on identical design of offered equipments required as per data sheets attached with tender specifications shall be furnished post order. The validity requirements for the type test reports for MV switchboards , breakers etc. shall be as below :-

S. No	Type Test	Equipment	Validity
1	Short Circuit Withstand Capacity	Panel and breaker	Up to 5 years from the final bid opening date or design change which is earlier
2	Temperature Rise	Panel and breaker	Up to 5 years from the final bid opening date or design change which is earlier
3	Internal Arc Fault	Panel	Till any design change
4	Degree of protection for panels	Panel	Till any design change
5	Breaker short circuit duty cycle test	Breaker	Till any design change

- 3.6.31 Contractor shall furnish details of type test certificate in attached format for Type test certificates Doc no. B269-999-16-50-DS-1030 during detailed engineering for review

3.7 NUMERICAL RELAYS AND SUBSTATION AUTOMATION SYSTEM

- 3.7.1 All numerical relays shall be digital (microprocessor based) & communicable type as per EIL Standard Specification 6-51-0055 and datasheet for Numerical relay attached with tender.
- 3.7.2 All relays to the extent possible shall be sourced from same make. All the numerical relays of each switchboard shall be suitable for communication on IEC-61850 protocol and shall be connected serially/LAN topology to Ethernet Switches.
- 3.7.3 All protective relays and meters shall be provided with test terminal blocks for secondary injection testing.
- 3.7.4 Hardwired lockout relay (86) shall be provided. Differential relays (87), restricted E/F (64R) relay as asked for in the data sheet shall be separate relay and shall not be combined with the main protection relay.
- 3.7.5 The requirement of numerical relays and integration shall be in compliance with the requirement given in attached data sheet, and specification. Even though data sheets define the requirement in terms of discreet relays (electromechanical type) but numerical relay comprising all required functions shall be provided. Under voltage and Overvoltage relay along with associated timers shall be part of the numerical relay.

- 3.7.6 Numerical relays provided for motor feeders shall use in-built under voltage relay and timer for delayed tripping on bus under voltage.
- 3.7.7 Minimum 4 nos. inputs (DI) and 4 nos. outputs (DO) as spare shall be provided in each numerical relay.
- 3.7.8 Provision of manual bypass of 87B shall be provided in Numerical relays
- 3.7.9 Relay logic shall be ensured to not provide trip in case of DC failure & restoration
- 3.7.10 Scheme of switchboard shall be engineered to achieve the control logic, as required, through relay logic.
- 3.7.11 All relays shall be integrated to ECS for monitoring and control. Provision shall be provided for monitoring & control at HMI also. The relays shall be integrated based on basic system architecture attached with the tender.
- 3.7.12 Conformal coating shall be done for all electronic equipments as per grade 3C3 (Harsh environment) of IEC 60721-3-3. Alternatively, it shall comply with ANSI/ ISA S71.04 class G3 or IEC 60068-2-60 for mixed flow gas test or ASTM B845. Certification for batch of supplied items shall be submitted by vendor for the same.
- 3.7.13 All relays shall have communication port for direct access of data through laptop. One laptop common for all relays shall be provided for the following purposes:
 - 3.7.13.1 Retrieving data from numerical relays.
 - 3.7.13.2 Uploading settings & I/O configuration.
 - 3.7.13.3 Retrieving & viewing disturbance recorder data
- 3.7.14 The Numerical relays shall be provided with suitable hardware, software and communication ports for communication with minimum two different client sources simultaneously.
- 3.7.15 The redundancy in communication hardware shall be provided as per the data sheet attached. In ring topology, the communication shall have no disruption due to loop open circuit or failure of communication port. Also the switch off of DC supply to any or more relay should not affect the communication to rest of the relay. Moreover the ring should not be shared between the switchboards. For LAN where star couplers are used, the communication from star coupler to Ethernet switches shall be dual redundant. Relays of different switchboard should not be connected to the same star coupler. Similar to ring architecture, the failure of one star coupler or failure of communication port or processor should not affect the communication of other star coupler to Ethernet switches.
- 3.7.16 Refer Specification for Numerical Relays (Doc no. 6-51-0055). 30% spare ports shall be provided in each Ethernet switch provided in switchboard and in SAS.
- 3.7.17 All the data as available in the relay including the status of DI should be considered to be communicated to HMI. The data required for final configuration shall be finalized during engineering. Similarly whether specified or not, serial interface shall have no limitation for data transfer to ECS. However data as required for ECS interface shall be decided during engineering.
- 3.7.18 GPS antenna and hardware shall be provided for time synchronization as ECS system has synchronization with GPS. The resolution of time synchronization shall be ± 1 millisecond or better throughout the entire system. Suitable ports shall be provided in the GPS for hook up of Owner's switchboard numerical relays for future use.
- 3.7.19 Separate Substation Automation system for HV and MV System shall be provided in each Substation. It shall include Ethernet switches, laptop, HMI (Engineering cum operator workstation) and software to be installed for interfacing with Numerical relays over IEC-61850.

- 3.7.20 Redundant upper level Ethernet switch shall be provided for each SAS system in wall mounted cabinet.
- 3.7.21 Supply, laying and termination of all interconnecting cables from switch boards to Ethernet switches including cable termination kits and accessories in each substation is in CONTRACTOR's scope. FO cable for connection between switchgear and Ethernet switch shall be supplied and laid in HDPE duct which is also to be supplied and installed by CONTRACTOR.
- 3.7.22 Thyristor control panels of Electric heaters shall be integrated to ECS/ Substation automation system.
- 3.7.23 VFD, Soft starter, DC System, UPS etc. shall be interfaced with SAS (Substation Automation System) on MODBUS TCP/IP
- 3.7.24 Laptop with Windows-8 or latest tested & compatible windows version and other required licensed software, hardware, accessories (serial data cables, VGA Cables, HDMI Cables, and USB Cables etc.) and materials shall be supplied as defined in the tender. The communication port on laptop shall match as that provided on the front of numerical relay. System configuration shall be latest proven model and upgradable. The minimum configuration for this project shall be Intel i7 processor, 1 TB HDD, 4 GB RAM, DVD R/W Multi Drive, 15" LED screen, 4 nos. USB Ports (minimum), Ethernet Port, RS-232 Serial Ports, HDMI Port, etc. Further, laptop shall have compatible ports and compatible hardware for interfacing with various other systems.
- 3.7.25 Laptop provided with SAS shall have functionalities specified under clause 6.4.1, 6.4.5 and 6.4.6 of 6-51-0055 attached with tender.
- 3.7.26 HMI with Windows-8 or latest tested & compatible windows version and other required licensed software, hardware, accessories (serial data cables, VGA Cables, HDMI Cables, and USB Cables etc.) and materials shall be supplied as defined in the tender. System configuration shall be latest proven model and upgradable. The minimum configuration for this project shall be Intel i7 processor, 1 TB HDD, 4 GB RAM, DVD R/W Multi Drive, 21" LED screen, 4 nos. USB Ports (minimum), Ethernet Port, RS-232 Serial Ports, HDMI Port, etc.
- 3.7.27 Laser printer shall be provided configured for line by line printing
- 3.7.28 Software for substation automation along with integrating hardware as required shall be supplied as a part of Laptop. Functionality minimum but not limited to the following shall be carried out. Customized software for substation application shall be supplied in non-returnable CD/DVD/USB Drive. Contractor to submit function design specification and screenshots of the various screen for Owner's review.
- Relay parameterization
 - Disturbance record
 - Data logging
 - Annunciation
 - Event/ status monitoring (including DI & DO of relays)
 - Feeder status monitoring
 - Event recording, motor starting transients, fault analysis etc.
 - Analogue signal monitoring and metering
 - Self-supervision
 - Single Line Diagram
 - View of historical data and generating trends
 - Preparation of maintenance schedule

3.7.29 **FACTORY ACCEPTANCE TEST**

FAT shall be conducted for project simulation. FAT procedure shall be prepared and submitted for Owner's review. The methodology shall be mutually agreed to verify the system simulation and intended specification of tender document. All graphics and navigation between different pages shall be configured to Owner's satisfaction and successful commissioning.

3.7.30 SITE ACCEPTANCE TEST

SAT shall be conducted to verify the actual simulation and shall be verified for required functionality and the scan time. Any modification as required to meet the tender document requirement and customization modification due to Owner's site engineer in charge shall be carried out with no commercial implication.

- 3.7.31 For system architecture, refer Block Diagram for Relay LAN and Substation Automation System (B269-999-16-50-3003) attached with tender.

3.8 VARIABLE FREQUENCY DRIVE PANELS FOR MOTORS

- 3.8.1 For single large/critical drives with VFD, redundant VFDs (Hot Standby) along with redundant PLC for change over without any common point of failure shall be provided and shall have provision for Auto/Manual change over between the running and standby VFDs without tripping / stopping the motor. Drives for motor driven ID/FD Fan etc. with only single drive shall be considered as critical drive. Any additional requirement and identification of critical drives shall be done during detailed Engineering and approval on same shall be obtained from Owner/EIL.
- 3.8.2 All drives for critical application shall be provided with HMI for trending & diagnostics.
- 3.8.3 Bypass feature in the VFDs shall generally be provided until & unless the same is prohibited by process & operation condition.
- 3.8.4 VFDs shall be installed in Air-Conditioned area, however, same shall be suitable for operation in non-air-conditioned environment also.
- 3.8.5 RS-485 serial port shall be provided for communication to HMI / ECS.
- 3.8.6 Requirement of dedicated clean earth for VFD system (if any) shall be suitably taken care by the CONTRACTOR.
- 3.8.7 The transformer for the VFD system (if required) shall be of dry type, VFD Panel mounted only.
- 3.8.8 Combined testing of motors and associated VFDs & input/output transformers as a unit shall be carried out & temperature rise, harmonics measured to ensure that the same is within permissible limits.
- 3.8.9 240V, 1-Phase power supply for motor and panel space heater shall be provided separately to the VFD. Necessary arrangement for controlling/interfacing these supplies shall be made available in VFD panels.
- 3.8.10 Joint declaration shall be furnished by EPCC CONTRACTOR, driven equipment vendor, VFD vendor and motor vendor confirming that driven equipment, VFD and motor compatibility have been verified and ensured for satisfactory operation of the complete system as per contract requirement specifically w.r.t. dv/dt, Vpeak and VTHD (O/P).
- 3.8.11 Effect of long length of cables shall be taken into consideration while sizing / designing VFD including its corresponding effects on motor design.
- 3.8.12 All special cables as required for VFDs based on VFD vendor recommendation shall be provided by CONTRACTOR.
- 3.8.13 Normally drives shall be without ventilating fans. If system demands, provision of ventilation with redundant fans and fan fail alarm to be provided. VFD internal cooling Fans shall be fed from its internal supply only.

- 3.8.14 For large VFD which is water cooled, exchanger etc. shall be kept outside the switchgear hall.
- 3.8.15 Diode O-Ring based dual supply shall be provided for VFD panels.
- 3.8.16 Vendor shall provide detailed harmonic analysis to establish that the offered VFD solution takes care of harmonics at point of common coupling (PCC) within permissible limits. This analysis shall include input supply system details such as point of common coupling (PCC), incoming voltage, minimum short circuit level, input transformer details etc. and filters shall be provided accordingly to mitigate the harmonics.
- In addition to harmonics at PCC, Vendor to also take care voltage regulation i.e. output voltage (i.e. voltage after the VFD output filter) close to input voltage i.e. 415V for MV VFD.

3.9 DC SYSTEM

- 3.9.1 The DC system shall be as per EIL standard specification 6-51-0019 and DC System datasheet attached with tender. Battery shall be Medium Discharge type. Minimum temperature for battery sizing shall be 5°C.
- 3.9.2 DC system configuration shall be as per sketch attached with the Design Basis.
- 3.9.3 110V DC system complete with Ni - Cd battery bank, battery charger & DCDB supplied for Switchgear protection and control shall be provided with 2 x 50% battery banks.
- 3.9.4 220V DC system complete with Ni - Cd battery bank, battery charger & DCDB supplied for critical lighting shall be provided with 2 x 50% battery banks.
- 3.9.5 25% spare capacity shall be considered while sizing the battery and battery charger. 20% spare feeders of each type and rating shall be provided in DCDB.
- 3.9.6 3 Pole switch shall be provided for battery isolation purpose. Battery Isolator shall not be located inside battery room.
- 3.9.7 Battery charger shall be SMPS based.
- 3.9.8 DC Earth fault monitoring relay shall be provided on the battery charger.
- 3.9.9 DCDB shall be provided with voltmeter & selector switches which have facility to check DC positive to negative, positive to earth & negative to earth voltage. Annunciation for same shall be provided and indicated to ECS also
- 3.9.10 Busbar to be provided on TOP in DCDB.
- 3.9.11 ECS Interface for each DC System shall be provided as per ECS I/O list.
- 3.9.12 Battery charger output interlocking system shall not be MCCB based
- 3.9.13 Online battery bank monitoring system shall be provided for 110V DC System battery banks. Provision for individual cell temperature, cell voltage & cell impedance shall be monitored and common alarm shall be provided for each category. Battery monitoring system shall have connectivity with ECS system and remote alarm facilities.
- 3.9.14 Specification for online cell booster shall be as under
- | | | | |
|----|-------------------------------------|---|---|
| 1. | Mains Voltage | : | 415V, +/-10%, 3phase |
| 2. | Efficiency | : | > 90% |
| 3. | Mains frequency | : | 50Hz |
| 4. | Max. Battery voltage can be charged | : | 24V |
| 5. | Charging current (max.) | : | 200A |
| 6. | Characteristics | : | Constant Current and Constant Voltage to be followed while charging |

7. Battery capacity : 20AH to 1000AH
8. Chargeable cells : Ni-Cd / 1-16 cells
9. Enclosure Protection : IP21
10. Weight : should be portable (weight less than 25 kg)
11. Ripple Content : 0.5% (max)
12. Protection :
 - a) output Short Circuit
 - b) Output polarity reversal protection
 - c) cell over charging
 - d) output Over Load
 - e) Voltage free output clamp
13. Maintenance : Maintenance Free
14. Setting Parameter : it shall having facility of setting
 - a) Type of Batteries/ charging characteristic
 - b) Battery capacity
 - c) No. Of battery cells
15. Display Parameter : LCD display indicating following
 - a) Charging voltage
 - b) Charging Current
 - c) Input AH (AH charged)
 - d) Status of charged
 - e) Fault indication (error code)
16. CE Marking : This unit meets the essential requirements of the low voltage & electromagnetic compatibility directives
17. Other Features :
 - a) It shall be based on latest microprocessor controlled high frequency switching technology.
 - b) It shall act following function:
 - i) AS A SICK CELL CHARGER: For ON LINE charging. No need to isolate the cell.
 - ii) AS A BATTERY CHARGER: To charge any voltage of the battery 2V to 48V (selectable)
 - iii) AS A RECONDITIONER: for reconditioning of VRLA cells to keep cells in a fully charged condition till they are installed.
 - iv) AS A TESTING EQUIPMENT: For type testing, bulk testing or acceptance testing of a cell or a Battery. While charging, AH capacity fed to the cell or a battery shall be continuously monitored and recorded.

3.9.15 Battery charger for DC System shall be installed in Air-Conditioned area but it shall be suitable for operation in non-air-conditioned area also. Battery backup time shall be 120 minutes for both DC system.

3.9.16 Both DC system shall be kept in Substation switchgear hall. Ni-Cd Batteries for DC system shall be installed in a separate battery room. Both the DC system shall be of same make.

- 3.9.17 Diode droppers for battery charger shall be provided to limit the load voltage to nominal voltage.
- 3.9.18 Battery stand shall be in Double row double tier execution.
- 3.9.19 Current feedback of each battery bank shall be provided to both the rectifiers so that in case of failure of one rectifier, another rectifier can control/ regulate the charging current of both battery banks.
- 3.9.20 The height of DCDB panel shall be same as that of battery charger.
- 3.9.21 Clearance between gland plates to terminating point shall be minimum 300mm in all the electrical equipments
- 3.9.22 Each of battery banks is to be located in a common battery room. CONTRACTOR to furnish number of air changes required to make the battery room safe i.e. non-hazardous. CONTRACTOR to furnish the proposed layout of battery rack in battery room maintaining 750 mm minimum clearance on all sides of battery rack.

3.10 UPS SYSTEM

- 3.10.1 UPS system shall be as per EIL Specification 6-51-0017 and UPS system datasheet attached with the tender.
- 3.10.2 UPS system configuration shall be Double Parallel redundant with Individual bypass as per sketch attached with the Design Basis.
- 3.10.3 110V AC UPS system complete with 2x 100% Ni - Cd battery bank & ACDB shall be provided for Instrumentation process loads
- 3.10.4 230V AC UPS system complete with 2x 100% Ni - Cd battery bank & ACDB shall be provided for Control supply of Thyristor Control Panel, VFD, Soft Starters, ECS, LAN system etc.
- 3.10.5 20% spare capacity shall be considered while sizing the battery and UPS. 20% spare feeders of each type and rating shall be provided in ACDB.
- 3.10.6 3 Pole switch shall be provided for battery isolation purpose. Battery Isolator shall not be located inside battery room.
- 3.10.7 UPS system shall be provided with additional separate earth bus for earthing of Isolation transformer. This earth bus shall be separate from earth bus provided for body earthing.
- 3.10.8 Online battery bank monitoring system shall be provided for 110V AC UPS System battery banks. Provision for individual cell temperature, cell voltage & cell impedance shall be monitored and common alarm shall be provided for each category. Battery monitoring system shall have connectivity with ECS system and remote alarm facilities.
- 3.10.9 ECS Interface for each UPS System shall be provided as per ECS I/O list.
- 3.10.10 Disturbance recorder shall have at least two analogue channels with sampling rate of 1ms or better for monitoring of both UPS output at one place. Disturbance recorder shall have minimum features:
 - Capacity to record at least 5 disturbances of 3 second each -
 - Disturbances shall triggered based on settable under voltage level. -
 - Option of settable pre - & post time
 - Shall have facility to take the data to laptop through USB/ suitable communication port.
 - Disturbance should be stored in "first in first out" mode without any manual intervention.
- 3.10.11 Specification for online cell booster shall be as specified in 3.10.14.
- 3.10.12 Busbar to be provided on TOP in ACDB.

3.11 FIRE DETECTION AND ALARM SYSTEM

- 3.11.1 Fire alarm system shall be engineered in line with the specifications attached with the bid document for all areas within battery limit including buildings.
- 3.11.2 Fire Alarm devices (i.e. DGFAP, detectors, MCP, hooters, HAB, exit sign, input module/control module) shall be supplied by Owner as free issue items (FIM) and quantities of same are as mentioned elsewhere in the tender. In case quantity required by CONTRACTOR is more than the indicated FIM, contractor shall supply the additional quantity without any time & cost implication. The make of these additional equipment/devices shall be of identical make, type & model no. as that of the free-issued equipment/devices.
- 3.11.3 Fire alarm system as required for unit/area including buildings within package battery limit shall be engineered by CONTRACTOR. CONTRACTOR will prepare the fire alarm layout for the building. Owner will free issue the FA devices as per the final approved layout within the limits as mentioned elsewhere in the tender.
- 3.11.4 Installation of all Free Issued Materials for Fire Alarm System and cabling including supply & laying of cables up to DGFAP for all field equipment in line with approved calculations shall be done by contractor. Installation shall be carried out as per installation details/ instruction details/ precautions provided by FA system manufacturer, approved Fire Alarm layouts, specification attached, approved sizing calculations and block diagram.
- 3.11.5 Interface cabling with air-conditioning system, clean agent system, HVWS and other systems shall be provided by contractor as applicable.
- 3.11.6 Testing and commissioning, of the Owner supplied fire alarm system will be done by others (Fire Alarm Vendor). However, contractor shall extend all necessary help and manpower to Fire Alarm vendor for executing works such as cable connection, disconnection and reconnection, detector removal, re-installation required during testing and commissioning of the system.
- 3.11.7 FAJB (Metallic), as required shall be in scope of CONTRACTOR. Fire alarm cabling inside building shall be done using armoured cables. Unarmoured cable will be used as a special case in concealed conduits only subject to Owner's approval.
- 3.11.8 Tinned copper cable lugs for termination of 1.5 sq.mm. multi stranded fire alarm cables in all indoor and outdoor equipments including panels, detectors, BGU, hooters, relay modules, exit signs, JB's, etc. shall be considered by CONTRACTOR. Cable glands with PVC shrouds for all indoor and outdoor equipments including panels, detectors, BGU, hooters, relay modules, exit signs, JB's, etc. shall also be considered by the CONTRACTOR.
- 3.11.9 All hardware used for installation and cable tags shall be of SS 304 grade.
- 3.11.10 CONTRACTOR to furnish the details of control voltage of various systems like HVAC system for designing of tripping contact by FA system manufacturer. CONTRACTOR to furnish tripping philosophy for HVAC system including tripping of VAM package and AHU package during engineering stage.
- 3.11.11 The manual break glass boxes shall be located at strategic locations in the plant. Manual fire alarm break glass boxes will be distributed throughout the protected area so that they are accessible in the normal path of exit from the area

3.12 PLANT COMMUNICATION SYSTEM

- 3.12.1 Plant communication system shall be engineered in line with the specifications attached with the bid document for all areas within battery limit including buildings.
- 3.12.2 Plant communication devices (i.e. Central Exchange, Operator Call station, Field Call Station, Loudspeaker, beacon lamp, etc.) shall be supplied by Owner as free issue items (FIM) and quantities of same are as mentioned elsewhere in the tender. The cables for the system are vendor specific and shall be informed during detailed engineering

- 3.12.3 In case quantity required by CONTRACTOR is more than the indicated FIM, contractor shall supply the additional quantity without any time & cost implication. The make of these additional equipment/devices shall be of identical make, type & model no. as that of the free-issued equipment/devices.
- 3.12.4 Plant communication system as required for unit/area including buildings within package battery limit shall be engineered by CONTRACTOR. CONTRACTOR will prepare the plant communication layout for the building. Owner will free issue the devices as per the final approved layout within the limits as mentioned elsewhere in the tender
- 3.12.5 Installation of all Free Issued Materials for Plant Communication System, PAJB and cabling including supply of PAJB and supply & laying of cables up to PAJB for all field equipment in line with approved layouts shall be done by contractor. Installation shall be carried out as per installation details/ instruction details/ precautions provided by Plant Communication system manufacturer, approved layouts, specification attached, approved sizing calculations and block diagram.
- 3.12.6 Testing and commissioning of the Plant Communication system will be done by Owner/others (Plant Communication Vendor). However, contractor shall extend all necessary help and manpower to Plant communication vendor for executing works such as cable connection, disconnection and reconnection required during testing and commissioning of the system.
- 3.12.7 Plant Communication cabling from Central exchange onwards to the PAJB, OCS, FCS, loudspeaker, beacon lamp, etc. shall be done by CONTRACTOR. Cabling inside building shall be done in concealed conduits using un-armored cables. Tinned copper cable lugs shall be considered for termination of multi stranded cables in all equipments. Cable glands with PVC shrouds for all equipments shall also be considered by the CONTRACTOR
- 3.12.8 All hardware used for installation and cable tags shall be of SS 304 grade.
- 3.12.9 Where distance between exchange and field call stations is longer, multiple cores shall be used in parallel for power supply cables, wherever required.
- 3.12.10 Basis for deciding spare cores shall be as under:

i). Cable with up to 7 pairs	1 spare pair required
ii). Cable with > 7 pairs up to 10 pairs	2 spare pairs required
iii). Cable with >10 pairs up to 40 pairs	4 spare pairs required
iv). Cable with >40 pairs up to 100 pairs	5 spare pairs required

3.13 TELEPHONE SYSTEM

- 3.13.1 Telephone system equipments as specified in scope of work shall be supplied, installed, tested and commissioned as per the specifications of this package.
- 3.13.2 Indoor Telephone Distribution Junction Box (TDJB) suitable for minimum 25 telephones shall be made out of 2.03 mm (14 gauge) sheet steel with Krone type terminals and with hinged lockable door. TDJB shall be provided with one anti-rust coat of primer and two finished coats of epoxy paint.
- 3.13.3 CONTRACTOR to note that incoming cables upto TDJB inside substation building shall be supplied and laid by others. However, termination and glanding of cables in TDJB JB is in scope of CONTRACTOR.
- 3.13.4 CONTRACTOR shall supply, install, test and commission flush mounting, plug - in type sockets for telephones including supply of sheet boxes with covers.
- 3.13.5 CONTRACTOR scope includes wiring from TDJB onwards to telephone sockets in concealed conduit for building.

3.13.6 Analog push button telephone handset to be supplied shall have the following functionalities :

- Redial / flash buttons.
- Ringer volume control.
- Hands free dialling.
- Two way speaker phone.
- Desktop/wall mountable.
- Caller ID facility.
- Minimum 99 incoming and 10 outgoing no. storage.
- Display of real time and date.
- Programmable flash.
- Alphanumeric 16 Digit Backlit LCD display without any battery or adopted in put power and shall display date, time, caller number & name at a time.
- Minimum 50 Names phone book.
- Should have Music on hold.
- Adjustable ringing tone.
- Telephone set should work on both tone & pulse mode.
- Dual mode FSK / DTMF system compatible with auto detection
- Telephone set & Ringer should be compatible with Openscape 4000 V8 type of system
- Telephone Sets should be supplied with battery, rosette, line cord & coil cord.

3.14 LAN SYSTEM

- 3.14.1 CONTRACTOR scope includes supply, installation, testing and commissioning of LAN system comprising of CAT 6A modular UTP jack including all connected material (i.e. face plate, surface mounted box, patch cord, etc.), circuit wiring from Ethernet switch rack to CAT 6A UTP Jack using CAT 6A LSZH UTP cables, CAT 6A modular patch cord.
- 3.14.2 CONTRACTOR to note that minimum three 5A convenience outlets with switch shall be provided along with for each LAN UTP Jack.
- 3.14.3 CONTRACTOR to note that connection of LAN system with refinery LAN shall be done by others
- 3.14.4 AC UPS considered for LAN, VFD control supply, ECS etc. shall be 230V SPN. AC UPS shall be supplied by Contractor & shall be installed at Substation.

3.15 MOTORS

- 3.15.1 MV Motors shall be energy efficient IE3 type as per IS 12615 and shall meet the requirements as per EIL standard specification 6-51-0064 and datasheet for MV motors attached with tender.
- 3.15.2 Motors installed outdoors shall have canopy (2 mm thick G.I. sheet steel) for additional weather protection.
- 3.15.3 Motors shall be capable for 20 % over speed without danger of mechanical failure.
- 3.15.4 All HV Motors shall be provided with temp. transmitters connected to DCS for data logging, trending and DCS trip command generation.
- 3.15.5 Terminal box of all the motor shall be suitable for rotation by 90 degree.
- 3.15.6 All LV motors rated up to & including 2.2KW shall be with STAR connected windings. Motors rated above 2.2KW shall be DELTA connected windings.
- 3.15.7 6 nos. duplex winding RTD & 2 nos. duplex bearing RTD with contact shall be provided for all HV motor. RTD/BTD output shall be taken directly to DCS.
- 3.15.8 For MV motors PTC thermistor shall be provided where process/DCS based temperature monitoring is required.

3.15.9 The cable entries of all Terminal Boxes of motors, before dispatch from motor manufacturer works, shall be fitted with suitably sized IP-55 Metallic Sealing Plugs to prevent water entry/ingress in motor windings through openings meant for cable entry in terminal boxes at construction site till the time motors are erected and cable terminations are done. Weatherproof nickel plated brass cable glands shall be supplied loose.

3.15.10 Motor bearing details shall be indicated on motor name plate to facilitate operation & maintenance team.

3.16 LOCAL CONTROL STATION

3.16.1 Industrial type weatherproof control stations (IP-65) for all motors, emergency stop push buttons for transformers / motors and emergency push buttons as required for plant operation and safety etc. shall be provided by the contractor.

3.16.2 Each motor shall have a separate push button station for motor start/stop in addition to local/remote, Auto/manual selector switch as per operation requirements. LCS for motors rated 5.5 kW and above shall be provided with ammeter. However, for all compressor & package auxiliary loads such as motor driven pumps, heaters etc. field ammeter shall be provided irrespective of motor/load rating

3.16.3 For LCS for VFD controlled motors, in addition the above requirements, speed raise /lower push buttons, speed indication etc. shall be provided.

3.16.4 One number emergency stop push button station with ammeter (where applicable) shall be provided near each motor having control not in the vicinity and at grade level for motors located at higher elevation. This push button shall be installed at an accessible place and clearly marked with suitable warning instructions.

3.16.5 Dual pushbutton to be provided in the transformer bay shall be wired in series and connected to the trip circuit of the upstream breaker such that pressing of both simultaneous shall trip the transformer circuit breaker. All contact of these push buttons shall be used as close permissive for the transformer circuit breaker. Additionally push buttons shall also be provided with covers and pushbutton shall be stay put type.

3.16.6 Each pushbutton provided in LCS shall have two elements / contacts. However local control stations stop push button for transformer shall have 3 NO + 3 NC contacts instead of 2 NO + 2NC specified in EIL standard specification 6-51-0006.

3.16.7 Local control stations installed in outdoor area shall have GI canopy for additional weather protection.

3.16.8 Local Push Button station at each entry of substation floor shall be provided and same shall be wired to LDB for control of normal lighting of switchgear/GIS hall & cable cellar.

3.17 MOTOR OPERATED VALVES

3.17.1 MOV shall be conventional type or 2 wire control as defined in instrumentation scope of work and specification attached with the bid document.

3.17.2 Fire safe MOV shall be provided if specified in Process data sheet. Fire survival type cable shall be provided for fire proof MOV's.

3.17.3 In the event of voltage dips/ power outage, status of MOVs (OPEN/ CLOSE indication) for remote annunciation shall not undergo any change. The wiring for all MOVs feedback controls shall be fail safe type. Any backup for power supply and hardware required for achieving the same shall be provided by vendor within the actuator.

3.17.4 MOV actuator shall be Non-intrusive type

3.18 EOT CRANE

3.18.1 All electrics for EOT crane shall comply to Datasheets, EIL Std Spec 6-51-0094. Anything required over and above that if specified, for safe and satisfactory operation of the EOT

crane shall be included by the vendor in his scope without any cost /time implications to purchaser.

3.19 CABLING

- 3.19.1 All Power cables shall comply with the EIL standard specification 6-51-0051 and datasheet attached with tender.
- 3.19.2 Power cables used shall be with 3.5/ 4 cores, except for motors, which shall be 3C. The conductor size shall be minimum 4mm².
- 3.19.3 The conductor material for power cables shall be copper up to 16 mm² and Aluminium above 16 mm². However in case of cables related to DC system and UPS system all cables from Battery charger & DCDB onwards and from UPS & ACDB onwards shall be with copper conductors irrespective of cable size.
- 3.19.4 All MV control cables, plant communication cables, telephone system cables and fire alarm cables shall comply with the EIL standard specification 6-51-0052 and datasheet attached with tender. Control cables shall be 2.5 mm², multistranded copper conductor, twisted pair and overall shielded, XLPE insulated type. Note that type of core insulation for these cables shall be Type A as per IS 5831 and material of Inner sheath shall be ST1.
- 3.19.5 All cable tags used for cable identification shall be of stainless steel grade SS 304.
- 3.19.6 For fire alarm system, power cables shall be 2.5 mm², copper conductor, XLPE Insulated armoured with FRLS outer sheath and cables for connecting various fire alarm devices shall be 1.5 mm², copper conductor, twisted pair XLPE Insulated, armoured with FRLS outer sheath. Fire alarm cables shall be multi-stranded type. Colour of outer sheath of fire alarm cables shall be RED. However, power cables for fire alarm shall be BLACK in colour.
- 3.19.7 For plant communication system, 0.9 mm dia twisted pair solid copper conductor XLPE insulated cables for interconnections between MCS / OCS / FCS & exchange and 1.5 sq. mm twisted pair multi stranded copper cable for connection to the loudspeakers shall be provided. Colour of outer sheath of plant communication cables shall be GREY.
- 3.19.8 For telephone system, cable from TDJB onwards to telephone sockets shall be 660 V grade, 0.63mm dia. annealed tinned copper conductor and PVC insulated. Colour of outer sheath of telephone cables shall be GREY.

3.19.9 FIBER OPTIC CABLES

- 3.19.9.1 Fiber optic cable shall be supplied along with HDPE duct.
- 3.19.9.2 The fiber-optic cable shall be of single mode type only with a minimum of 2 spare fibers in each cable. Procedure of data transmission, error control and recovery shall be as per acceptable standards.
- 3.19.9.3 All lengths shall be joint free single continuous lengths. Coating and the colour of the fiber shall not react with the surrounding jelly. Outer sheath shall be flame retardant low smoke (FRLS) type.
- 3.19.9.4 Fiber-optic data cable shall be suitable for water-submergence duty and high temperature withstand as per the routing requirements in the plant. All lengths shall be joint-free continuous lengths.
- 3.19.9.5 Optical fibers shall be coated with UV cured double acrylate resin. It should not have any reaction with cladding or core material.
- 3.19.9.6 The coatings shall be in various colours in order to facilitate fiber identification. Fiber colours shall correspond to latest revision of IEC publication 60793-2 and 60304. The colours shall correspond reasonably with standard colours and shall readily be identifiable and shall be durable. The colours should have good colour fast properties also in the

presence of other materials during the lifetime of cable. The coating and the colour shall not react with the surrounding jelly.

- 3.19.9.7 The fiber optic cable shall be protected against damages from termite, rodent, fire, chemicals (such as oil & natural gas, LPG and other petroleum/ petrochemical products), moisture and water over the life time of the cable.
- 3.19.9.8 Moisture barrier – Polymer coated aluminium tape placed longitudinally over the cable core. The tape shall form a close fit around the cable core with a sealed overlap of 6mm minimum. The thickness of each polymer layer shall be 0.04 mm minimum. The thickness of fully annealed aluminium foil shall be 0.15 mm minimum.
- 3.19.9.9 The armouring of the optical fiber cable shall be of corrugated steel (electrolytically chrome plated low carbon steel) tape both side coated with ethylene acrylic copolymer, applied longitudinally with minimum overlap of 6mm. The thickness of the steel tape shall be 0.15 mm minimum. The thickness of each polymer layer shall be minimum 0.04 mm minimum.
- 3.19.9.10 The cable shall have sufficient strength to withstand a load of value $T = 9.81 \times W$ newton, where W = mass of 1 km in kg. The load shall not produce total strain exceeding 0.25% in the fiber.
- 3.19.9.11 The termination enclosures of the optical fiber cable should be dust tight (No dust ingress) and protected against immersion in water (suitable for continuous immersion in water) and should be complete with all accessories including splice cassettes splice protection and all other accessories including accessories for electrical continuity of metallic layers of optical fiber cable and OFC preparation kit along with instruction sheet.
- 3.19.9.12 All fibres (including spare fibers) of a cable shall be terminated in the termination enclosure by pigtailed. Subsequent connection shall be by patch chords. Supply and erection of termination enclosure, pigtail, patch chord etc. is in vendor's scope. OTDR analysis/report shall form part of the testing activities of the OFC network.
- 3.19.9.13 Vendor shall furnish past track record for the selected make of the fiber optic cable, preferably for the past EIL projects during drawing review stage.
- 3.19.9.14 HDPE duct shall be permanently solid lubricated/ with spiral groove, UV-protected, fire retardant (Class V2 as per UL-94 and with limited oxygen index of 21 or higher as per ASTM D2863), of 40 mm outer diameter (+5.0/-0.0 mm) minimum thickness 3.7 mm, suitable to withstand load of 6 kg/m².
- 3.19.9.15 All HDPE ducts shall be supplied along with accessories such as push fit coupler, bend and elbow, end plug, simple plug, sonic head, etc. required for blowing cable into HDPE duct by compressed air technology.

3.20 CABLING SYSTEM

- 3.20.1 Cable tray support along with cable trays inside substation cable cellars shall be provided by CONTRACTOR. Cable tray shall be provided on both side of vertical supports in multi-tier arrangement with minimum 6 cable trays uniformly spaced at 300 mm, on each vertical support along the complete length of substation. Vertical support shall be provided for complete height of cable cellar, fixed at cable cellar floor and roof. Span between two consecutive supports shall not exceed 3000 mm.
- 3.20.2 Cables shall be laid within unit battery limit in sand filled RCC trenches. The minimum sizes of the trenches shall be as specified elsewhere in the bid package. Cable trays as required shall also be provided by the CONTRACTOR within the packages battery limit. For above ground cabling on sleepers, only MV cables shall be laid.
- 3.20.3 Engineering for sizing, deciding the number and routing of cable trench/cable trays within CONTRACTOR's battery limits shall be carried out by the CONTRACTOR based on number

and sizes of cables. These details shall be finalized during detail engineering, which shall be taken care by the CONTRACTOR without any impact on cost and time to Owner/ Consultant.

- 3.20.4 CONTRACTOR shall also size, supply, lay and terminate the power & control cables for Owner supplied equipments (Free issued items) to be located in the packages battery limit.
- 3.20.5 All cable trays as required as per CONTRACTOR scope, shall be GI type with SS hardware and shall be provided by CONTRACTOR. Coupling and connection hardware of cable trays shall be of stainless steel grade SS 304.
- 3.20.6 GI pipes for cable protection above ground, floor sleeves, supports wherever necessary, cable markers, identification tags, GI saddles, saddle bars and associated accessories, all other galvanized hardware like nuts, bolts, washers, grouting bolts as necessary, shall also be provided
- 3.20.7 Entry of all electrical cables to SRR/CR shall be through MCT only.
- 3.20.8 GI Sheet covers shall be provided for top most cable tray and vertical extent of cable trays. GI Sheet covers shall be provided at the bottom of the bottom most cable trays, if trays are laid on pipe rack with hydrocarbon piping below the cable trays
- 3.20.9 Wherever trenches/trays within battery limit have interface with the trays and trenches outside battery limit, the details shall be finalized during detailed engineering. Trenches and trays shall be provided up to the battery limits as per the final approved layouts without any impact on cost and time to owner
- 3.20.10 It shall be CONTRACTOR's responsibility to co-ordinate the cable trench/ tray routing from the package battery limit area, control room and substation building etc. with other agencies involved. Trenches and trays shall be provided up to the battery limits as per the final approved layouts without any impact on cost and time to owner.
- 3.20.11 In cable trays/trenches 20% spare space shall be provided. 40% spare shall be considered in Electrical Road Crossings.
- 3.20.12 Lugs to be supplied by the CONTRACTOR shall meet the following requirements for all terminations for the equipments in the scope of CONTRACTOR.
 - Aluminum conductor cable termination on Aluminum bus bar/ terminals (like switchboards) - Aluminum lugs
 - Aluminum conductor cable termination on Copper bus bar/ terminals (like motor) - Bimetallic lugs having Al barrel & tinned Cu palm
 - Copper conductor cable termination on Aluminum bus bar - Bimetallic lugs having tinned Cu barrel & Al palm
 - Copper conductor cable termination on copper bus bar/ terminals - Tinned copper lugs.
 - Lugs provided for termination of HV & MV cables at switchgear end shall be of long barrel type.
- 3.20.13 Glands to be supplied by the CONTRACTOR shall be of nickel-plated brass for all cabling & termination for the equipments in the scope of CONTRACTOR. The cable glands shall be single compression type for indoor equipments & double compression type for outdoor equipments.
- 3.20.14 Installation of HV termination & straight through joint kits shall be done through authorized jointers of kit manufacturer only.
- 3.20.15 MV Control cable shall be of Multistranded conductor, twisted pair individual & overall shielded, XLPE insulated type.
- 3.20.16 The Cable outer sheath Color for various twisted pair cables shall be as follows

MV Control Cables	Black base color
MV Communication Cables	Gray base color
MV Fire Alarm Cables	Red base color
MV Fire Safe Cables	White base color

3.21 EARTHING AND LIGHTNING PROTECTION

- 3.21.1 Earthing system of the entire package shall be designed to meet the statutory requirements.
- 3.21.2 Earth Resistivity Value shall be measured by CONTRACTOR at minimum five locations before earthing system design calculation.
- 3.21.3 Contractor shall measure the earth resistivity of soil as per Wenner's four electrode method. For determining the earth resistivity, five test locations shall be chosen to cover the whole site as per the site-Engineer-in-charge. This number shall be increased if the test results obtained shows a significant difference. The tests shall be conducted during the dry season
- 3.21.4 Earthing system shall conform to following standards:
 - 3.21.4.1 IEEE-80 Guide for safety in AC substation grounding.
 - 3.21.4.2 IS-3043, Code of practice for earthing.
 - 3.21.4.3 CBIP Tech. report for Earthing System for HV Substations.
 - 3.21.4.4 CEA Regulations as amended from time to time and the relevant regulations of the Electricity Supply Authority concerned.
 - 3.21.4.5 The earthing work shall also conform to EIL specification for Installation of earthing system.
- 3.21.5 Lightning protection shall comply with the requirements of IS/ IEC 62305. Contractor to furnish calculation for lightning protection of building. Lightning strip size shall be minimum 25 x 3 mm.
- 3.21.6 Cross-section of earthing conductor shall be designed to prevent fusing of conductor and deterioration of joint under most adverse conditions of fault. The same shall be determined as per IS: 3043, and to meet the regulations of CEA Regulations. For earthing conductor sizing, duration of earth fault current duration to be considered, shall be minimum one second.
- 3.21.7 The entire installation shall be done in accordance with standards mentioned herein. The contractor shall carry out any changes desired by the electrical inspector or the owner, in order to make the installation conform to CEA Regulations at no extra cost.
- 3.21.8 Earthing system shall be designed to have a low impedance to ground and a current carrying capacity consistent with the fault current. The earth loop impedance to ground shall not be in excess of 1.0 Ω . The main earth loop shall be laid at a depth of minimum 500 mm below grade level.
- 3.21.9 Test disconnect facilities shall be provided for the earth pits to check their earth resistance periodically.
- 3.21.10 Contractor shall provide earth grid up to battery limit of the package including provision of earth plate near the battery limit for interconnection of the unit earth grid with the Owner's main plant grid. CONTRACTOR shall extend & connect the plant earthing grid to main earthing grid, at minimum two points.
- 3.21.11 All earthing hardware (i.e. nut, bolts, etc.) for earth pits, earth plate connection cable trays earthing, etc. shall be of stainless steel grade SS 304.

- 3.21.12 Contractor to note that separate dedicated earth electrodes shall be provided for lightning protection.
- 3.21.13 All earth pits for earthing and lightning protection shall be maintenance free chemical earth pit with Cu bonded high tensile low carbon steel core electrode.
- 3.21.14 Separate clean earth system shall be provided for Numerical relays, VFD, Soft Starters, Thyristor Panel, SAS in Substation and for Instrumentation requirement (DCS/PLC/Analyzer shelters) etc. in Control room/ SRR/ Unit as required.
- 3.21.15 Material of connection of equipments to earth plate shall be as per the equipment earthing schedule enclosed with the tender document.
- 3.21.16 Minimum size of the main earth grid shall be 100 x 12 for Substation and 50 X 6 mm GI. for Unit. However, Earthing sizing calculation shall be furnished by Contractor for the final GI earth strip selected.
- 3.21.17 Adequate number of earth plates for taking branch connections shall be provided.

3.22 LIGHTING SYSTEM

- 3.22.1 Normal lighting, Emergency lighting and DC Critical lighting shall be provided as per Electrical Design Philosophy.
- 3.22.2 All lighting fixtures shall be LED type, supplied complete with associated LED lamp and driver
- 3.22.3 25% of total fixtures shall be fed from emergency lighting panel for illumination, in case of failure of normal power supply.
- 3.22.4 All lighting fixtures shall be suitable for the area in which they are installed. All hardware of the lighting fixtures like nuts, bolts, mounting brackets for ceiling & column mounting and adaptors for installation on poles shall be with MOC of SS304.
- 3.22.5 For fixture mounted on pole dedicated standalone junction box shall be provided at bottom for loop-in loop-out.
- 3.22.6 Lighting & Power panels shall be standardized to have 6, 12 or 18 single phase outgoing feeders. The panel shall be provided with 30% spare outgoing.
- 3.22.7 All lighting poles shall be hot dipped galvanized type with SS hardware.
- 3.22.8 Twin cluster LED type medium intensity flashing lamps, maintenance-free aviation lighting for all tall structures, stacks etc. as per aviation regulations and norms shall be provided. Aviation lighting fixtures at alternate elevation shall be fed from different circuit to ensure availability of aviation lighting in case of failure of one circuit
- 3.22.9 DC critical lighting shall be provided at exit, escape route inside the building/plant area and other strategic locations in package battery limit.
- 3.22.10 All lighting fixtures shall also have independent earth terminal outside the enclosure.
- 3.22.11 Cable from lighting panel onwards to the outdoor lighting fixtures shall be 3Cx2.5mm², Copper conductor, and armored FRLS cable.
- 3.22.12 It is vendor's responsibility to ensure that adequate lighting is maintained within package battery limit with minimum lux level specified as per clause 7.4.12 of 6-51-0099. The same will be measured and demonstrated at site. In case additional lighting fixtures and associated circuit/cabling is required, the same will be provided by vendor without any time/cost implication to owner.
- 3.22.13 415/ 415V Dry type lighting transformer shall be supplied with vector group as Dyn1

3.23 SPECIAL REQUIREMENTS FOR LEDs FIXTURES

- 3.23.1 TECHNICAL REQUIREMENTS OF LED:

- 3.23.1.1 LED efficacy shall be greater than > 140Lumen/Watt @ 350mA drive current. In respect of LEDs of higher power ratings, drive current greater than 350mA can be accepted if the LED's LM 80 / IS: 16105 test reports support the same.
- 3.23.1.2 LED type shall be SMD (surface mounted device) type LED for all applications. COB type to be considered only for applications such as High bays, Flood Lights & Flameproof Light Fittings.
- 3.23.1.3 Approved makes for different LED technology/types shall be as follows:

LED Technology/ Type	Approved Make
SMD	Nichia, Osram, Lumileds (Erstwhile Philips Lumileds), CREE
C.O.B	Citizen, Bridgelux
Domestic/Decorative Luminaires	Everlight Taiwan, Edison Taiwan, Samsung Korea, Osram Germany along with makes approved for SMD

- 3.23.1.4 Test Report for Ambient Temperature of 55 / 85 / 105 °C at rated and maximum current shall be submitted for SMD type LED. For COB type LED, as soldering temperature is not applicable for COB technology, LM 80 test report shall be submitted.
- 3.23.1.5 TM 21 life projection calculations along with LM80 for all three ambient temperature of 55 / 85 / 105°C as per applicable standard shall be submitted to substantiate that life of LED Chip shall be more than 50000 Hrs for both commercial and Industrial range and 25000 Hrs for LED Bulb, domestic and decorative Range.
- 3.23.1.6 Reported life Span of LEDs used in the Luminaire shall be greater than 50,000 Hrs at the soldering point temperature of 85°C and at the luminaire driving current.
- 3.23.1.7 The LEDs shall comply with Ptioto biological Safety norms as per IEC 62471 / EN62471 / IS: 16108 and should fall in the exempt group for indoor luminaires and in exempt or low risk group for outdoor LED luminaires.
- 3.23.1.8 View angle : Typical 120°
- 3.23.1.9 The colour temperature of the proposed white colour LED shall be from 5700K (i.e. 5665K±355K) to 6500K for indoor type luminaire Step 5 or Step 3 McAdam ,as per ANSI standard C78.377A, & 5700K (i.e. 5665K±355K). For outdoor type luminaires, Step 7 McAdam, as per ANSI standard C78.377A, will be accepted on account of colour consistency.
- 3.23.1.10 The Colour Rendering Index (CRI): CRI should include all colour range from R1 to R15, shall be > 80 for Indoor luminaire and > 70 for Outdoor luminaire.
- 3.23.2 TECHNICAL REQUIREMENTS FOR LED DRIVER
- 3.23.2.1 Min. efficiency of driver: The minimum efficiency of LED driver shall be 85% for driver power output rating <=40W and 87% for driver power output rating > 40W.
- 3.23.2.2 Power factor of complete fitting shall be greater than 0.90.
- 3.23.2.3 In-built high voltage cutoff shall be >= 290Volt.
- 3.23.2.4 Driver Surge Protection standard: Surge Protection for minimum 2kV for indoor and minimum 3kV for Outdoor LED systems shall be provided. However, if a site is prone to lightning and surge, 10kV surge protection shall be required. In case of outdoor luminaires, the Surge Protection Device (SPD) should be series type with fail safe.

- 3.23.2.5 Total Harmonic Distortion (THD): Less than 10 % for full load for more than 20 W and less than 20% for less than 20W. Not applicable for Domestic/Decorative LED fixtures.
- 3.23.2.6 Isolated driver shall be used. Short circuit protection /Open load protection shall be provided
- 3.23.2.7 For driver power output rating > 50W, potted driver shall be provided.
- 3.23.2.8 The power supply shall be connected to the LED PCBs through proper connectors.
- 3.23.2.9 EMI/ EMC compliance: The driver shall comply to the following EMI/ EMC standards:
 - CISPR 15/ 18:6873 (CE, RE, CDN) or compliance to equivalent EN standard.
 - IEC: 61347 (reference standards are listed as follows)
- 3.23.2.10 Driver shall comply with the safety requirements laid down in IEC: 61347 - 2 - 13/ EN: 61347 - 2 - 13/ IS: 15885 - 2 - 13.

3.23.3 TECHNICAL REQUIREMENTS OF ELECTRONIC COMPONENTS USED IN LED LUMINAIRE

The circuit boards and electronic components to be used in the luminaire should be of rating/type so as to provide reliable functioning. Following shall be ensured during procurement:

- 3.23.3.1 MCPCB is to be used for SMD technology for LED wattage in excess of 0.5. The minimum thickness should be 1.0 mm for indoor and 1.6 mm for outdoor type luminaire. However, the same is not applicable for COB.
- 3.23.3.2 FR4 grade PCBs of min. thickness of 1.6 mm shall be used in driver circuits. The same is not applicable for COB.

3.23.4 TECHNICAL REQUIREMENTS OF LED LUMINAIRE

- 3.23.4.1 The luminaire shall have LM-79 / IS: 16106 test report from a NABL accredited laboratory.
- 3.23.4.2 The min. system lumen efficacy of the luminaire shall be 95 lm/W (for luminaire system wattage <=15W) and 100lm/W for wattage >15 W.
- 3.23.4.3 Following shall be required in terms of secondary lens/ optics:
 - Outdoor industrial luminaire like well glass, flat glass may not have secondary lens/optics.
 - For other Industrial and outdoor fixtures, luminaire must have secondary lens/optics of type PMMA/Borosilicate glass/Polycarbonate.
- 3.23.4.4 Color temperature: 5700K (5665±355K, as per ANSI standard C78.377A)
- 3.23.4.5 Housing of luminaire: Housing of outdoor and/or FLP shall be Pressure die-cast LM6/ADC12/LM24. For indoor, non-weather proof items like CRCAIPC/Aluminium Extrusion housing can be used.
- 3.23.4.6 Cover type: For outdoor type fittings, cover type shall be Toughened glass or UV stabilized polycarbonate whereas, for indoor and non-weather proof items, UV stabilized Poly Carbonate can be used.
- 3.23.4.7 Minimum Ingress Protection Required for LED Flood Light / Outdoor Industrial is IP 65.
- 3.23.4.8 Impact Resistance: For outdoor fittings minimum impact resistance shall be IK-05 and not applicable for indoor fixtures.
- 3.23.4.9 Temperature rise test: When the luminaire has stabilized thermally, soldering point temperature shall be <=85°C for SMO type but for COB type the temperature rise test shall not be applicable.

- 3.23.4.10 Temperature rise (above ambient) of heat sink should generally remain within 20°C - relaxation on this account can be granted as long as the soldering point temperature limit of 85°C is not violated and there is no unacceptable outcome.
- 3.23.4.11 BIS Registration: The luminaire shall have BIS approval for surface mounted luminaire as applicable.
- 3.23.4.12 Flameproof tight fittings shall be certified for use in hazardous area as per area classification and the flameproof certificate shall be submitted by the vendor. Explosion proof certificate from PESO shall be submitted before or along with supply of such light fittings.

3.23.5 TESTING OF LED LUMINAIRE

- 3.23.5.1 Following acceptance tests shall be carried out / type test & routine test certificates from NABL accredited Labs shall be provided as per relevant standards.
- Visual and dimensional checks
 - Resistance to humidity test
 - Insulation resistance (IR) test
 - High Voltage test
 - Over-voltage protection
 - Surge protection
 - Total harmonic distortion (THD) test
 - Reverse polarity test
 - Temperature rise test
 - Ingress protection test
- 3.23.5.2 Type test report/ certificate as per relevant standards on selected sample including endurance test as per IS10322 & Safety test for Drivers as per IS15885 from NABL accredited lab shall be submitted.

3.23.6 MISCELLANEOUS REQUIREMENTS

- 3.23.6.1 For LED fixture, integral junction box shall be provided with 3 nos. cable entries for loop-in, loop-out and associated wiring to fixture. Alternatively 2 nos. cable entries for loop-in and loop-out shall be provided with internal wiring for driver and lamp.
- 3.23.6.2 All lighting fixtures shall be supplied complete with associated LED lamp and driver.
- 3.23.6.3 All lighting fixtures shall be supplied with fixture mounting nuts and bolts of stainless steel SS-304. Fixture mounting bolts & nuts for mounting the light fittings on already installed clamps/brackets. However, Clamps/brackets mounting bolts & nuts are excluded from vendor's scope.
- 3.23.6.4 LED type lighting fixtures shall fulfill the following requirements:
- LED lamps and Drivers shall be provided with min. 5 years warranty period.
 - Lighting fixtures reserved for use in 240 Volt AC Emergency Circuit shall have additional RED Circular ring marking for identification purpose for hazardous area identification. This detail shall be furnished to successful vendor during detailed engineering.
 - Vendor shall indicate the following parameters as a minimum in fixture drawings:
 - Fixture Wattage and LED Wattage
 - Actual Consumption of Fixture
 - Driver Consumption
 - Fixture Life time

- Luminous Efficacy of fixture
- Lumen Output of Fixture
- Tolerance for Voltage and wattage rating
- Power factor of Fixture
- Beam Angle of Lighting Fixture
- Weight of Fixture
- LED LAMP and Driver Warranty Period
- Driver Surge Protection
- Compliance to IEC-61347-2-13 for LED Driver
- BIS Certification no. for Driver
- Driver Make and Model No.
- LED Make and Model no.
- LED type i.e. COB (Chip on Board) or Multichip etc.
- Quantity of Fixtures
- No. of Cable entries for Fixture along with quantity of FLP Cable glands and FLP Stopper plug.
- PESO/CIMFR/BIS License certificates numbers along with dates.
- IES files of all LED lighting fixtures finalized during detail engineering shall be furnished for owner/EIL records.

3.24 FIXED TYPE SPACE HEATER PDB

- 3.24.1 PDB shall be installed in safe area and shall be suitable for safe area. Ingress protection shall be IP-41.
- 3.24.2 PDB shall be single front, and fixed type, free standing floor mounted type. PDB shall be minimum 415V, 200 Amp, 50Hz, TPN, 25 kA (1 sec.) with two number MCCB incomers mechanically interlocked with each other. MCCB shall be provided with shunt trip and short circuit release.
- 3.24.3 The switchboard shall be non-compartmentalized type instead of compartmentalized specified in 6-51-0012. However, other requirements of 6-51-0012 shall be complied with.
- 3.24.4 Incomer feeder shall be provided with voltmeter and ammeter. All indicating lamps shall be LED type.
- 3.24.5 Terminals for outgoing feeder's upto 16A shall be suitable for 10 Sq.mm. cable. Terminals for upto 32A and 63A feeders shall be suitable for 25 mm² cable. Supply of lugs and nickel-plated brass cable glands for all cabling & termination in the scope of vendor inclusive of cable glands for incoming cable to PDB. The cable glands shall be single compression type.

3.25 REQUIREMENT FOR AIR CONDITIONING

- 3.25.1 Contractors scope shall include sizing, design, engineering, manufacturing, supply, installation, testing and commissioning, packing and delivery at site of all the electrical equipments including supply of all commissioning spares, special tools and tackles as per the specifications and the datasheets attached or referred. The major electrical equipments for the package includes
- 3.25.1.1 All MV motors
- 3.25.1.2 Power distribution board - PDB (As per EIL specification 6-51-0012) for all motors and other load of the package, separate for each building (PDB shall be installed in AC Plant/ Package room, AHU room, as required).

- 3.25.1.3 Supply, laying and termination of all power and control cabling for all package loads.
- 3.25.1.4 Cable trays, as required for laying the cables for the motors/ loads.
- 3.25.1.5 Local control panels/ local push button stations (as required).
- 3.25.1.6 Earthing material as required for earthing for package equipments.
- 3.25.1.7 Any other equipment not specifically mentioned above but required for normal operation of the package equipments.
- 3.25.2 PDB shall be single front, compartmentalized, and fixed type. PDB shall be suitable for 415V, 50Hz, TPN, 65 kA (1 sec.) with single bus, two SFU incomers (4 Pole) provided with manual transfer facility and mechanical interlocking between incomers.
- 3.25.3 The number of feeders in the PDB shall be as per the electrical loads of the respective building, where PDB is located. PDB for AC Plant room in shall also include feeders for downstream PDBs located in each AHU Room
- 3.25.4 All PDBs shall be suitable for TOP Cable entry. Minimum clear space of 1000mm shall be maintained in front of PDBs.
- 3.25.5 Incomer feeder shall be provided with voltmeter and ammeter. Incomer SFU shall be 4 Pole type. All motor & other feeders shall be provided with hardware as per the respective datasheets for same attached with the tender, however same shall be in fixed execution. Field ammeter shall be provided in LCS for motors above 55 kW.
- 3.25.6 Providing required interlocking between main PDB & sub PDB of A/C system of a particular building shall be in vendor scope.
- 3.25.7 For Air-conditioning, all blowers shall trip and all "Fire Dampers" shall automatically close on receipt of "Fail-safe FIRE signal" i.e. normally closed but open on Fire condition contact. CONTRACTOR shall take care of this contact in fire alarm system of building. Further distribution of fire signal to each vendor's sub PDB in AHU room (for air-conditioning system) shall be in vendor's scope.
- 3.25.8 All indicating lamps shall be LED type. LED for Space heater 'ON' indication shall be provided for all feeders.
- 3.25.9 20% spare outgoing feeder or minimum one of each type, whichever is higher shall be provided for each PDB
- 3.25.10 Control transformer shall be provided for each outgoing feeder module.
- 3.25.11 Required number of earth plate shall be provided within AC room, AHU room, and pressurization room. Further connection of individual equipments with earthing system shall be done by contractor. For earthing of various equipments upto earth plate, earthing schedule 7-51-0116 attached with the tender shall be followed
- 3.25.12 All the Electrical work of this package shall be carried-out as per EIL Standard Spec no. 6-51-0093 for package units.
- 3.25.13 Co-ordination required for lighting and fire alarm installation works for areas with false ceiling and/ or air-conditioning ducts is in scope of vendor.

3.26 ECS INTERFACE

- 3.26.1 All signals as per ECS IO List sheet attached elsewhere shall be provided in respective equipment for interface with the Electrical control system.
- 3.26.2 CONTRACTOR to note that for signal interface with DCS for soft status and monitoring signals from contactor motor feeders, cable shall be laid and terminated up to ECS panels. Data from ECS RTU shall be hooked up from ECS RTU to DCS through soft link. Interconnection between ECS RTU and DCS shall be by Owner.

3.26.3 Number of analogue / digital IOs for ECS interface shall be worked out by the CONTRACTOR as per the ECS I/Os list attached.

3.26.4 CONTRACTOR to note that:

3.26.4.1 Acquisition of input/output (I/O) signals as hardwired or software:

- All numerical relays shall be connected to a substation automation system. ECS shall communicate with the substation automation system to acquire relay and metering status I/O signals of the relays. These I/O signals have been indicated as “relay and metering LAN” in the typical I/O list.
- All other I/Os shall be acquired hardwired and have been indicated as “hardwired” in the typical I/O list.
- In case any of these data cannot be acquired over the relay LAN, these signals have to be provided as hardwired. For requirement of numerical relays, refer Electrical part of contract document.

3.26.4.2 The I/O list is indicative only. Any other I/O required to meet the contract requirements shall be identified and provided by CONTRACTOR

3.26.4.3 Guidelines for ECS I/O Interface Design

Analogue Input Signals Signal transducers for hard-wired analogue inputs shall have accuracy class 0.1 for the range 0-120%. All transducers shall be externally-powered types. External power supply shall be 230V AC UPS.

For all measurements for I, V, MW, MVAR, Hz, obtained on the relay and metering LAN, maximum possible accuracy shall be ensured

Digital Input Signals

Alarm (D)

Alarm is a signal which requires operator to be alerted such as VT circuit MCB (closed, open), relays 86 & 95 (operated, reset), auto-changeover (blocked, not blocked), DC control supply (healthy, failed), line voltage (unhealthy, healthy), bus voltage (unhealthy, healthy), motor trip from process, under-voltage trip. This shall be hardwired / on relay LAN as specified.

For hardwired signal, potential free contacts of rating 1 A, 110V DC or 240 V AC, make to alarm (NO) preferred. CONTRACTOR shall specifically indicate if NC contact is being provided in place of NO contact.

Generally a hardwired alarm point is put under "sequence of event" monitoring

Status (S)

For hardwired signal, potential free contacts of rating 1 A, 110V DC or 240 V AC, make to alarm (NO) required

Digital Output Signals

Command (C)

Hardwired through potential free changeover type contact of interposing relay, contact rating 5 A, 240 V AC and/or 4 A, 110V DC. Coil rating shall be 24 V DC

3.27 REQUIREMENTS FOR ONLINE TEMPERATURE MONITORING SYSTEM FOR HV & MV SWITCHBOARDS

3.27.1 Online Temperature Monitoring System (OTMS) for HV Switchboards at all critical point mentioned below shall be provided for each switchboard.

In each vertical, wireless sensors shall be located as per the following:

- a. Each horizontal bus bar terminal/ tap-off connection in busbar compartment.
- b. Each cable /bus duct connection points in cable compartment.

c. One sensor per phase of cable connection points shall be considered irrespective of number of runs of cable.

3.27.2 Online Temperature Monitoring System (OTMS) for MV Switchboards shall conform to the following:

In each vertical panel, wireless sensors shall be located as per the following:

i. For MV Switchboard (PCC/PMCC/EPMC) having Air circuit breaker panels:

a. Each horizontal bus bar terminal/tap-off connection in busbar compartment.

b. Each bus duct/cable connection points in cable compartment.

c. One sensor per phase of cable connection points shall be considered irrespective of number of runs of cable.

ii. OTMS is not required for MCC, ASB, LDB & ELDB.

3.27.3 The temperature sensors installed shall be suitable for wireless, with direct contact to hot point, operating range from -10°C to 125 °C. The accuracy shall be as per the following:

± 3°C accuracy for 0°C to 80 °C range.

± 4°C accuracy for full range (-10°C to 0°C and 80°C to 125 °C)

3.27.4 The system shall allow at least 1 configurable threshold (alarm)

3.27.5 OTMS system shall have the provision to send complete data to SAS/ Owner's ECS for monitoring and investigation. The system shall be online to immediately provide an abnormal temperature alarm (with identification/location of the abnormal temperature) to the owner's operator system.

3.27.6 Complete data of OTMS shall be accessible in the SAS (through switchboard level Ethernet switches) & associated SAS Laptop/ HMI. The protocol for communication shall be either IEC 61850 or MODBUS TCP/IP or MODBUS RTU or other open protocol and shall be decided by CONTRACTOR. Accordingly, protocol convertors/gateways at suitable locations as required shall be provided by CONTRACTOR for data integration on IEC 61850 protocol from Master Ethernet switch to Owner's ECS system.

3.27.7 Online temperature monitoring data shall be available in both Owner's ECS as well as Substation Automation System (SAS). OTMS shall be integrated with owner's ECS so that temperature monitoring can be done through Owner's ECS

4 MISCELLANEOUS REQUIREMENTS

4.1 Equipment numbering scheme for equipment located in Substation shall be as per Design Basis document. Numbering scheme for other equipments shall be decided during detailed engineering.

4.2 VFD systems shall be sized taking care of input voltage variation (i.e. ±10%) and voltage drop within the VFD system and motor cable.

4.3 Power system study shall be carried out in ETAP. CONTRACTOR shall furnish the native file of ETAP after carrying out the preliminary study and also along with the final report.

4.4 CONTRACTOR shall furnish complete relay coordination and relay settings for the complete package including coordination with other EPCC CONTRACTOR/owner, relay settings for the upstream feeders.

4.5 Suitability of cable terminal boxes/chambers for the respective cables sizes / runs as per the approved cable schedule shall be ensured by the CONTRACTOR.

4.6 All nuts, bolts, washers, spring washers, grouting bolts, anchor fasteners, etc. necessary for completion of job wherever used shall be of stainless steel SS304. External hardware for lighting fixture, junction boxes, 230V receptacles, and lighting panel shall be of stainless steel grade SS304.

- 4.7 All lugs to be supplied shall be heavy duty, long barrel, crimping type and made of tinned copper. Sector shaped/circular barrel lugs shall be provided for making connections for cables having sector shaped/circular geometry of conductors respectively.
- 4.8 Cable tag shall be stainless steel with cable tag engraved. All spare holes at feeder end shall be sealed using metallic plate and GI hardware.
- 4.9 Cable glands shall be of nickel-plated brass. Cable glands shall be single compression type for indoor equipments & double compression type for outdoor equipments.
- 4.10 CONTRACTOR to note that 3D modelling of substation building and equipments shall be done by contractor in line modelling specification attached with tender. PDF/ Hard Copy of GA drawings of Owner's equipments to be installed in the substation shall be provided to CONTRACTOR during detail engineering
- 4.11 Wherever single core cables are to be terminated in switchboard, aluminum gland plates shall be provided.
- 4.12 All Emergency Stop/Stop pushbuttons on LCS/LCP/Switchboard shall be provided with protective covers to avoid accidental operation.
- 4.13 Contractor shall include painting and marking of all buses, individual incomers, all outgoing feeders etc. with detail such as Tag no., feeder rating, sending end source reference etc. for all switchboards.
- 4.14 All switchboards, panels, etc. shall be provided with LED indications and adequate no. of LEDs shall be provided to give required illumination.
- 4.15 All HV & MV Breaker fed motor feeders (>55kW), schematics shall have provision for auto start and auto re-acceleration with feature to inhibit irrespective of process/licensor's requirement. Reacceleration scheme for contactor fed motors (<=55kW) shall be provided by CONTRACTOR for all those drives requiring reacceleration as per Process requirements.
- 4.16 For Electrical Heat Tracing system, temperature sensing device shall be RTD. Controllers with all requisite status and control signals shall be provided accordingly. These signals shall be also wired up to control room by the contractor.
- 4.17 Lugs having sector shaped / circular barrel shall be used for making connections for cables having sector shaped / circular geometry of conductor respectively.
- 4.18 All accessories like nuts, bolts, washers, earthing studs etc. shall be made of stainless steel SS-304.
- 4.19 For owner supplied items, feeders at 415V/230V AC/ 110V DC/ 230V AC UPS voltage shall be provided by the contractor in the respective switchboard supplied by them. The details for same shall be provided during detailed engineering.
- 4.20 Contractor shall comply with various requirements as per Ministry of Power (GoI) various orders regarding testing of all equipment, components & parts imported for use in the power supply system and network in the country to check any kind of embedded malware/Trojans/cyber threat and for adherence to Indian Standards. Necessary testing of their equipment/ components at designated labs & obtaining test certificates in line with MOP orders shall be done by Contractor/ Vendor.
- 4.21 All the critical inputs must be wired in SAS/ECS for proper monitoring.
- 4.22 Armoured cables with double compression glands shall be used inside Battery Rooms along with FLP fittings/equipments.
- 4.23 Color of HDPE duct for various application shall be as under :

Sr. No.	Application	Colour
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1.	Fire Alarm System Data highway OFC cables	Fire Red
2.	Substation Automation system	Black with blue strips
3.	ECS System OFC Cables	Black with red strip for main data highway. Black with blue strip for redundant data highway.
4.	HDPE conduit for LAN line OFC	YELLOW conduit with BLACK strip
5.	HDPE conduit for Feeder differential protection System	GREEN conduit with WHITE strip

- 4.24 CONTRACTOR shall provide separate RCBO & MCB or separate ELCB & MCB for each lighting outgoing circuit at local lighting distribution panel. Common RCBO/ ELCB + MCB unit is not acceptable. ELCB/ RCBO shall be rated for 30mA in field and 300mA in indoors.
- 4.25 For wiring just above the false ceiling, METSEC channel shall be used. For wiring on true ceiling black enamelled surface conduits shall be used.
- 4.26 Street lighting poles shall not be used for Unit Access Way illumination. Floor mounted poles as per standard with hazardous area lighting shall be used.
- 4.27 All MV feeders rated 400A and above shall be provided with ACB.
- 4.28 Relay connection to the Ethernet Switch shall be in star topology however LAN for Ethernet Switches shall be on IEC-61850-RSTP only.
- 4.29 In 110V UPS system, All Non-DCS loads shall be provided with isolation transformer. In 230V UPS system, isolation transformer is not envisaged.
- 4.30 All Copper Control Cables shall be twisted paired (Individual shielded and overall shielded) only. Minimum 10% spare pair or minimum 1 spare pair shall be provided.
- 4.31 CONTRACTOR shall furnish the duly filled-in B269-475-16-50-LL-8701 (Technical Compliance – Electrical) (Attached herewith) along with Bid document.

5 SPARES

- 5.1 Commissioning spares for all electrical equipments are included in Package Contractor's scope of supply and shall be included in the base price.
- 5.2 Mandatory Electrical spares as per document No. B269-475-16-50-SL-8701, are included in Contractor's scope of supply.
- 5.3 CONTRACTOR shall submit a list with unit prices of recommended spares for two years of normal operation for all electrical equipment provided as a part of this package.
- 5.4 Recommended list of maintenance spares for two years operation shall include the following as a minimum for motors. Vendor shall ensure to quote for the same.
- Bearing for DE/NDE-one set
 - Terminal box cover with screws
 - Fan
 - Terminal block

6 INSPECTION AND TESTING AT MANUFACTURER'S WORKS

- 6.1 All major electrical equipment and material shall be subject to inspection by owner/ Consultant or authorized representative at manufacturers' works. Contractor/Vendor/ Sub-Vendor shall furnish all necessary information concerning the supply to owner/ Consultant.
- 6.2 During fabrication, all the equipment shall be subject to inspection by owner/ Consultant or by an agency authorized by the owner to assess the progress of work as well as to ascertain that only quality raw material is used.
- 6.3 Type, routine and acceptance tests to be conducted on all equipment shall include all tests as specified in standard specifications & data sheets enclosed with the package.
- 6.4 Contractor shall ensure that the electrical equipment procured have type test certificates.
- 6.5 All routine and acceptance tests as specified by the applicable standards shall be carried out by the contractor/vendor/sub-vendor and these tests shall be witnessed by owner/ Consultant or an agency authorized by owner/ Consultant Any other test and quality assurance requirements as defined elsewhere in the package shall also be complied.
- 6.6 All the equipment offered shall have valid type test certificates of recognized testing house such as CPRI, CMRI, PTB, BASEEFA, UL or equivalent.
- 6.7 Wherever, EIL Inspection and test plan is not available for electrical equipments, CONTRACTOR/ Supplier shall develop QAPs using the specific requirements of Inspection and testing as covered in the tender. The QAPs are required to be reviewed and approved by EIL/Owner.

7 INSTALLATION, FIELD TESTING & COMMISSIONING AT SITE

- 7.1 Contractor shall carry out the installation, field testing and commissioning of all items including installation in field, testing and commissioning of free issue items in accordance with Consultant installation standard & standard specification attached with tender.
- 7.2 Contractor shall coordinate with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.
- 7.3 Contractor shall comply with the requirements of Mechanical Completion as described in relevant section of Bid document.
- 7.4 Obtaining clearance for energizing the complete electrical facilities covered under this tender and approval of installation / drawings from central electrical inspector and any other concerned approving authority e.g. CCOE (PESO), OISD etc. shall be in the scope of the contractor.
- 7.5 CONTRACTOR shall also avail OEM (Original Equipment Manufacturer) services for testing and commissioning of equipment such as Numerical relays, large induction motors, large VFDs & soft starter motors etc. However for other equipment, CONTRACTOR shall ensure services of manufacturers' representatives for supervision of installation, testing and commissioning
- 7.6 Splicing of FO cable and taking over from cable laying contractor and glanding of same shall be in the scope of CONTRACTOR. OTDR test shall be done mandatorily after taking over from cable laying contractor.
- 7.7 Chequered plate shall be painted in accordance with painting specification enclosed elsewhere in the bid package.
- 7.8 Painting/ marking/ numbering of all buses of switchboards and each incoming/ outgoing feeder with details of tag number, feeder rating in front and rear of panel and all other equipments viz. transformers, VFDs, Soft starters, Thyristor panels, lighting fixtures, FA devices, junction boxes, motors, welding receptacles, convenience receptacles, local control stations, etc. shall be done as per requirement of Engineer-in-charge at site.

8 STATUTORY APPROVAL OF WORKS

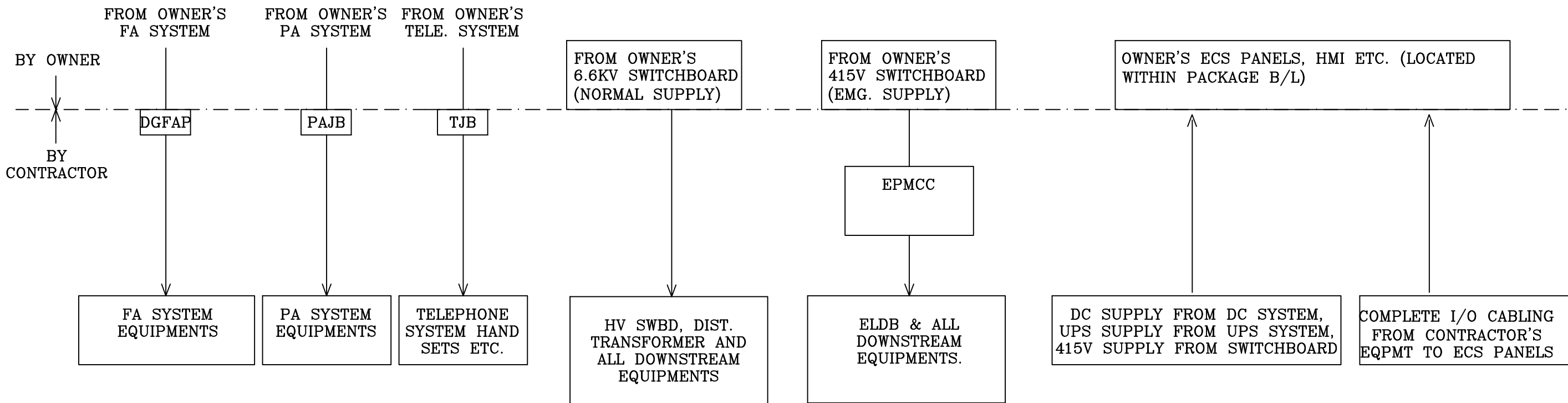
- 8.1 The contractor shall obtain approvals from the concerned electrical inspectorate for installation drawings and engineering of the electrical system and equipment covered under the contractor's scope. Any modification or additional requirements of the electrical inspectorate shall have to be carried out by the contractor at his own cost without affecting time schedule. Arranging for any other approvals required for the complex, from agencies such as CCOE, CEA etc. are included in the contractor's scope. For electrical equipment to be installed in hazardous area, statutory approval certificates shall be furnished by the contractor. Any additional testing, if required, shall be carried out by the contractor without affecting project time schedule at no extra cost to Owner.
- 8.2 The inspection and acceptance of the work as above shall not absolve the Contractor from any of his responsibilities under this package. Obtaining clearance for energizing the complete electrical facilities covered under this tender, and approval of installation and drawings from the Chief Electrical Inspectorate/CEA/SEB/Power Supply Company shall be the responsibility of the contractor.

9 MAKES OF EQUIPMENT AND COMPONENTS

- 9.1 List of approved vendors for Electrical equipment/components is as mentioned elsewhere in the Vendor List, attached with the tender.
- 9.2 All electrical equipment shall be brand new with state of art technology and proven track record. No prototype shall be offered. The make and type of equipment, if not specified in this bid document, shall be subject to approval of owner/ Consultant.
- 9.3 Additional makes of imported items shall be subject to Owner/ Consultant's approval during detailed engineering.
- 9.4 Vendor may procure material from any of the listed vendors. However current validity and range of approval as per Consultant enlistment letter, workload, stability and solvency need to be verified by the vendor before placement of order.
- 9.5 Vendor shall ensure the availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply. Vendor/ sub-vendor shall give a notice of at least one year to the end user of equipment and PMC before phasing out the products/spares to enable the end user for placement of order for spares and services.

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EIL-505, A3-297X420



NOTES:

- SUPPLY AND LAYING OF 6.6kV HV CABLES AND ASSOCIATED CONTROL AND OFC CABLES FROM OWNER'S SWITCHBOARD FOR NORMAL POWER SUPPLY TO CONTRACTOR'S 6.6KV SWITCHBOARD SHALL BE BY OWNER. TERMINATION OF CABLES AT CONTRACTOR'S EQUIPMENT SHALL BE DONE BY CONTRACTOR. TERMINATION OF ASSOCIATED CONTROL CABLES & OFC CABLES AT CONTRACTORS EQUIPMENT SHALL BE DONE BY CONTRACTOR. CABLE TRAYS / TRENCHES FROM OWNER'S SWITCHBOARD/SYSTEM UPTO PACKAGE BATTERY LIMIT SHALL BE MADE AVAILABLE BY OWNER. FURTHER CABLE TRAYS / TRENCHES INSIDE PACKAGE BATTERY LIMIT SHALL BE IN THE SCOPE OF PACKAGE CONTRACTOR.
- SUPPLY AND LAYING OF 1.1kV MV CABLES AND ASSOCIATED CONTROL FROM OWNER'S SWITCHBOARD FOR ONE SINGLE POINT 415V EMERGENCY POWER SUPPLY TO CONTRACTOR'S 415V SWITCHBOARD (I.E. INCOMER ONE ONLY) SHALL BE BY OWNER. TERMINATION OF CABLES AT CONTRACTOR'S EQUIPMENT SHALL BE DONE BY CONTRACTOR. TERMINATION OF ASSOCIATED CONTROL CABLES AT CONTRACTORS EQUIPMENT SHALL BE DONE BY CONTRACTOR. CABLE TRAYS / TRENCHES FROM OWNER'S SWITCHBOARD/SYSTEM UPTO PACKAGE BATTERY LIMIT SHALL BE MADE AVAILABLE BY OWNER. FURTHER CABLE TRAYS / TRENCHES INSIDE PACKAGE BATTERY LIMIT SHALL BE IN THE SCOPE OF PACKAGE CONTRACTOR.
- SUPPLY & LAYING OF PA & TELEPHONE CABLES UPTO JB's IN THE PACKAGE BATTERY LIMITS SHALL BE IN SCOPE OF OWNER. DEVICES PROVIDED WITHIN PACKAGE BATTERY LIMITS SHALL BE WIRED UPTO RESPECTIVE JB's LOCATED WITHIN PACKAGE BATTERY LIMIT BY THE CONTRACTOR. TERMINATION OF THESE CABLES SHALL BE DONE BY THE CONTRACTOR.
- SUPPLY & LAYING OF FA DATA HIGHWAY OFC CABLE UPTO DGFAP IN THE PACKAGE BATTERY LIMITS SHALL BE IN SCOPE OF OWNER. DEVICES PROVIDED WITHIN PACKAGE BATTERY LIMITS SHALL BE WIRED UP TO DGFAP LOCATED AT SUBSTATION (SS-112) BY THE CONTRACTOR. TERMINATION OF THESE CABLES SHALL BE DONE BY THE CONTRACTOR.
- AC/DC POWER SUPPLY TO OWNER'S ECS PANELS, ECS HMI ETC. SHALL BE BY CONTRACTOR.
- FOR DETAIL SCOPE & FREE ISSUE ITEM DETAILS, REFER ELECTRICAL SCOPE OF WORK & SUPPLY (DOC.NO. B269-475-16-50-SOW-8701).
- 6.6KV HV SWITCHBOARD, HV ISOLATOR BREAKER PANELS(IBP), CAPACITOR BANKS, OTHER ELECTRICAL SYSTEMS I.E. UPS SYSTEM, DC SYSTEM, ECS SYSTEM, FA SYSTEM, PA SYSTEM & TELEPHONE SYSTEM, EMERGENCY SWITCHBOARD (INCLUDING 415V EPMCC), ASB, LIGHTING SYSTEM (INCLUDING LDB, ELDB) ETC SHALL BE COMMON FOR THE PACKAGE SUB UNITS I.E. RODMP, ZLDP & CPU.
HOWEVER, DISTRIBUTION TRANSFORMERS AND ASSOCIATED MV SWITCHBOARDS (PMCC & MCC) SHALL BE SEPARATE FOR FEEDING THE MV LOADS OF THE FOLLOWING SUB UNITS:
A) RODMP+CPU AND B) ZLDP.



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NEW DELHI

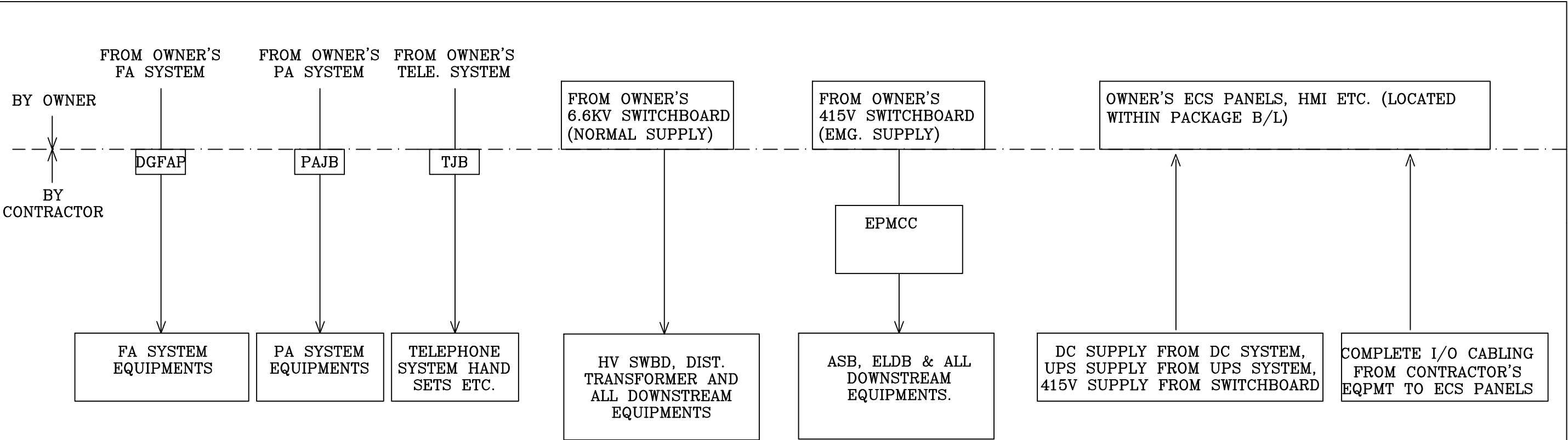
		RO-DM/CPU, ZLD, PACKAGE
DWG. NO.	REF. DRAWING	M/s IOCL-PR

C	08.03.2022	REVISED & REISSUED FOR BIDS	SNM	MK	HK
B	28.06.2021	REVISED & REISSUED FOR BIDS	SK	HK	HK
NO.	DATE	REVISION	BY	CHK	APPD


SCOPE BLOCK DIAGRAM
RODMP /ZLDP /CPU
PACKAGE

Drawing No	REV.
B269-475-16-50-3001 SHT 1 OF 1	C

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- NOTES:
- SUPPLY AND LAYING OF 6.6kV HV CABLES AND ASSOCIATED CONTROL AND OFC CABLES FROM OWNER'S SWITCHBOARD FOR NORMAL POWER SUPPLY TO CONTRACTOR'S 6.6KV SWITCHBOARD SHALL BE BY OWNER. TERMINATION OF CABLES AT CONTRACTOR'S EQUIPMENT SHALL BE DONE BY CONTRACTOR. CABLE TRAYS / TRENCHES FROM OWNER'S SWITCHBOARD/SYSTEM UPTO PACKAGE BATTERY LIMIT SHALL BE MADE AVAILABLE BY OWNER. FURTHER CABLE TRAYS / TRENCHES INSIDE PACKAGE BATTERY LIMIT SHALL BE IN THE SCOPE OF PACKAGE CONTRACTOR.
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 - SUPPLY & LAYING OF PA & TELEPHONE CABLES UPTO JB's IN THE PACKAGE BATTERY LIMITS SHALL BE IN SCOPE OF OWNER. DEVICES PROVIDED WITHIN PACKAGE BATTERY LIMITS SHALL BE WIRED UPTO RESPECTIVE JB's LOCATED WITHIN PACKAGE BATTERY LIMIT BY THE CONTRACTOR. TERMINATION OF THESE CABLES SHALL BE DONE BY THE CONTRACTOR.
 - SUPPLY & LAYING OF FA DATA HIGHWAY OFC CABLE UPTO DGFAP IN THE PACKAGE BATTERY LIMITS SHALL BE IN SCOPE OF OWNER. DEVICES PROVIDED WITHIN PACKAGE BATTERY LIMITS SHALL BE WIRED UP TO DGFAP LOCATED AT SUBSTATION (SS-122) BY THE CONTRACTOR. TERMINATION OF THESE CABLES SHALL BE DONE BY THE CONTRACTOR.
 - AC/DC POWER SUPPLY TO OWNER'S ECS PANELS, ECS HMI ETC. SHALL BE PROVIDED BY CONTRACTOR.
 - FOR DETAIL SCOPE & FREE ISSUE ITEM DETAILS, REFER ELECTRICAL SCOPE OF WORK & SUPPLY (DOC.NO. B269-475-16-50-SOW-8701).

 ENGINEERS INDIA LIMITED NEW DELHI			RWTP WORKS M/s IOCL-PR	B	08.03.2022	REVISED & ISSUED FOR BIDS	SNM	MK	HK	SCOPE BLOCK DIAGRAM RWTP WORKS	Drawing No	REV.
				A	28.06.2021	ISSUED FOR BIDS	AKG	HK	HK		B269-475-16-50-3011	B
	DWG. NO.	REF. DRAWING		NO.	DATE	REVISION	BY	CHK	APPD		SHT 1 OF 1	

CLIENT : INDIAN OIL CORPORATION LTD.

UNIT : RWTP / RODMP / ZLDP / CPU PACKAGE

PROJECT : PANIPAT REFINERY EXPANSION PROJECT (P-25)

EIL JOB NO. : B269

DISCIPLINE : ELECTRICAL

TENDER NO. : B269-475-17-44-PA-T-8701

C	08-03-2022	REVISED AND REISSUED FOR BIDS	SNM	MK	HK
B	27-11-2020	REVISED AND REISSUED FOR BIDS	AKG	HK	HK
A	13-05-2020	ISSUED FOR BIDS	SK	HK	HK
REV. NO	DATE	PURPOSE	PREPARED BY	REVIEWER	APPROVER

Mandatory spares for each applicable items shall be supplied as per Clause 6.1 of Engineering Design Basis (Electrical), B269-999-16-50-EDB-1001 attached with the tender document.

In addition to the above, following mandatory spares shall also be supplied:

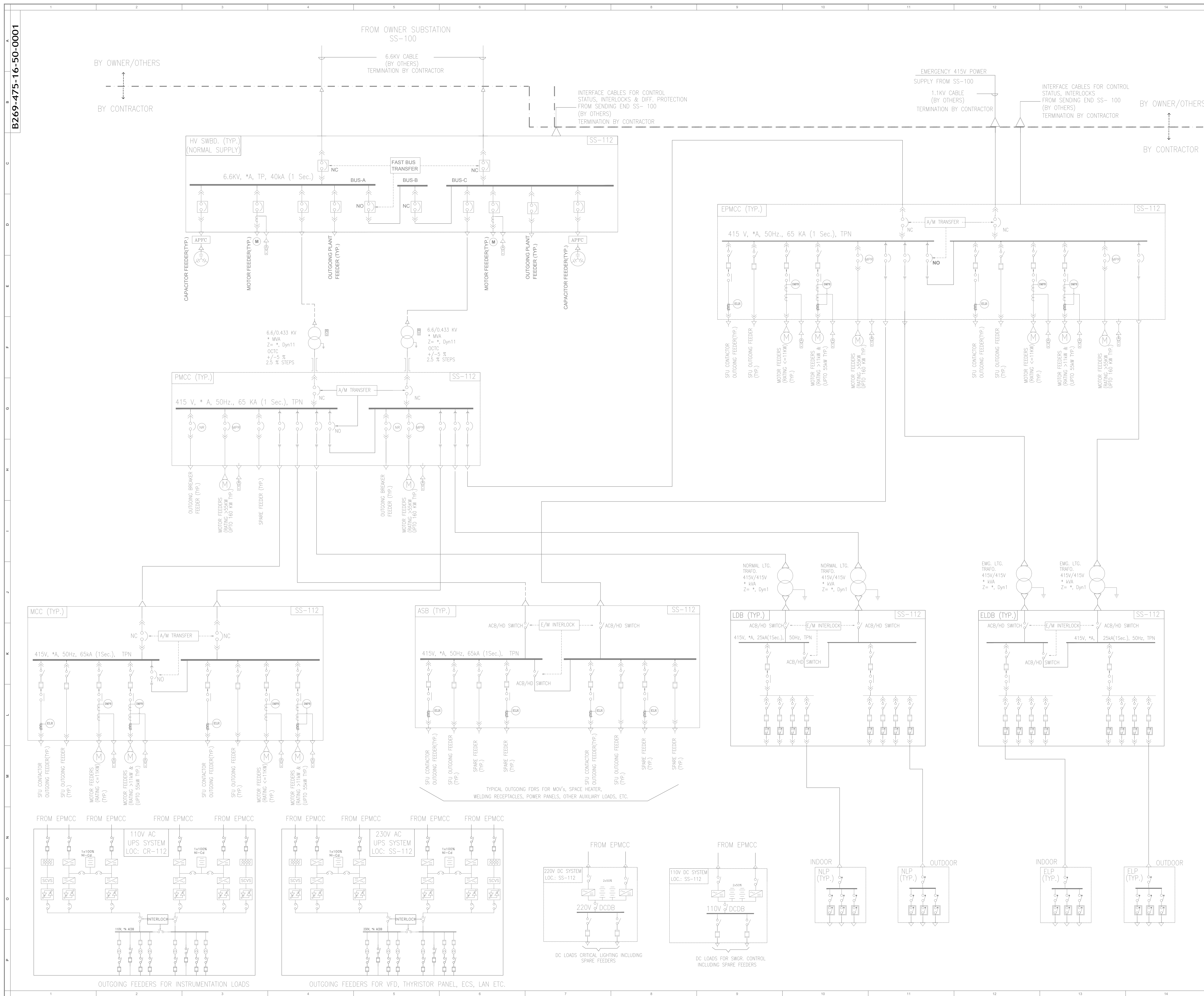
Sr. No	PART DESCRIPTION	QUANTITY REQUIRED
1.	6.6kV Air Insulated Switchboard (AIS)	One set of spare common for AIS IBPs
1.1.	Ethernet Switch for 6.6 kV AIS IBP	1 Nos. (Each type)
2.	415V PMCC/ MV Switchboard	One set of spare for each switchboard
2.1.	Ethernet switch for 415V PMCC	1 Nos.
3.	415V Fixed Type PDBs	One set of spare for each switchboard
3.1.	Control fuses	10 Nos. each rating & type
3.2.	Indicating lamps covers	5 Nos. of each colour
3.3.	Indicating lamps	20% or 3 Nos. (min.), whichever is more
4.	Variable Frequency Drive	One set of spare for each Variable Frequency Drive
4.1.	Complete Power module (rectifier/invertor)	1 No of each rating & type
5.	Soft Starter	One set of spare for each Soft Starter
5.1.	Complete Power module (rectifier/invertor)	1 No of each rating & type
5.2.	Transistors / IGBT / IGCT	1 No of each rating & type
5.3.	Control cards	1 No of each type
5.4.	Power supply cards	1 No of each rating & type
5.5.	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
5.6.	Control fuses / MCB	10 Nos. of each rating & type
5.7.	Contactors	10% of each type OR 1 no. (min) of each type, whichever is more
5.8.	Indicating lamps	20% OR 1 nos. (min.), whichever is more
5.9.	Indicating lamps covers	2 nos of each colour
5.10.	Blocker Diode	2 nos. of each rating & type

NOTES:

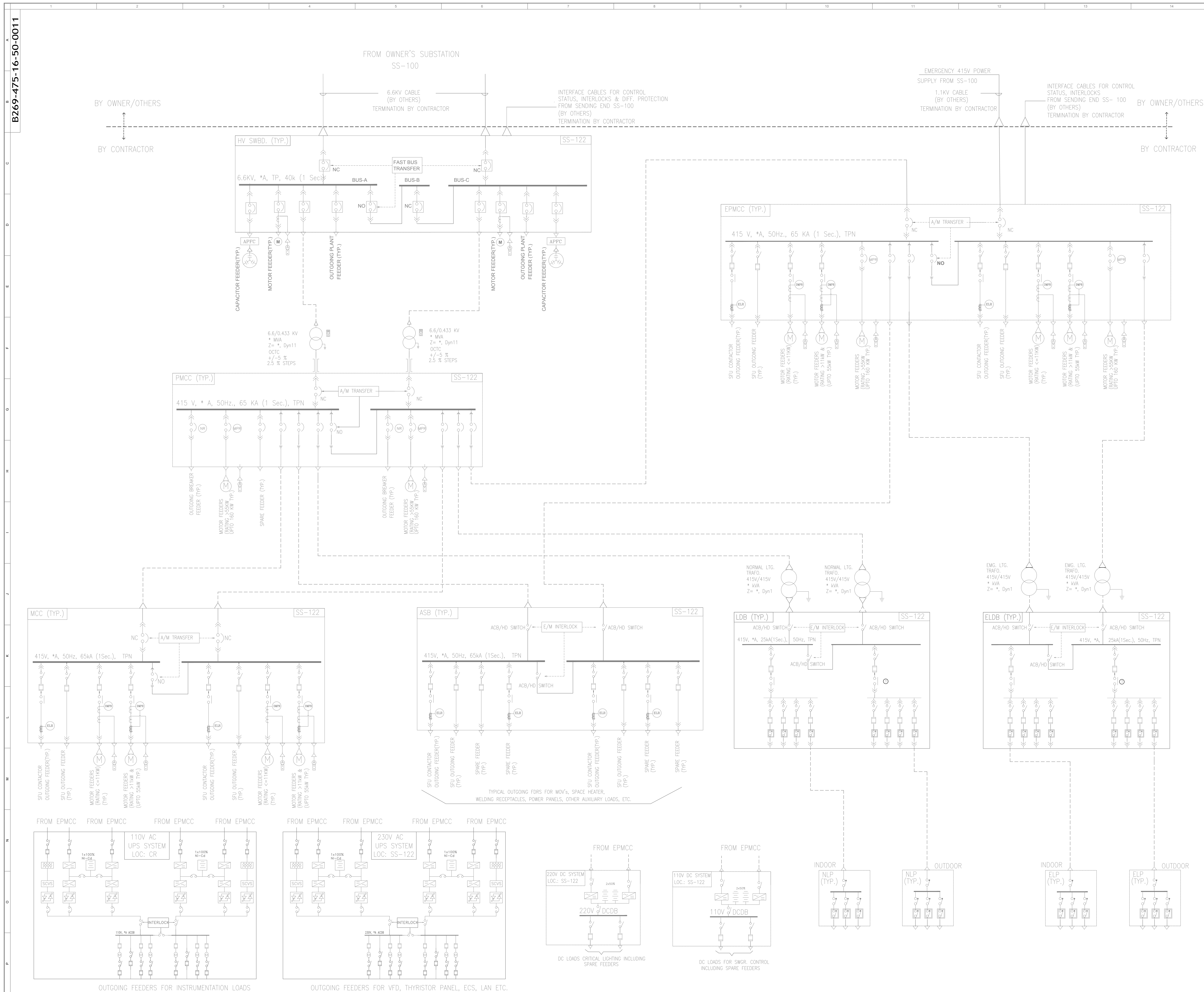
- The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.

2. The terminology used under 'Item Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.
3. Wherever % age is identified, Contractor shall supply next rounded figure.
4. Mandatory spares as indicated above do not cover commissioning spares.
5. Mandatory spares as indicated above do not cover two year O&M spares.
6. Mandatory spares shall be applicable for electrical items of sub-packages as per mandatory spares

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TECHNICAL COMPLIANCE (ELECTRICAL)

RWTP/RODMP/ZLDP/CPU PACKAGE (TENDER NO. B269-475-17-44-PA-T-8701)

CLIENT : INDIAN OIL CORPORATION LTD.

PROJECT : PANIPAT REFINERY EXPANSION PROJECT (P-25)

JOB NO. : B269

A	08.03.2022	ISSUED FOR TENDER	SNM	MK	HK
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

S. NO.	COMPLIANCE STATEMENT / QUERY	BIDDER'S CONFIRMATION/ ANSWER
1.	Confirm that the scope of work shall be complete in all respects as specified in the tender document/Technical Amendment and all other equipment, materials and work not explicitly mentioned but nevertheless required to fulfil the functional requirements shall be deemed to be included in the scope of CONTRACTOR with no additional cost and time implication to the Owner.	
2.	CONTRACTOR is informed that the detailed offers from the equipment manufacturer for all equipment is not required to be furnished in the Contractor's proposal at this stage. If any such details are furnished by the CONTRACTOR in their proposal, these shall not be reviewed or taken cognisance of at this stage. These details shall be treated as preliminary and for reference and record purpose only and shall not be contractually binding. Confirm compliance.	
3.	This Technical Compliance with categorical confirmation against each of the clauses shall be furnished along with the bid. Deviation, if any, against the applicable specifications and codes duly consolidated at one place (under Exceptions / Déviations List Form). Please note that vendor specific deviations will not be considered. In case no deviations are furnished, it will be presumed that all requirements are fully met. Any deviations/deletions/corrections made by the CONTRACTOR elsewhere will not be taken cognisance of and all such deviations shall deemed to have been withdrawn by the CONTRACTOR. Confirm compliance	
4.	Confirm that the equipment and components supplied shall be from one of the approved vendors given in the bid document.	
5.	Confirm that the electrical documents, all Drawings / Data requirements as per scope of work and as per specifications and codes attached and referred to have been included and shall be submitted as per Vendor data Requirements B269-475-16-50-VR-8701.	
6.	Confirm that obtaining approval of CEA / Electrical inspectorate of state as applicable for energisation of electrical installation is included in the scope of CONTRACTOR.	
7.	Confirm that commissioning spares as required for each electrical equipment has been included in the proposal.	
8.	Confirm that Operation and Maintenance spares required for the two years of normal operation for all equipment along with unit prices and quantities as recommended by the equipment manufacturer have been quoted.	
9.	Confirm that Special Tools and Tackles, as required for each electrical equipment, have been included in the proposal.	

10.	Confirm that the cable trenches / trays required between substation and unit, between Control Room/ SRR and unit and between Control Room and substation are included in the package.	
11.	Furnish the average and maximum power consumption requirement for complete Package with breakup of electrical loads (individually for RWTP, RODM/ZLD/CPU and CPU-PNCP). Confirm that rating and quantities of equipment such as transformers, switchgear etc. as required during detailed engineering to meet the requirement of the package shall be included without any impact on cost and time to OWNER. However minimum number of equipment and their rating shall be as per SLD and bid package requirements.	
12.	Furnish the average and maximum emergency power requirement for complete Package (individually for RWTP, RODM/ZLD/CPU and CPU-PNCP) with break-up of electrical loads.	
13.	Confirm that all consumables such as transformer oil, lubricants etc. as applicable for initial charge and for commissioning and site performance guarantee run have been included.	
14.	Confirm that all Inspection & acceptance, type tests as required for each equipment, as per the Engineering Design basis and as per specification and Codes attached and referred to have been included by the CONTRACTOR in his proposal.	
15.	For electrical equipment to be installed in hazardous areas, approval certificates of PESO shall be furnished during detailed engineering stage for all the offered equipment. Where ever required suitable timely action shall be initiated by the CONTRACTOR to fulfil the requirements of the above statutory authority including additional testing if required without affecting project time schedule and no extra cost to the OWNER. Confirm compliance.	
16.	Confirm that required number of adequately rated equipment with spare capacity, quantities of feeders etc. including spare feeders as per specifications shall be provided without price and time implication to OWNER.	
17.	Furnish the kW rating of the largest motor envisaged in the Package (individually for RWTP, RODM/ZLD/CPU and CPU-PNCP).	

Notes: -

1. The Bidder shall indicate his reply in the space provided in the Technical Confirmation List. In case space provided is not adequate, the reply may be furnished separately under suitably numbered annexure / attachments duly referred against the comment / query.
2. The Compliance Statements / Queries are required to be categorically confirmed / answered by the bidder and the completely filled in Tech Confirmation list shall be submitted together with the Bid.

Bidder's Signature and Stamp

मध्यम वोल्टेज स्वीचबोर्ड के लिए विनिर्देश

SPECIFICATION FOR MEDIUM VOLTAGE SWITCHBOARD

6	08.12.2021	REVISED AND SPECIFICATION	ISSUED AS STANDARD	CA/RKS	SA	PG	SM
5	21.12.2016	REVISED AND SPECIFICATION	ISSUED AS STANDARD	CA/RKS	SA	BRB	RN
4	23.03.2011	REVISED AND SPECIFICATION	ISSUED AS STANDARD	DA	SG	UAP	DM
3	01.03.2005	REVISED AND SPECIFICATION	ISSUED AS STANDARD	SSM	RR	AAN	SKG
2	19.11.2001	REVISED AND SPECIFICATION	ISSUED AS STANDARD	SSM	AAN	VPS	GRR
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman	Approved by

Abbreviations:

A	:	Ampere	kA	:	kilo Amperes
AC	:	Alternating Current	kVA	:	kilo Volt Ampere
ACB	:	Air Circuit Breaker	kW	:	kilo Watt
ASB	:	Auxiliary Service Board	LDB	:	Lighting Distribution Board
BIS	:	Bureau of Indian Standard	LED	:	Light Emitting Diode
CEA	:	Central Electricity Authority	LOTO	:	Lock Out Tag Out
CPRI	:	Central Power Research Institute	LV	:	Low Voltage
CRCA	:	Cold Rolled Cold Annealed	mA	:	milli Ampere
CT	:	Current Transformer	MCB	:	Miniature Circuit Breaker
DC	:	Direct Current	MCC	:	Motor Control Center
EIL	:	Engineers India Limited	MCCB	:	Moulded Case Circuit Breaker
EPDM	:	Ethylene Propylene Diene Monomer	NC	:	Normally Closed
FRLS	:	Flame Retardant Low Smoke	NO	:	Normally Open
HDPE	:	High Density Poly Ethylene	PCC	:	Power Control Center
HRC	:	High Rupture Capacity	PMCC	:	Power cum Motor Control Center
IEC	:	International Electrotechnical Commission	PT	:	Potential Transformer
IP	:	Ingress Protection	PVC	:	Poly Vinyl Chloride
IS	:	Indian Standard	R-C	:	Resistor-Capacitor
Ics	:	Rated service short circuit current	SWG	:	Standard Wire Gauge
Icu	:	Rated ultimate short circuit current	V	:	Volt
Icw	:	Rated short time withstand current	VA	:	Volt Ampere
			XLPE	:	Cross Linked Poly Ethylene

Electrical Standards Committee

Convenor: Mr. Parag Gupta

Members: Mr. M.K. Sahu
Ms. Arvind NP Singh
Mr. Harish Kumar
Ms. Shalini Verma
Mr. Raman Sood
Mr. V.K. Jain
Ms. Shirali Aggarwal
Mr. Ayush Mathur (Projects)
Mr. Rajesh Sinha (Inspection)

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1.0 SCOPE

- 1.1** This specification covers the requirements of design, manufacture, testing, packing and supply of fixed and draw out type medium voltage switchboards.

2.0 CODES AND STANDARDS

- 2.1** The equipment shall comply with the requirements of the latest revision of the following standards issued by BIS unless otherwise specified.

IS : 1248	:	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories.
IS: 2705, Part I	:	Current transformers - General requirements
IS : 2824	:	Method for determining the proof and the comparative tracking indices of solid insulating materials.
IS : 3618	:	Phosphate treatment of iron and steel for protection against corrosion.
IS : 5082	:	Wrought aluminum and aluminum alloy bars, rods, tubes and sections for electrical purposes.
IS : 5578	:	Guide for marking of insulated conductor.
IS : 11353	:	Guide for uniform system marking and identification of conductors and apparatus terminals.
IS : 13703	:	Low voltage fuses for voltages not exceeding 1000 V AC or 1500 V DC.
IS : 16227	:	
/ IEC: 61869	:	Instrument transformers.
IS/IEC: 60255	:	Measuring Relays and Protection Equipment.
IS/IEC: 60269	:	Low voltage fuses.
IS/IEC: 60529	:	Degree of protection provided by enclosures (IP Code).
IS/IEC: 60947	:	LV Switchgear and control gear.
IS/IEC: 61439	:	Low voltage switchgear and control gear assemblies.
IEC: 61641	:	Enclosed low-voltage switchgear and control gear assemblies - Guide for testing under conditions of arcing due to internal fault.

- 2.2** In case of imported equipments, standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian standards.
- 2.3** The equipment shall also conform to the provisions of CEA Regulations with latest amendments and other statutory regulations currently in force in the country.
- 2.4** In case Indian standards are not available for any equipment, standards issued by IEC or equivalent agency shall be applicable.
- 2.5** In case of any contradiction between various referred standards/specifications/data sheet and statutory regulations, the most stringent requirement shall govern and decision of owner/EIL in this regard shall be final & binding.

3.0 GENERAL REQUIREMENTS

- 3.1** The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.
- 3.2** Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply.
- 3.3** Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/spares to enable the end user for placement of order for spares and services.

4.0 SITE CONDITIONS

- 4.1** The switchboards shall be suitable for installation and satisfactory operation in an air-conditioned/pressurised substation or in a covered shed/enclosed electrical room (e-room) or in a substation with restricted natural air ventilation in a tropical, humid and corrosive atmosphere.
- 4.2** The switchboards shall be designed to operate under specified site conditions. If not specifically mentioned, a design ambient temperature of 40° C and altitude not exceeding 1000 metres above mean sea level shall be considered.
- 4.3** All the equipment described in this specification shall be suitable for continuous duty with the specified ratings under the mentioned ambient conditions unless indicated otherwise.

5.0 DESIGN AND FABRICATION REQUIREMENTS

- 5.1** Medium voltage switchboard shall be metal enclosed fully draw out or fixed, as specified in datasheet/ job specification, free standing, floor mounting, compartmentalised, modular type suitable for indoor installation. Draw out type switchboards shall be with form of internal separation "Form-4b" whereas Fixed type switchboards shall be with form of internal separation minimum "Form-3b" as per IS/IEC 61439 unless otherwise specified elsewhere. The switchboard shall be a type tested assembly (TTA) as per IEC 61439.
- 5.2** The switchboard enclosure shall be dust and vermin proof and shall provide a degree of protection not less than IP-41 as per IS/IEC 60529.
- 5.3** The switchboard shall be assembled out of vertical panels of uniform height, not exceeding 2450 mm in a single line up.
- 5.4** It shall be possible to extend the switchboard, in either direction at a later date. End of bus bars shall be suitably drilled for this purpose. Panels at extreme end shall have openings, which shall be covered with plates screwed to the panel.
- 5.5** The switchboard shall be designed to ensure maximum safety during operation, inspection, connection of cables, relocation of outgoing circuits and maintenance, with the bus bar system energised and without taking any special precautions.
- 5.6** Adequate means shall be provided to prevent shorting of power and / or control terminals due to accidental dropping of maintenance tools etc. inside the switchboard. Checking and removal of components shall be possible without disturbing adjacent equipment/ modules/ feeders.
- 5.7** All identical equipments and corresponding parts shall be fully interchangeable.
- 5.8** The frame, of individual vertical panels shall be fabricated using pressed and cold rolled sheet steel. The sheet steel used for panel shall be of minimum 2 mm (14SWG) CRCA except the doors and covers that may be made of 1.6 mm (16SWG) CRCA. Wherever required, stiffeners shall be provided to increase mechanical strength of large size doors and covers.
- As an alternative to CRCA, Aluzinc/ pre-galvanised sheet steel can also be provided for internal inter-panel partitions only as per vendor's standard manufacturing practices. However, all external surfaces shall be of CRCA with specified paint shade.
- 5.9** The switchboard shall be provided with integral base frame for each vertical panel. The switchboard integral base frame shall be suitable for tack welding.
- 5.10** All openings, covers and doors shall be provided with gaskets of Neoprene/HDPE/EPDM or equivalent around the perimeter to make the switchboard dust and vermin proof.
- 5.11** All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made of galvanized or zinc passivated or chromium plated high quality steel bolts, nuts and washers, secured against loosening.
- 5.12** Suitable removable type eyebolts/ lifting hooks shall be provided for lifting of the panel/shipping section. These eyebolts/ lifting hooks, when removed shall not leave any opening in the panels.

- 5.13 Non-magnetic cable gland plates (min. 3 mm thick) shall be provided for termination of single core cables.
- 5.14 The switchboard shall be formed using distinct vertical panels each comprising of the following compartments.
- 5.14.1 A metal enclosed horizontal bus bar compartment running at the top or rear, unless otherwise specified.
- 5.14.2 Individual feeder modules in multitier mode.
- 5.14.3 Vertical bus bars serving all feeder modules in the vertical panel.
- 5.14.4 Cable termination compartment.
- 5.14.5 Perforated sheet steel / insulating material enclosed, horizontal auxiliary bus bars for control, interlock, indication and metering running horizontally.
- 5.15 Metal sheets shall be provided between two adjacent vertical panels running upto the full useful height of the switchboard.
- 5.16 MCC/ MCC part of PMCC shall be of single/double front execution as specified in data sheet/job specification. However circuit breaker panels shall be in single front execution only.
- 5.17 Motor starter and MCCB/switch fuse modules shall not be accommodated at front and rear of ACB Incomer and bus coupler panels.
- 5.18 The MCC/ASB/LDB switchboards shall be provided with castle-key interlock between incomers and bus-coupler switches for manual changeover of supplies unless otherwise specified elsewhere.
- 5.19 All metering and protection equipment associated with a particular circuit, as specified in data sheet, shall be housed in separate and independent compartment earmarked for that particular circuit and in the fixed portion of the vertical panel in case of breaker panels.
- 5.20 All auxiliary devices for control, reset, indication, measurement and protection such as push buttons, control and selector switches, indicating lamps, measuring instruments and protective relays shall be mounted on the front side of the respective compartment. The design shall be such that all power ON / OFF or START / STOP and relay reset operations shall be performed without opening the panel door.
- 5.21 Unless otherwise specified elsewhere, the switchboard assembly and components shall be suitable for use in pollution degree 3 environment as per IS/IEC.
- 5.22 In open doors condition of compartment, all live parts or terminals of all door-mounted, internal components and bus contact openings shall be IP-2X protected.
- 5.23 **LOTO arrangement**
- 5.23.1 Pad locking arrangement shall be provided for rack in operation of breaker as well as for the panel door meeting LOTO requirements.
- 5.23.2 LOTO arrangement shall be provided for each module of draw-out switchboard PCC/PMCC/MCC etc. and shall include provision for the following:
- Provision for hooking lockout devices by multiple lock arrangement to prevent opening of panel door and racking-in of circuit breaker.
 - Provision for attaching tag-out device for warning against energisation and to provide information regarding date of isolation, agency working on the equipment, etc.
 - Provision for Hasp such that the same shall be put-in and closed in the locking arrangement of the breaker/switch and panel door.
- 5.24 The panel shall be internal arc tested as per IEC 61641 requirements for full short circuit current for a duration of 0.1 second (minimum) unless specified otherwise in job specification/ datasheet and shall be qualified to comply with all the 7 criteria as per IEC 61641. However

where the circuit is protected by a current limiting device, then duration shall be 0.2 second (minimum) as per IEC 61641.

- 5.25 The Depth of MCC/ASB/LDB panels in double front execution shall be preferably limited to 1000 mm and in no case depth shall exceed 1200 mm.
- 5.26 For switchboards rated upto and including 5000A, forced cooling for any of the equipments and components i.e. bus bars, circuit breakers etc. shall not be provided.
- 5.27 The switchboard shall be supplied complete with supports for clamping outgoing and incoming cables.
- 5.28 The Bus PT shall be provided in the respective bus section of switchboard.
- 5.29 All breakers/ load break switches of incomers and bus coupler(s) shall be with 4 poles unless otherwise specified elsewhere.

5.30 Space Heaters & Panel Illumination

The switchboard panels shall be provided with space heaters to prevent moisture condensation. The space heater shall be located in the bottom part of each panel and shall be supplied from 240 V AC auxiliary buses for space heater. The space heater shall be provided with a switch, fuse or double pole MCB and thermostat having adjustable setting range of 30-70° C. Further, one number 240V AC, 6/16A, 5 Pin socket for owner's use shall be provided inside panels. The panels shall be provided with LED light of required wattage with switch and fuse or MCB.

5.31 Auxiliary Bus Bars

- 5.31.1 Auxiliary bus bars (solid – rectangular or circular), each of minimum size 16-mm² copper, shall be provided for the following applications.
 - a) Panel space heater supply and motor space heater supply.
 - b) AC Control supply.
 - c) DC Control supply.
 - d) AC PT supply for energy meters, voltage operated relays etc.
- 5.31.2 Tee-off connectors shall be used for distributing auxiliary supply to each vertical panel. Rubber grommets shall be used for all wire entries to make the entries dust and vermin proof.
- 5.31.3 Provision for hook up of external AC space heater/ DC control supply to be provided either in bus PT panel or bus coupler panel.

5.32 Bus Bar

- 5.32.1 Bus bars shall be of high conductivity electrolytic aluminium or copper supported on insulators made of non-hygroscopic, non-inflammable material with tracking index equal to or more than that defined in Indian standards.
- 5.32.2 The main bus bars shall have uniform current ratings throughout their length as specified in data sheet/job specification. The current rating of the neutral shall be half that of the phase bus bars. Removable neutral links shall be provided on feeders to permit isolation of the neutral bus bar. The neutral bus bar shall be provided alongside of the phase bus bars.
- 5.32.3 Both horizontal and vertical bus bars, bus joints, risers, connecting bus bar links/ terminals to equipment and supports shall be capable of withstanding dynamic and thermal stresses of the specified short circuit currents.
- 5.32.4 Only zinc passivated or chromium plated high tensile strength steel bolts, nuts and washers shall be used for all bus bar joints and supports.
- 5.32.5 The hot spot temperature of bus bars, conductors, including joints, at design ambient temperature shall not exceed 95° C under normal operating conditions. However, for silver plated joints, the allowable maximum temperature shall be 115°C.

- 5.32.6 The current rating as defined for switchboard, bus bar and components in data sheet/enquiry document are for design ambient temperature at site conditions and for being inside the panel/ cubicle at fully loaded condition. The vendor shall suitably derate the nominal rating to suit the above condition considering ambient temperature inside panel/ cubicle.
- 5.32.7 All bus bars shall be insulated with heat shrunk PVC sleeves of 1100 V grade. Red, yellow and blue colour shall be used for phase bus bars and black colour shall be used for neutral bus bars. Alternatively, colour bands at suitable intervals along PVC sleeved bus bars may be provided. The sleeves shall be rated to withstand the system line-to-line voltage for 1 minute. Removable type shrouds shall be provided for joints & tap off points.
- 5.32.8 Minimum clearance between live parts, between live parts/neutral to earth shall be 19 mm. However clearances between terminals at components shall be as per applicable individual standards for respective components.
- 5.32.9 Vertical bus bars for circuit breaker panels shall be sized depending upon the rating and number of breakers per vertical panel. However vertical bus bars of all other panels shall be of uniform cross section.

5.33 Wiring and Terminals

- 5.33.1 Inside the switchboards, the wiring for power, control, signalling protection and instrument circuits shall be done with BIS approved FRLS, PVC/XLPE insulated copper conductor wires having 660/1100 V grade insulation. The wiring shall preferably be enclosed in flame retardant plastic channels or neatly bunched together.
- 5.33.2 PVC/ XLPE insulated copper conductor of cross section 1.5 mm^2 may normally be used provided the control fuse rating is 10 A or less. For higher fuse ratings minimum 2.5 mm^2 copper conductor shall be used. Each wire shall be terminated at a separate terminal. CT circuit wiring shall be done with 2.5 mm^2 copper conductor.
- 5.33.3 Shorting links/suitable arrangement for shorting CT secondary shall be provided.
- 5.33.4 Each wire shall be identified at both ends by PVC ferrules.
- 5.33.5 Inter panel wiring within each shipping section shall be switchboard vendor's responsibility. For wiring between shipping sections, vendor shall provide terminal blocks on adjoining shipping sections and supply suitable jumpering wires. Inter-panel wiring shall be taken thorough PVC sleeves or rubber grommets.
- 5.33.6 A minimum of 10% spare terminals shall be provided on each terminal block.
- 5.33.7 Conductors shall be terminated with adequately sized compression-type lugs for connection to equipment terminals and strips. Stranded conductors shall be soldered at the ends/ crimped with suitable lugs before connections are made to the terminals. Sufficient terminals shall be provided on each terminal block to ensure that not more than one outgoing wire is connected per terminal.
- 5.33.8 Terminal strips shall preferably be separated from power circuits by metal barriers or enclosures. All spare input and output contacts of numerical relays, auxiliary relays, contactors, timers, etc shall be wired up to the terminal strips/block (ensuring that two terminals are provided for each contact).

5.34 Earthing

- 5.34.1 All panels shall be connected to a tinned copper earth bus bar running throughout the length of the switchboard at the bottom of the panels.
- 5.34.2 The minimum earth bus size shall be $30 \times 6 \text{ mm}^2$ copper for fault level up to 31.5kA and $50 \times 6 \text{ mm}^2$ copper for fault level above 31.5kA.
- 5.34.3 All doors and movable parts shall be earthed, using flexible copper connections, to the fixed frame of the switchboard. Provision shall be made at the end panels of each switchboard to connect the earthing bus bar to the plant earthing grid at two ends.

- 5.34.4 All non-current carrying metallic parts of the mounted equipment shall be earthed. Minimum 4 nos. 10 mm diameter bolts with nuts shall be provided on the earth bus for termination of fourth core of cable per vertical panel.

5.35 Nameplate

- 5.35.1 A nameplate with the switchboard designation shall be fixed at the top of the central panel. A separate nameplate giving details for each feeder compartment of all panels shall be provided. Danger nameplate shall be provided at the front and rear of each panel.
- 5.35.2 The nameplates for feeder compartments shall be in two parts. One part shall have necessary details pertaining to the compartments number of vertical panel of the switchboards. The other parts shall be removable and shall contain all details regarding the feeder number for drives/equipment controlled by the particular module as per approved single line diagram.
- 5.35.3 Blank nameplates shall be provided for all spare and vacant modules.
- 5.35.4 Nameplate or polyester adhesive stickers shall be provided for each equipment mounted inside the switchboard. Special warning plates shall be provided on removable covers or doors giving access to cable terminals and bus bars.
- 5.35.5 Special warning labels shall be provided inside the switchboards also, wherever considered necessary. Identification tags shall be provided inside the panels matching with those shown on the circuit diagram.
- 5.35.6 Engraved nameplates shall preferably be of 3- ply (Black-White- Black) lamicoid sheets or anodised aluminium or traffolyte. However back engraved perspex sheet nameplates may also be acceptable. Nameplates shall be fastened by screws and not by adhesives.

5.36 Painting

- 5.36.1 After preparation of the under surface, the panel shall be spray painted with two coats of epoxy based final paint or shall be powder coated. The colour shade of final paint shall be as RAL-7032, unless specified otherwise. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint, etc.
- 5.36.2 All unpainted steel parts shall be zinc passivated, chromium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.

6.0 SPECIFIC REQUIREMENTS OF AIR CIRCUIT BREAKER PANELS

- 6.1 The breaker panels shall have distinct bus bar, breaker and cable compartments.
- 6.2 The design of each compartment shall be such as to prevent movement of vermin from a particular compartment to any other compartment of the panel when the breaker is withdrawn and compartment door is closed.
- 6.3 In order to minimise accidental access and avoid accidents due to falling tools, all the outgoing links shall be shrouded.
- 6.4 Outgoing air circuit breaker can be mounted in a maximum of two-tier execution while the incoming/bus coupler air circuit breaker shall be in single tier execution only.

6.5 Cable Compartment

- 6.5.1 Separate compartment, totally enclosed from all sides, shall be provided for cable termination, on the rear/front side. Access to cables shall be from the rear/front side after opening the cabling compartment cover.
- 6.5.2 The incoming / outgoing cable termination shall be staggered for each circuit and barriers of sheet steel or insulating material shall be provided between terminations of two circuits such that maintenance on one circuit could be carried out while the other circuit is live. Suitable clamping arrangements shall be provided for cables and cable termination. Terminal blocks shall not be used for supporting the cables.

- 6.5.3 The incoming supply for PCC/ PMCC panels shall be through top entry bus ducts or through bottom entry cables unless specified otherwise. The outgoing cables shall have bottom entry unless specified otherwise.
- 6.5.4 The cable terminations shall be suitably sized for receiving specified number of cables per termination and provision shall be made for terminating each outgoing cable with a separate bolted connection. In case the total number of cables entering a particular panel cannot be accommodated in the cabling compartment of the panel, an extension panel of full height shall be added to the cabling compartment for accommodating extra cables. Alternatively, in view of extra cables, provision for back to back connections of cables may be offered.

6.6 Circuit Breaker Compartment

- 6.6.1 The circuit breaker compartment shall be fully draw-out. Suitable guides shall be provided to facilitate easy withdrawal of the circuit breaker.
- 6.6.2 The current transformers for the ammeter/protection circuits shall be mounted on the fixed portion of the compartment. However, current transformers associated with built-in releases may be mounted on the breaker trolley.
- 6.6.3 All terminals except wiping/sliding type control terminals shall be shrouded with plastic covers to prevent accidental contact. For direct termination, clip-on shrouded type terminals shall be provided.
- 6.6.4 There shall be three positions for the draw out trolley viz:
- "Service" position - In this position both power and control circuits shall be connected. This shall be the normal operating position of the circuit breaker.
 - "Test" position - The power contacts shall be disconnected in this position but the control connections shall not be disturbed, testing provision for the entire control circuitry shall be available in test mode including close and trip of breakers.
 - "Drawout" Position - both power and control circuits shall be disconnected in this position and breaker removed from the cubicle.
- 6.6.5 The circuit breaker shall be lockable in "service" and "test" positions. Safety shutters shall be provided when the breaker is in withdrawn/drawout position.
- 6.6.6 The earth connection must remain connected in "Test" position. Earthing of the unit shall be done with a "pin" or with scrapping earth connections.
- 6.6.7 The earth connection shall make before the main power / control contacts make and break after the power /control contacts are disconnected. Earthing connection through a plug and socket connection shall not be acceptable

6.7 Interlocks

Following interlocks shall be provided:

- 6.7.1 Compartment doors shall be interlocked against opening when breaker is in closed condition. However, it shall be possible to defeat this interlock for inspection purposes.
- 6.7.2 It shall not be possible to push "in" a drawn out circuit breaker in closed condition or withdraw a circuit breaker in closed condition.
- 6.7.3 It shall be possible to operate a circuit breaker only in the defined "Full in" or "service" and "test" position inside the panel. It shall not be possible to operate the breaker in intermediate positions while inserting or withdrawing circuit breaker.
- 6.8 Any unused circuit breaker compartment shall be fully equipped and provided with compartment door, vertical bus bars rated for breaker ratings envisaged in the vertical panel and control terminals/ wiring etc. such that the same could be used for housing outgoing breakers in future without any modifications to the panel.

7.0 SPECIFIC REQUIREMENTS OF FEEDERS OTHER THAN ACB FEEDERS

- 7.1** The design of drawout feeder modules shall not change for single front or double front execution. Separate vertical bus bars shall be provided for each front side modules.
- 7.2** All identical feeder modules shall be interchangeable.
- 7.3** Each vertical panel shall have a separate cable alley. The width of this cable alley shall be sufficient to accommodate all the cables and shall have free access for cable terminations and in any case shall not be less than 250 mm minimum. The cable alley width more than 250 mm shall be provided in case of requirement of termination of large number of outgoing cables as required. Cable alleys shall be provided with suitable doors.
- 7.4** Sheet steel barrier shall be provided between individual compartments and cable alley. This barrier shall be provided with opening for power and control connections and it shall be possible to safely carryout maintenance work on cable connections to any one circuit in the cable alley with the bus bars and the adjacent circuits live.
- 7.5** Maintenance and connection of cables to any modules shall be possible without having to take out the modules from its position from the panel.
- 7.6** The outgoing feeder trolleys for drawout type switchboard shall be fully drawout and shall have the following features.
- 7.6.1** It shall be possible to withdraw the trolley without having to unbolt or unscrew any power and control connections to the equipment mounted on the withdrawable trolley.
- 7.6.2** Both power and control connections shall be drawout type. All line and bus PTs shall be in drawout execution only. However, outgoing modules having size more than half of the useful vertical height of the panel may be in mixed combination of drawout /fixed type.
- 7.6.3** Control supply transformer modules may be provided in fixed execution.
- 7.6.4** The trolley withdrawal shall be by means of crank and screw arrangement. Alternatively movement on guided rollers or swivelling guide levers for self guided movement may also be acceptable. Plug in operation shall be independent of manual force. An insulating handle for racking in/ out modules shall be provided, as required.
- 7.6.5** For drawout type feeders of size equal to or greater than half the useful vertical height of panel, positive clamping arrangement shall be provided on the top portion of the trolley in addition to clamping arrangement at the bottom, to ensure all round positive pressure on the power drawout contacts once the trolley is plugged in. Alternatively fixed execution can be accepted for feeder with higher rating, equal to or greater than 400A in case of vendor's standard design, subject to Owner's approval.
- 7.6.6** Power drawout contacts shall preferably be located towards the bottom portion of each trolley. The trolley shall be lockable in fully plugged in position and devices shall be provided to ensure positive plugging in. In test position, power contacts shall be totally isolated and a device shall be provided for indication of test position. In test position, testing provision for the entire control circuitry shall be available.
- 7.7** The incomer and bus tie feeders with load break switches rated 800A and above may be in fixed execution
- 7.8** Various compartment sizes in a vertical panel shall be multiples of a basic dimension. However the minimum module size for switch fuse/MCCB feeder and motor starter/contactors feeder shall not be less than that defined in data sheet/job specification. Vertical bus bars shall be pre-drilled at regular intervals for complete flexibility for changes in size of modules.
- 7.9** All switch drives other than rotary control switches, shall be lockable in 'OFF' position.
- 7.10** The switches/Moulded case circuit breakers shall be interlocked with the compartment door to prevent opening of the door when the switch/ moulded case circuit breaker is in 'ON' position and to prevent switching on when the door is open. A defeat mechanism for this interlock shall also be provided.

- 7.11 The maximum height of the operating handle and switches shall not exceed 1900 mm and the minimum height shall not be below 250 mm.
- 7.12 Unused modules in the panel shall be fully equipped with hinged door & vertical bus bars and shall be suitable for mounting power and control terminals for starter modules and cradle for future use.
- 7.13 The power contactor in starter/ feeder modules of PMCC/ MCC shall be provided with R-C circuit across the AC supply contactor coil and surge suppressor/ diode in case of DC supply contactor coil. Further, low burden auxiliary contactors shall be provided in each contactor controlled motor starter modules for receiving start and stop command from remote.

8.0 SWITCHGEAR MODULES

- 8.1 Switchboard shall be completely lined up in one straight row with the type and quantities of feeders as defined in switchboard data sheet. Generally the feeders of three main categories are identified as circuit breaker, motor starters and MCCB or switch fuse.
- 8.2 Starter modules required for motor control shall be of the following types and internal control wiring of all starter modules of each type shall be identical for all ratings.
- 8.2.1 FVNR Full Voltage Non -Reversing starter with minimum 18 control terminals.
- 8.2.2 FVR Full Voltage Reversing starter with minimum 24 control terminals.
- 8.2.3 FVNR - HD Full Voltage Non -Reversing Heavy Duty starter with long starting time such as for compressors and fans etc. with minimum 18 control terminals.
- 8.3 Switch fuse/MCCB /contactor feeder modules shall be of following types and internal control wiring of all modules of each type shall be identical for all ratings.
- 8.3.1 SFU/MCCB Switch Fuse Unit or MCCB modules with no control terminals.
- 8.3.2 SFC/MCCB+C Switch Fuse Contactor or MCCB with contactor modules with 18 control terminals.
- 8.4 Control transformer shall be provided for each FVR/FVNR/SFC starter/MCCB+C starter/feeder modules or bus section of the PMCC/MCC switchboard having contactor control feeders as specified in the datasheet/job specification or elsewhere. Each control transformer of starter/feeder module shall be sized for taking control supply load of all components of starter module. In case control transformer is provided in bus section, same shall be sized for control supply load of entire switchboard. Switchboard having two bus sections and coupled by bus tie shall have manual changeover switch for the control transformers. The control transformer shall have at least 10% spare capacity. The control transformer secondary shall be earthed at one end.
- 8.5 To facilitate site modification due to changes in motor KW ratings and to minimise spares inventory, overload relays and power fuse links shall meet the following requirements.
- 8.5.1 All bimetal overload relays shall be separately mounted type with connecting links rated for the maximum rating of the contactor in a starter module.
- 8.5.2 Bimetal overload relays of various current ranges required for motors likely to be connected to a contactor must be identical in dimension for inter-changeability. In case offered relays are with different dimension for any particular starter module, special mounting plate suitable for mounting different relays shall be provided in all the modules of that size.
- 8.6 Heavy duty starters shall be provided with saturable type, current transformer operated; overload relays only, which shall be suitable for motor starting time of 15-60 seconds.
- 8.7 All contactor controlled starter feeders shall meet the requirements of type-2 co-ordination as per IS/IEC: 60947. However, contactor controlled motor feeders shall meet the requirements of type-2 co-ordination as per IS/IEC: 60947 considering energy efficient motors of IE-3 type, unless otherwise specified elsewhere.

9.0 SWITCHBOARD COMPONENTS

9.1 Circuit Breakers

9.1.1 Circuit breakers shall be air break, draw-out type and 3/4 poles as specified in the datasheet/job specifications and in this specification above. Circuit breaker shall be suitable for $I_{cs}=I_{cu}=I_{cw}=100\%$ for 1sec.

9.1.2 The circuit breakers shall be provided with mechanically operated emergency tripping device. This device shall be available on the front of the panel. Mechanically operated 'closing' device shall be provided for all breakers. However mechanical closing shall be inhibited for all breakers in service position.

9.1.3 The circuit breakers shall be provided with minimum 4 NO + 4 NC contacts, wired and available for owner's use. In case contacts are directly not available in breaker, auxiliary latching type relays shall be used to multiply the auxiliary contacts of the breakers.

9.1.4 Circuit breaker's Open and closed positions; Service and test locations and spring charged condition shall also be indicated mechanically in addition to electrical indications.

9.1.5 Unless otherwise specified, all circuit breakers in the switchboard shall be provided with electrical power operating mechanism. Wherever circuit breakers are provided in place of Isolators, Breaker can be manually operated type.

9.1.6 Operating Mechanism

- a) Electric power operating mechanism shall be motor wound spring charged stored energy type. However, manual-operating mechanism may be of the spring charging stored energy type or spring assisted type. For circuit breakers with electrical power operating mechanism, provision shall also be made for manual spring charging. Closing time of circuit breakers with manual operating mechanism shall be independent of the speed of the operating handle.
 - b) All stored energy operating mechanisms shall be equipped with the following features:
 - i) Failure of springs, vibrations or shocks shall not cause unintended operation of breaker or prevent intended tripping operation.
 - ii) Closing of circuit breakers shall be prevented unless the spring is fully charged.
 - c) All electrical power operating mechanisms shall be suitable for remote operation and shall be equipped with the following features:
 - i) Provided with universal motor operable on AC or DC control supplies.
 - ii) Provided with emergency manual charging facility. The motor shall be automatically, decoupled (mechanically) once the manual-charging handle is inserted.
 - iii) Closing operation of circuit breaker shall automatically initiate charging of the spring for the next closing operation without waiting for tripping of circuit breaker.
 - iv) Closing operation shall be completed once the closing impulse is given and the first device in the control scheme has responded even though the control switch / Push Button is released, provided no counter trip impulse is present.
- 9.1.7 Circuit breaker trip and closing coils, in case of electrically operated breakers and trip coil in case of mechanically operated breakers and circuit breaker indication shall be suitable for satisfactory operation on a control supply system indicated in data sheets/job specification.
- 9.1.8 Circuit breakers shall be provided with anti-pumping and trip free feature.
- 9.1.9 Circuit breakers shall be provided with operation counters.

- 9.1.10 Releases are not required to be provided with breakers where relays are used. However breaker-having AC control supply voltage shall be provided with under voltage release unless specified otherwise.

9.2 Switches

- 9.2.1 All switches or fuse switches shall be load break, heavy duty/motor duty, air break type provided with quick make/break manual operating mechanism. The operating handle shall be mounted on the door of the compartment having the switch.
- 9.2.2 Rating of switches for starter module shall meet the requirements of AC-23 duty as per IS/IEC 60947 and minimum rating shall be as specified in job specification/data sheets.

9.3 Fuses

- 9.3.1 Fuses shall be non-deteriorating HRC cartridge link type.
- 9.3.2 Power fuses shall be pressure fitted type and shall preferably have ribs on the contact blades to ensure good line contact.
- 9.3.3 It shall be possible to handle fuses during off load conditions with full voltage available on the terminals. Wherever required fuse pullers shall be provided. The fuse base shall be so located in the modules to permit insertion of fuse pullers and removal of fuse links without any problem.

9.4 Contactors

- 9.4.1 The contactors shall be air break type, equipped with three main contacts and minimum 1NO+1NC auxiliary contacts. The main contacts of a particular contactor for motor starter module shall have AC-3 or AC4 ratings, as specified in data sheet
- 9.4.2 Unless specified otherwise, the coil of the contactor shall be suitable for operation on 240 V, 1 Phase, AC supply.

9.5 Thermal Overload Relay

- 9.5.1 Bimetal relays shall be provided for protecting the motor from thermal overload.
- 9.5.2 Bimetal relays shall be manually reset type with the reset push button brought out on the front of the panel. The reset push button shall be capable of being operated without opening the compartment door.
- 9.5.3 Bimetal relays shall be three elements positive acting ambient temperature compensated type with adjustable setting range.
- 9.5.4 Bimetal relays shall have built-in single phasing prevention feature, which operates even with 50% rated current at the time of single phasing.
- 9.5.5 The rating of Bimetal relay shall be selected by vendor based on type-2 coordination and full load current of IE-3 motor.

9.6 Moulded Case Circuit Breakers

- 9.6.1 MCCBs shall be provided with spring assisted quick make/ break manually operated trip free mechanism. Wherever specified, MCCB shall be suitable for remote tripping operation and the tripping device shall be suitable for the specified control supply voltage. MCCB shall be suitable for $I_{cs}=I_{cu}=100\%$.
- 9.6.2 MCCBs shall be provided with a tripping device with inverse time characteristic for over load protection and instantaneous characteristics for short circuit protection and MCCB rated above 125A shall preferably have adjustable settings.
- 9.6.3 'ON' and 'OFF' position of the operating handle of MCCB shall be displayed and the operating handle shall be mounted on the door of the compartment housing MCCB.
- 9.6.4 Each MCCB shall be provided with minimum 1 NO + 1 NC auxiliary contact and 1NO contact for tripping indication/alarm for owner's use.

9.6.5 MCCBs shall be provided with solenoid/ motorised closing mechanism to make them suitable for remote closing operation if specified. The closing solenoid/motor shall be suitable for specified control supply voltage.

9.6.6 MCCB's as part of motor starter module shall be current limiting motor duty type and type tested for type-2 co-ordination as per IS/ IEC 60947 considering energy efficient motors of IE-3 type unless otherwise specified elsewhere.

9.7 Relays

9.7.1 Type of relay shall be numerical, communicable, static or electro-mechanical type as specified in the data sheet /job specification.

9.7.2 All electro-mechanical protective relays shall be back connected, of drawout type, suitable for flush mounting, and fitted with dust-tight covers. Alternatively, "plug-in" type relays will also be acceptable. Auxiliary relays and lock out relays are acceptable in fixed execution.

9.7.3 The protective (static or electro-mechanical type) relay cases shall have a provision for insertion of a test plug at the front for testing and calibration purpose using an external power supply. It shall be possible to test the relays without disconnecting the wiring and without withdrawing the relays. The insertion of the test plug shall automatically short circuit the CTs and permits extension of external power supply to the relay.

9.7.4 Each protective relay shall be provided with minimum 2 numbers potential free contacts of required configuration.

9.7.5 Each tripping relay shall be of lockout type with hand reset coil cut-off contact.

9.7.6 Protective relays shall be preferably mounted on the front side and upper part of the panel and mounting of relays on the lower portion shall be avoided.

9.7.7 Earth Leakage Relay shall be manually hand reset type. In case hand reset feature is not available in the offered relay model, vendor to provide external hardware logic for manual hand resetting of the earth leakage relay.

9.7.8 Stabilizing resistor shall be provided along with the relays including numerical relays as required to avoid spurious tripping.

9.8 Instrument Transformers (CTs/PTs)

9.8.1 Current transformers shall generally conform to IS:16227 and any special requirement with respect to numerical relay shall be taken care by the vendor.

9.8.2 For general guidance the vendor shall note that the protective current transformers shall have an accuracy class "5 P" and an accuracy limit factor of minimum "20". However CTs for restricted earth fault shall be of class "PS"/"PX". Vendor shall co-ordinate the knee point voltage, magnetising current for PS class CTs to avoid saturation and mismatching of CTs provided at other end by other vendor.

9.8.3 Current transformers for metering shall have an accuracy class 1.0 and instrument security factor not greater than 5.0.

9.8.4 The current transformers in breaker feeders shall be capable of withstanding the applicable peak momentary short circuit and the symmetrical short circuit current.

9.8.5 The voltage transformers shall be cast resin type transformers and PT shall generally conform to IS:16227. PT shall be provided with HRC fuses on primary side and Miniature circuit breakers with auxiliary contact on the secondary side.

9.9 Measuring Instruments

9.9.1 All measuring instruments shall be of 96 x 96 mm square pattern, flush mounting type for incomer and outgoing feeders in the switchboard. The accuracy class for all instruments shall be 1.0 as per IS: 1248.

9.9.2 All auxiliary equipment such as shunts, transducers, CT, PT, etc. as required shall be included in the supply of the switchboard.

- 9.9.3 All AC ammeters and voltmeters shall be of moving iron type. Ammeters for motor feeders shall have a non-linear compressed scale at the end to indicate motor starting current and red mark for the full load current.
- 9.9.3 The KW/KWH meters shall be suitable to measure unbalanced loads on 3 phases 4-wire system. Test terminal block shall be provided for KWH meters.
- 9.9.4 Digital meters shall be provided, if specified in job specification/data sheets. All digital meters shall be highly reliable, accurate, compact and self powered. Digital meter data shall be saved in case of power failure. Field programming from front of the meter shall be possible and shall have RS232/485 port in case specified in the job specification/data sheet.

9.10 Control/ Selector Switches

- 9.10.1 All control/ selector switches shall be rotary type, having a cam-operated contact mechanism. Circuit breaker control switches shall be 3-position CNT, spring return to neutral from both Close and Trip positions. They shall have pistol-grip handles and shall be lockable type. Knob type handle shall be provided for other control/ selector switches.
- 9.10.2 Ammeter selector switches shall have make before break feature on its contacts. The selector switch shall generally have 4 positions, three for reading 3 phase currents and the fourth position for off. The voltmeter selector switch shall also have 4 positions. Three positions shall be used to measure phase-to-phase voltage and fourth shall be OFF position.

9.11 Push Buttons

Push button colours shall be as follows:

Stop /open/emergency stop	:	Red
Start/close	:	Green
Reset/test	:	Yellow / Black /White

The stop push button shall be stay put type & shall have protective hood to avoid accidental operation.

9.12 Indication

- 9.12.1 Clustered LED type indicating light with minimum 8 mm diameter size shall be provided for indications.
- 9.12.2 Breaker positions (Close, Open, spring-charged, test position, service position) electrical indications, with colors as given below, shall also be provided:

Breaker 'Closed'/ ON	:	Red lamp
Breaker 'Open'/ OFF	:	Green lamp
Breaker auto-trip	:	Amber lamp
Trip circuit healthy	:	White lamp
Spring charging	:	Blue lamp

- 9.12.3 Outgoing feeder (Close, Open, trip) electrical indications, with colors as given below, shall also be provided:

'Closed'	:	Red lamp
'Open'	:	Green lamp
'Trip'	:	Amber lamp

9.13 Auxiliary Relays/Contactors

Auxiliary relays/contactors shall generally be used for interlocking and multiplying contacts. However, in the case of numerical relays, the interlocking logic shall be built in the relay itself.

9.14 Timers

For re-acceleration duty, timers shall be electronic type or static type. The time settings, where specified, shall be accurately set before despatch of the switchboard. Timer provided for control of capacitor feeder and re-acceleration feeders shall have minimum setting of 0-5 minutes.

9.15 Miniature Circuit Breaker

MCB shall provide high mechanical and electrical life, reliable protection of circuits against overload and short circuit and shall have minimum breaking capacity of 9 kA unless otherwise specified. Positive ON/OFF indication shall be provided.

10.0 INSPECTION, TESTING AND ACCEPTANCE

10.1 During fabrication, the switchboard shall be subject to inspection by EIL / Owner, or by an agency authorised by the Owner, to assess the progress of work, as well as to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to EIL / Owner's inspectors.

10.2 For testing requirements refer Inspection & Test Plan No. 6-81-1018. Prior notice of minimum 4 weeks shall be given to EIL/owner for witnessing the final testing of the complete assembly to ensure satisfactory operation of all components. Tests shall be carried out at manufacturer's works under his care and expense.

10.3 Test certificates of bought out components shall be submitted to the inspection agency, as per Inspection and Test Plan no. 6-81-1018.





11.0 PACKING AND DESPATCH

All the equipment shall be divided into several shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for selected mode of transportation i.e. by ship/rail or trailer. The panels shall be wrapped in polyethylene sheets before being placed in wooden crates /cases to prevent damage to the finish. Crates /cases shall have skid bottoms for handling. Special precaution notations such as 'Fragile', 'This side up', 'Centre of gravity', 'weight', Owner's particulars, Purchase order number etc. shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing should be suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed. A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be supplied duly enclosed in a waterproof cover along with the shipment.

बैटरी चार्जर के लिए विनिर्देश

SPECIFICATION FOR BATTERY CHARGER

6	03/12/21	REVISED AND REISSUED AS STANDARD SPECIFICATION	 SKS	 RS	 PG	 SM
5	17/11/16	REVISED AND REISSUED AS STANDARD SPECIFICATION	PB/MHR	RS	BRB	RN
4	11/04/11	REVISED AND REISSUED AS STANDARD SPECIFICATION	RS	PG	UAP	DM
3	10/09/08	REVISED AND REISSUED AS STANDARD SPECIFICATION	RS	NS	JMS	VC
2	25/03/02	REVISED AND REISSUED AS STANDARD SPECIFICATION	VCB	JMS	VPS	GRR
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

AC	:	Alternating Current
Ah	:	Ampere-hour
BIS	:	Bureau of Indian Standards
CEA	:	Central Electricity Authority
CRCA	:	Cold Rolled Cold Annealed
DC	:	Direct Current
DCDB	:	Direct Current Distribution Board
ECS	:	Electrical Control System
EIL	:	Engineers India Limited
EMC	:	Electro Magnetic Compatibility
FRLS	:	Flame Retardant Low Smoke
IEC	:	International Electrotechnical Commission
IEEE	:	Institute of Electrical and Electronics Engineers
IP	:	Ingress Protection
IS	:	Indian Standard
LED	:	Light Emitting Diode
MCB	:	Miniature Circuit Breaker
MCCB	:	Moulded Case Circuit Breaker
MR	:	Material Requisition
MSL	:	Mean Sea Level
Ni-Cd	:	Nickel Cadmium
PC	:	Personal Computer
PCB	:	Printed Circuit Board
PO	:	Purchase Order
PVC	:	Poly Vinyl Chloride
RFI	:	Radio Frequency Interference
RMS	:	Root Mean Square
TCP/IP	:	Transmission control protocol/Internet Protocol
V	:	Volt
VDE	:	Verband Der Elektrotechniker
VRLA	:	Valve Regulated Lead Acid
XLPE	:	Cross Linked Poly Ethylene

Electrical Standards Committee

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1.0 SCOPE

This specification covers the design, manufacture, testing at manufacturer's works, packing and supply to site of Battery Chargers and Distribution Boards.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS/ IEC/ IEEE:

IS 1248	Direct acting indicating analogue electrical measuring instruments and accessories.
IS 3700	Essential rating and characteristics of semi-conductor devices.
IS 4411	Code of designation of semi-conductor devices.
IS 5001	Guide for preparation of drawings for semi-conductor devices and integrated circuits.
IS 5469	Code of practice for the use of semi-conductor junction devices.
IS 6619	Safety code for semiconductor rectifier equipment.
IS 12021	Control transformers for switchgear and control gear for voltages not exceeding 1000VAC.
IS 13703	Low voltage fuses for voltages not exceeding 1000VAC or 1500V DC.
IS 14901	Semiconductor Devices - Discrete Devices and Integrated Circuits
IS 16539	Semiconductor Converters
IS/IEC 60269	Low-Voltage Fuses
IS/IEC 60947	Low voltage switchgear and control gear.
IS/IEC 61439	Low-Voltage Switchgear and Control gear assemblies
IEC 60068	Environmental testing.
IEC 60146	Semiconductor converters general requirements and line commutated convertors.
IEEE 519	Recommended Practice and Requirements for Harmonic Control in Electric Power system.

2.2 In case of imported equipment, the standards of the country of origin shall be applicable, if these standards are equivalent or more stringent than the applicable Indian standards.

2.3 The equipment shall also conform to the provisions of CEA regulations with latest amendments and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC or equivalent agency shall be applicable.

2.5 In case of any conflict between various referred standards/ specifications/ datasheets and statutory regulations, the most stringent requirement shall prevail and Owner's/ EIL's decision in this regard shall be final and binding.

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of the art technology and a proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 10 years from the date of supply.

3.3 Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/spares to enable the end user to place order for spares and services.

4.0 SITE CONDITIONS

The Battery Chargers shall be suitable for installation and satisfactory operation in a pressurised or non-pressurised substation with restricted natural air ventilation in a tropical, humid and corrosive atmosphere. The Battery Chargers shall be designed to operate under site conditions as specified in the data sheet. If not specifically mentioned therein, design ambient temperature of 40°C and altitude not exceeding 1000 m above MSL shall be considered for all equipment.

5.0 TECHNICAL REQUIREMENTS

5.1 Input Power Supply

5.1.1 The Battery Chargers shall be suitable for input power supply as defined in the data sheet. If not specified therein, these shall be suitable for the following input power supply:

Voltage : 415V \pm 10%
Frequency : 50 Hz \pm 3%

In addition to the above variations, the input voltage may be subject to transient variations comprising of voltage dips up to 20% of normal voltage during motor start-up, voltage interruptions during short circuits as well as frequency variations due to large motor start-up. The Battery Chargers shall operate satisfactorily with a total harmonic distortion of up to 5% in the input power supply.

The Battery Chargers shall also be designed to operate satisfactorily while drawing input power from an emergency diesel generator set.

5.1.2 The incoming power supply to the Battery Charger system shall be provided by 2 independent feeders. One feeder shall supply power to each rectifier.

5.2 Battery Charger

5.2.1 Design Basis

5.2.1.1 The Battery Charger system shall have two chargers (Charger-1 & Charger-2). Both chargers shall be of identical design and rating. The battery to be connected to the chargers shall be of Nickel Cadmium/ flooded electrolyte Lead Acid/ VRLA type as indicated in the data sheet. Battery Chargers for flooded Lead Acid and Nickel Cadmium batteries shall be sized to provide quick charging of the battery within a duration of 10 hours. Battery Chargers for VRLA battery shall be sized to provide quick charging of the battery up to 90% of rated Ampere hours within a duration of 12 hours and to 100% within 32 hours. Each charger shall be sized for the most stringent of the following duty conditions, whichever is higher:

a. Offline quick charging of the battery assembly. The charger shall be sized as under:

Charger rating in Amps. = 0.14 Ah(C₁₀) of battery (for Lead Acid battery)
= 0.2 Ah(C₁₀) of battery (for VRLA battery)
= 0.2 Ah(C₅) of battery (for Nickel Cadmium battery)

b. Online float charging of the battery assembly while feeding the complete DC load. The charger shall be sized as under:

Charger rating in Amps. = 1.15 x Average DC load + float charging current
(Average DC load = Area under the battery duty cycle/ battery duty cycle duration).

5.2.1.2 Each charger shall have a 3 phase full wave, controlled rectifier bridge with protective devices.

5.2.1.3 Independent current limits shall be provided for charger load current and battery charging current. Subsequent to a discharge cycle and completion of quick charging, when battery is connected to charger under float mode, the battery current shall be monitored, controlled and limited to set value automatically irrespective of the value of load current. Fast acting semi-

conductor fuses shall be provided for protection against internal short circuits. In case of external short circuits, the chargers shall be protected by rapid shutdown of the semi-conducting power devices. The high speed semi-conductor fuses used for rectifier protection shall be complete with trip indication.

- 5.2.1.4 Filter circuits consisting of smoothing choke and condenser, complete with protection to limit the ripple content at the output, shall be provided.
- 5.2.1.5 Silicon blocking diodes shall be provided in the charger output circuit to prevent back-feed from battery into the charger and filters.
- 5.2.1.6 Protection against reverse battery connection and DC earth fault relay for earth leakage detection shall be provided.
- 5.2.1.7 Silicon blocking diodes (min. 4 nos.) connected to 80% tap of the battery bank shall be provided to maintain continuity in the DC supply to the load.
- 5.2.1.8 Internal cooling of the charger unit shall preferably be by natural ventilation. If forced air cooling is necessary, a redundant air cooling fan shall be provided. The charger components shall be capable of delivering their rated output with one forced air cooling fan out of service. Under this condition, maximum continuous temperature of components shall not exceed the permissible limits. In case of chargers with forced cooling, loss of ventilation alarm/ trip with override facilities shall be provided.
- 5.2.1.9 Selection, sizing and suitability of all components used for various applications shall be vendor's responsibility and the rating of components shall be increased, if required, to suit associated components during execution of the order without any claim for extra price or time.
- 5.2.1.10 The DC system shall be unearthed. However, a high impedance earth fault relay shall be provided for the protection of the battery.
- 5.2.1.11 Each charger shall be galvanically isolated from the input power supply by providing a double wound transformer at its input. The transformer shall be natural air cooled, dry type suitable for location inside a panel.
- 5.2.1.12 RFI filters shall be provided to suppress the radio frequency interference to permissible limits. The production of radio frequency interference voltages shall not exceed the value of suppression grade N as defined in VDE-0875. Battery charger shall be designed to comply with EMC requirements as per IEC 60146/ IS16539. Additional RFI/ EMC filters as required to comply with EMC requirement shall be provided.
- 5.2.1.13 Transient/ surge protection devices shall be provided in the input circuit of chargers to protect them against surges & voltage spikes.
- 5.2.1.14 The Chargers shall be designed to draw power from mains supply at a minimum power factor of 0.85 lag while sharing the rated load in normal operating configuration.
- 5.2.1.15 The chargers shall be designed to ensure that the harmonic component in the input currents are limited as per recommendations of the latest edition of IEEE-519, so as not to cause undue harmful effects on other sensitive equipment operating on the same supply bus. Suitable filters/ harmonic traps shall be provided, as required, for this purpose.
- 5.2.1.16 All breakers shall be adequately rated for the required continuous rating and breaking capacity as applicable. Paralleling of breaker/ switch/ contactor poles to achieve the required current rating is not acceptable. All output isolating devices shall be double pole type. The DC contactors shall be operated with a DC control supply using ON/ OFF selector switches and not push buttons.
- 5.2.1.17 All the thyristors, diodes and other power electronic devices shall be protected with high speed semiconductor fuses. I²t co-ordination between fuse and semi-conducting power devices shall be ensured.

5.2.1.18 The Battery Chargers shall be specifically designed to limit float and quick charging voltages to the battery to limits recommended by the battery manufacturer. Output voltage shall be limited to maximum +10% of nominal system voltage when the battery is float charged while feeding the load. Vendor shall specifically ensure that the charger output voltage does not exceed the recommended limits of operation under any conditions of internal/ external fault or operation, including:

- Filter capacitor fuse failure of either charger
- DC output switch OFF of either charger
- DC output fuse blown of either charger.

Other specific current/ voltage limits during normal charging/ operation of the chargers shall also be incorporated in the design of the chargers.

5.2.2 Operation and Performance

5.2.2.1 Operation (Option – I)

The DC system shall comprise of 2 Nos. Float cum quick Chargers (each rated for 100% capacity) with 1 set of battery (Refer typical scheme block diagram option – I). All functionalities & operation shall be available for both Auto & Manual mode of operation of chargers.

- a. Normal operation requires that the battery assembly shall be float charged simultaneously by both Chargers-1 & 2 while feeding the DC load, the chargers thus operating in parallel and equally sharing the total load.
- b. However in case of failure of either of the chargers, the other charger shall float charge the battery while feeding the complete DC load. Faulty charger shall automatically get disconnected from the healthy system.
- c. In case of AC mains failure or failure of both the chargers, the battery shall continue to supply the load.
- d. The process of changeover from float to quick charging and reverting from quick to float charging shall be selectable in Automatic or Manual mode by means of an Auto/ Manual selector switch. In Automatic mode, the changeover from float to quick charging shall be initiated through a current sensor, set at a preset value. Similarly, the changeover from quick to float charging shall also be automatic based on current sensing. In Manual mode, both change over from float to quick charging and from quick to float charging shall be performed manually using push buttons. When quick charging mode is selected, the battery charger shall initially charge the battery under constant current mode followed by constant voltage (finishing charging) mode or as per the battery manufacturer's recommendation. Changeover from constant current to constant voltage (finishing charging) mode shall be fully automatic. A backup synchronous or digital timer shall also be provided for initiating the changeover to float mode by default after a preset time period. The timer range shall be 0 to 24 hours or the nearest available as per manufacturer's standard range.
- e. In the event of failure of the charger feeding the load, when battery is being quick charged by the other charger, continuity in DC supply shall be maintained from the battery to the load through 80% tap of the battery bank followed by full battery supplying the load through contactor C-2 (refer block diagram Option – I). The healthy charger shall changeover to float mode from quick mode and shall feed the DC load while float charging the battery.
- f. Interlock shall be provided to ensure that when either of the chargers is selected in quick charging mode, it will be disconnected from both the DC load and the other charger operating under float charging mode. Further interlock shall be provided to prevent operating both chargers under quick mode.

- g. The chargers shall have facility for manual mode of operation in the event of failure of controller under closed loop control. The selection shall be done through Auto/ Manual selector switch.
- h. Energisation of contactor for DC critical lighting shall be initiated by means of an AC mains failure relay complete with Auto/ Manual selector switch, On/ Off push buttons etc.

5.2.2.2 Operation (Option – II)

- a) The DC system shall comprise of 2 nos. Float cum quick Chargers (each rated for 100% capacity) and 2 sets of Batteries (each of the battery sets rated for 50% AH capacity unless specified otherwise in datasheet/ job specification). (For typical scheme, refer block diagram Option - II). All functionalities & operation shall be available for both Auto & Manual mode of operation of chargers.
- b) Normal operation requires that Battery-1 shall be float charged by Charger-1 while Battery-2 shall be float charged by Charger-2. In this case both the chargers 1 and 2 shall feed the DC load by operating in parallel and equally sharing the total load.
- c) Selection of Float / quick mode shall be Automatic or Manual based on the position of selector switch for Auto / Manual selection.
- d) In case of failure of either of chargers, the other charger shall float charge both the batteries while feeding the complete DC load. Faulty charger shall automatically get disconnected from the healthy system.
- e) In case of AC mains failure or failure of both the chargers, both the batteries shall continue to supply the load by equally sharing the load current.
- f) After restoration of power supply, one of the Charger (say Charger-1) shall float charge Battery-1 and also feed the complete DC load while the other Charger-2 shall quick charge Battery-2. Upon completion of quick charge of Battery-2, Charger-2 shall switchover to float mode and shall float charge Battery-2 and also feed the complete DC load while the other Charger-1 shall switchover to quick mode and shall quick charge Battery-1.
- g) The process of changeover from float to quick charging and reverting from quick to float charging mode shall be selectable in Automatic or Manual mode by means of Auto / Manual selector switch.
- h) In automatic mode, the changeover from float to quick charging shall be initiated through a current sensor set at a preset value. Similarly, the changeover from quick to float charging shall also be automatic based upon current sensing and through timer.
- i) In manual mode, both the changeovers i.e. from float to quick charging and from quick to float charging shall be performed using push buttons. When quick charging mode is selected, one of the battery charger (say Charger-1) shall initially charge the battery under constant current mode followed by constant voltage (finishing charging) mode or as per the battery manufacturer's recommendation. Changeover from constant current to constant voltage (finishing charging) mode shall be fully automatic. A back-up synchronous or digital timer shall also be provided for initiating the changeover to float mode by default after a preset time period. The timer range shall be 0 to 24 hours or the nearest available as per manufacturer's standard range.
- j) In the event of failure of charger feeding the load (say Charger-1), when Battery-2 is being quick charged by the other Charger-2, Charger-2 shall changeover to float mode and continuity of 100% DC supply to the load shall be maintained from the Charger-2 while float charging both Battery-1 as well as Battery-2 after providing suitable time delay.
- k) In an event of AC mains failure, when one of the Charger (say Charger-1) is float charging the Battery-1 and supplying the 100% DC load while the other Charger-2

was quick charging Battery-2, continuity of 100% DC supply to the load shall be maintained from Battery-1 (through 100% tap). Further, Battery-2 (which was being quick charged) shall also be made available, after providing suitable time delay, to feed the DC load by operating in parallel with Battery-1 and sharing the total load.

- l) Interlock shall be provided to ensure that when either of the chargers (say Charger-1) is selected in quick charging mode, it will be disconnected from both the DC load as well as the other Charger-2 operating under float charging mode. Further interlock shall be provided to prevent operating both chargers under quick mode.
- m) The chargers shall have facility for manual mode of operation in the event of failure of controller under closed loop control. The selection shall be done through Auto/Manual selector switch.
- n) Energisation of contactor for DC critical lighting shall be initiated by means of an AC mains failure relay complete with Auto/Manual selector switch, On/Off push buttons etc.

5.2.2.3 Performance

- a. Both chargers shall be of solid state design, constant voltage and current limit type. The output voltage shall be stabilised to within $\pm 1\%$ of set value in float charging mode for mains steady state voltage and frequency variation of $\pm 10\%$ and $\pm 3\%$ respectively, and load variation of 10 to 100% at any temperature up to the design ambient temperature specified in the data sheet. However, the variation in output voltage can be up to $\pm 2\%$ for chargers with rated output voltage up to 24V.
- b. Under constant current quick charging condition, the DC output current shall be maintained within $\pm 2\%$ of set value.

The output voltage dynamic response of the charger unit with battery disconnected shall not vary more than $\pm 10\%$ of nominal output voltage in the event of step load of up to 50% of the rated output. The output voltage shall be restored to a value within the steady state limits within 250 msec.

- c. The maximum allowable RMS ripple voltage, with battery disconnected, shall be equal to or less than 2% of the nominal output voltage.
- d. The maximum noise level from the chargers measured at 1 metre distance in any position, at any load between 0- 100% with all normal cooling fans running shall not exceed 75 dB(A).

5.2.2.4 Controls

The minimum controls shall include but not be limited to those shown in the block diagrams (OPTION-I or OPTION-II as applicable):

5.2.2.5 Panel Metering and Indication

These shall include but are not limited to those shown in the block diagrams (OPTION-I or OPTION-II as applicable):

LEDs provided for indication shall be cluster type with adequate brightness and minimum 2 Nos. LEDs chips per light. LEDs shall be connected in parallel and each LED chip having diameter not less than 3mm.

5.2.2.6 Annunciation

Static type audio-visual annunciator with annunciation windows, acknowledge, test and reset push buttons and hooter shall be provided on each charger for the following annunciations. Any additional relays/ components, including DC under voltage relay and current sensors, required for this purpose shall be provided in the chargers. Facility for bypassing the audio alarm on each charger shall also be provided.

- DC under voltage
- DC overvoltage
- DC earth leakage
- AC incoming power supply failure
- AC input fuse blown-off
- Thyristor/ diode failure or Thyristor/ diode protection fuse failure
- DC output fuse blown-off
- DC battery fuse blown-off
- Filter Capacitor fuse blown-off
- Load on Battery (using current direction sensing with time delay)
- Battery under voltage/ Disconnected during discharge (using zero current sensing)
- Cubicle fan failure/ cubicle temperature high (for chargers with forced cooling).

One summary alarm potential-free contact each for Battery, Charger-1 and Charger-2 shall be wired to terminal block for remote annunciation.

Charger shall also be provided with port to hook up all indication and audio visual alarm, as specified above with owner's PC/ ECS through serial interface with industry standard protocol i.e. RS-485/ TCP/IP/ IEC61850 etc.

5.2.2.7 Printed Circuit Boards (PCBs)

PCBs used in the chargers shall be made of glass epoxy material. The PCBs shall be firmly clamped in position so that vibration or continued usages do not result in loose contacts. All PCBs shall be fitted in a manner to avoid replacement of a PCB by a wrong spare card. The PCBs shall be provided with visual light emitting diode (LED) status indications, monitoring points/ test connections and setting potentiometers in a readily accessible location which is visible without removing the PCBs.

5.2.2.8 Conformal coating shall be done for all PCBs, electronic components complying to Harsh environment class G3 as per standard IEC60068.

5.2.2.9 Vendor shall provide adequate protection to the system.

5.3 Construction of Chargers/ Distribution Board

5.3.1 Each Battery Charger and DC distribution board shall be housed in a separate free standing cubicle with minimum IP-31 degree of protection. All panels shall be of the same height so as to form a panel line up which shall have good aesthetic appearance. Chargers-1 & 2 shall be installed side by side whereas DCDB may be located separately and interconnected to the charger through cables. The DCDB shall accommodate outgoing feeders as desired. Each panel shall be provided with a LED light of required wattage with a door operated switch and a thermostatically controlled MCB protected space heater.

The DCDB shall be compartmentalised with each outgoing feeder housed in a separate compartment and shall comply with form of internal separation, minimum "Form-3b" as per IS/IEC 61439. Cable alley of minimum 200 mm width with suitable supports shall be provided for the termination of cables for each vertical arrangement of outgoing feeders in DCDB.

5.3.2 The Charger, DCDB and Cell Booster enclosures shall be fabricated from structural/ CRCA sheet steel or Galvanised sheet steel. The frames shall be fabricated by using minimum 2 mm thick sheet steel while the doors and covers shall be made from minimum 1.6 mm thick sheet steel. Wherever required, suitable stiffeners shall be provided. The panels shall be provided with suitable louvers for ventilation backed by wire mesh. They must be suitable for use in a tropical climate. Hinged doors shall be provided at the front and back as required. Inter panel sheet steel barriers shall be provided. Charger enclosure material shall comply with EMC requirements.

5.3.3 Bus bars shall be colour coded and live parts shall be shrouded to ensure complete safety to personnel intending routine inspection by opening the panel doors. All the equipment inside

- the panel and on the doors shall have suitable nameplates and device tag numbers as per the schematic diagram. All wires shall be ferruled and terminals shall be numbered.
- 5.3.4 The DCDB incomer and main bus bars shall be rated based on the maximum load current considering an additional 10% design margin for contingencies. The rating shall be selected from standard available ratings and shall be adequate for the expected short circuit current. The bus bar voltage shall be higher than the recommended quick charging voltage for the system. The insulation for all equipment where provided shall be heat resistant, moisture proof and tropicalised.
- 5.3.5 All power and control switches shall be rotary/ cam operated type. All power switches shall be air insulated load break type. Vendor shall ensure that all equipment/ components such as incomer switches, outgoing DC switches, MCCBs, push buttons, indicating lamps, charger mode selector switches, voltage control switches, annunciator windows etc. are suitably located on the charger and distribution board door such that they can be operated without opening the front door. Power switches shall be provided with a door interlock. In case of difficulty in installation on the charger front panel door, the AC incoming power switches, DC outgoing switches and MCCBs may be installed within the panel provided that they are operable after opening the front panel door. However, all other selector/ control switches, push buttons, indicating lamps, annunciators, meters etc. shall necessarily be installed on the front panel door as specified above.
- 5.3.6 All instruments shall be switchboard type, back connected and maximum 96 x 96 mm square size. Accuracy class of all meters shall be 1%. Digital meters capable of displaying different parameters can be considered subject to Owner's/ EIL's approval. Analogue instrument scales shall have a red mark indicating maximum permissible operating rating.
- 5.3.7 All fuses shall be link type and shall be located inside the panel. Diazed fuses shall not be accepted.
- 5.3.8 All power and control wiring connections within the panels shall be carried out with 660V grade, PVC/ XLPE insulated, Flame Retardant Low Smoke (FRLS), BIS marked wires having stranded copper conductors. However, copper strip connections shall preferably be used for currents exceeding 100A. Control wiring for electronic circuits/ components shall be through copper flat ribbon cable or copper wire of minimum 0.5mm diameter. Ferruling of wires shall be as per relevant IS.
- 5.3.9 For all cabling external to panels, power cables shall be with aluminium/ copper conductors and control cables shall be with copper conductors. All cable connections shall be from the bottom of the panel. Removable bolted undrilled gland plates shall be provided for all external cable connections. Separate test terminals shall be provided for measuring and testing the equipment to check performance.
- 5.3.10 A suitably sized earth bus shall be provided at the bottom of the panels running through the panel line up with provision for earth connections at both ends to owner's main earth grid. All potential free metallic parts of equipment shall be suitably earthed to ensure safety.
- 5.3.11 The maximum height of the operating handles/ switches shall not exceed 1800 mm and the minimum height shall not be below 300 mm.
- 5.3.12 All components/ devices/ feeders shall be provided with screwed nameplates and lettering shall be of minimum 6 mm height.
- 5.3.13 Panels shall undergo manufacturer's standard cleaning and painting cycle. After preparation of the under surface, the panel shall be painted with two coats of epoxy based final paint. Colour shade of final paint shall be RAL 7032. All unpainted steel parts shall be suitably treated to prevent rust formation. If these parts are moving elements, then they shall be greased.

5.4 Cell Booster

Cell booster shall be suitable for charging one to six cells within the time duration specified at Cl.5.2.1.1. It shall be suitable for charging not only new cells before being introduced to the battery bank but also for any treatment to be given to individual weak cells. Cell booster shall be suitable for $240\text{ V} \pm 10\%$, $50\text{ Hz} \pm 3\%$ SPN input power supply. Cell booster output voltage shall be in the range of 0-18V and 0-12V for Lead Acid and Nickel Cadmium batteries respectively. Cell booster shall be sized as under:

For Lead Acid battery	=	$0.14 \times \text{Ah}(C_{10})$ of cell
For VRLA battery	=	$0.2 \times \text{Ah}(C_{10})$ of cell
For Ni Cd battery	=	$0.2 \times \text{Ah}(C_5)$ of cell.

Cell booster shall have a heavy duty switch fuse or MCCB on both AC incomer and DC output sides, along with AC voltmeter, DC ammeter, DC voltmeter and indicating lamps for AC/ DC power ON & reverse battery connection. The output voltage and current of cell booster shall be manually controlled using a suitably rated variac or a full wave controlled rectifier bridge. Suitable interlock shall be provided so as to ensure that the variac/ controlled rectifier is at its minimum position while switching on the cell booster. Cell booster shall be portable type with wheels. Each cell booster shall be supplied with 5 m long flexible copper conductor, PVC insulated braided cables for both AC incoming power supply and DC output connection to the battery. An industrial type 3 pin 15A plug shall be provided on AC incoming cable end and lugs shall be provided on DC outgoing cable end.

5.5 Reliability

All necessary care shall be taken in selection, design, manufacture, testing and commissioning of the equipment for ensuring high system reliability. The following design considerations shall be taken into account to ensure maximum availability of the system:

- 5.5.1 There shall be no common device between the two units, the failure of which could cause shutdown of more than one charger.
- 5.5.2 It shall be possible to attend to any individual power circuit for maintenance without affecting the total DC supply.
- 5.5.3 Series-parallel combination of smaller devices to achieve specified rating shall not be acceptable.

6.0 INSPECTION, TESTING AND ACCEPTANCE

- 6.1 During fabrication, the equipment shall be subjected to inspection by EIL / Owner or by an agency authorised by the Owner, to assess the progress of the work and to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to EIL's/ Owner's inspector.
- 6.2 For testing requirement, Inspection & test plan for battery chargers (Standard no. 6-81-1019) shall be followed. Prior notice of minimum 4 weeks shall be given to EIL/owner for witnessing the final testing of panel to ensure satisfactory operation of all components. Tests shall be carried out at manufacturer's works under his care and expense.
- 6.3 Test certificates of bought out components shall be submitted to the inspection agency, as per Inspection and Test Plan no. 6-81-1019.

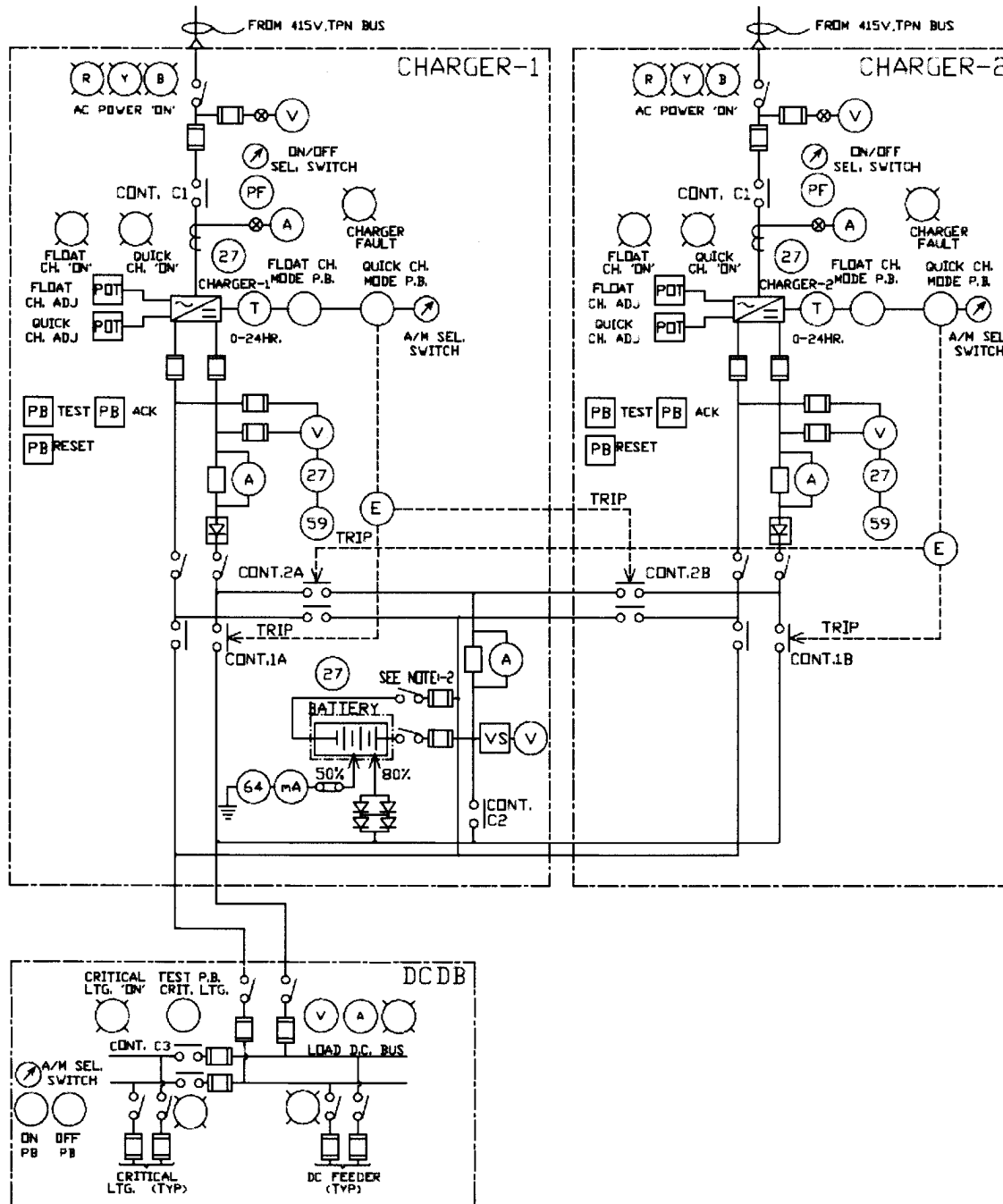
7.0 PACKING & DESPATCH

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/ rail or trailer. It shall be wrapped in polythene sheets before being placed in crates/ cases to prevent damage to finish. The crates/ cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's

particulars', 'PO Nos.' Etc., shall be clearly and indelibly marked on the packages together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains and high ambient temperature. A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be supplied along with the shipment duly enclosed in a waterproof cover.

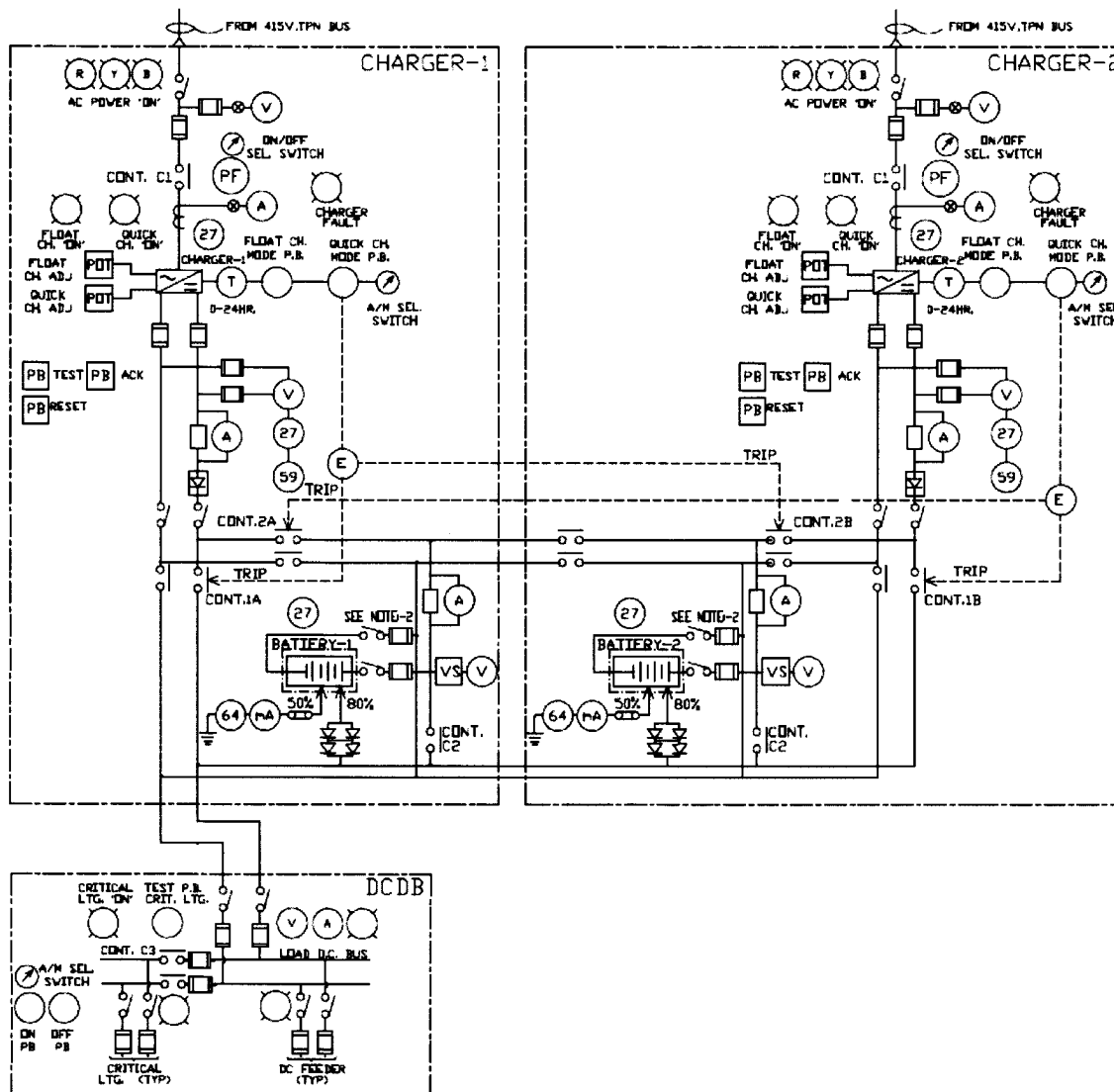
OPTION-I



NOTES: -

1. a) THE DC CONTACTORS SHALL HAVE A TESTED/ PUBLISHED DC RATING EQUAL TO OR EXCEEDING THE MOST STRINGENT CURRENT CARRYING AND BREAKING REQUIREMENTS CONSIDERING ADEQUATE DESIGN MARGINS.
b) PUSH BUTTONS ARE NOT ACCEPTABLE IN PLACE OF SELECTOR SWITCHES FOR THE ON/OFF SWITCHING OPERATIONS OF THE CONTACTORS.
c) THE DC CONTACTORS SHALL BE OPERATED WITH A DC CONTROL SUPPLY.
2. SUITABLY RATED DC MCCB CAN BE ACCEPTED IN PLACE OF SWITCH FUSE UNIT AT BATTERY OUTPUT

OPTION-II



- THE DC CONTACTORS SHALL HAVE A TESTED/ PUBLISHED DC RATING EQUAL TO OR EXCEEDING THE MOST STRINGENT CURRENT CARRYING AND BREAKING REQUIREMENTS CONSIDERING ADEQUATE DESIGN MARGINS.
 - PUSH BUTTONS ARE NOT ACCEPTABLE IN PLACE OF SELECTOR SWITCHES FOR THE ON/OFF SWITCHING OPERATIONS OF THE CONTACTORS.
 - THE DC CONTACTORS SHALL BE OPERATED WITH A DC CONTROL SUPPLY.
- SUITABLY RATED DC MCCB CAN BE ACCEPTED IN PLACE OF SWITCH FUSE UNIT AT BATTERY OUTPUT.
- BATTERY CONFIGURATION SHALL BE 2X50% AH CAPACITY UNLESS SPECIFIED OTHERWISE IN DATASHEET/ JOB SPECIFICATION

शुष्क किस्म के डिस्ट्रीब्यूशन ट्रांसफार्मर के लिए विनिर्देश

SPECIFICATION FOR DRY TYPE DISTRIBUTION TRANSFORMERS

6	10.12.21	REVISED AND REISSUED AS STANDARD SPECIFICATION	MKM	HK	PG	SM
5	23.11.16	REVISED AND REISSUED AS STANDARD SPECIFICATION	NT	SA	BRB	RN
4	11.04.11	REVISED AND REISSUED AS STANDARD SPECIFICATION	MK	SA	UAP	DM
3	21.03.11	REVISED AND REISSUED AS STANDARD SPECIFICATION	NT	SA	UAP	DM
2	20.09.05	REVISED AND REISSUED AS STANDARD SPECIFICATION	ND	AKT	AAN	VJN
Rev No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

BIS	:	Bureau of Indian Standards
CEA	:	Central Electricity Authority
CT	:	Current Transformer
EIL	:	Engineers India Limited
GI	:	Galvanised Iron
HV	:	High Voltage
IEC	:	International Electrotechnical Commission
IP	:	Ingress Protection
IS	:	Indian Standard
KVA	:	Kilo Volt Amperes
MSL	:	Mean Sea Level
MV	:	Medium Voltage
PO	:	Purchase Order
PVC	:	Poly Vinyl Chloride
XLPE	:	Cross Linked Poly Ethylene
51G	:	Back up Earth Fault Protection Relay
64R	:	Restricted Earth Fault Protection Relay

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1.0 SCOPE

The intent of this specification is to define the requirements for design, manufacture, testing, packing and supply of cast resin / resin impregnated dry type distribution transformers.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of the latest revision of the following standards issued by BIS (Bureau of Indian Standards) unless otherwise specified.

IS: 1271	:	Electrical Insulation-thermal evaluation and designation
IS: 2026, Part 11	:	Power Transformer - Dry-Type Transformer
IS: 2705, Part 1	:	Current transformers - General requirements
IS: 10028	:	Code of practice for selection, installation and maintenance of transformers
IS: 11171	:	Dry type power transformers
IS: 16227		
/ IEC: 61869	:	Instrument transformers
IS/IEC: 60529	:	Degrees of Protection Provided by Enclosures (IP Code)

2.2 In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent to or stringent than the applicable Indian standards.

2.3 The equipment shall also conform to the provisions of the CEA Regulations with latest amendments and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC or equivalent agency shall be applicable.

2.5 In case of any conflict between requirements specified in various applicable documents for the project, the most stringent one shall prevail. However Owner's / EIL's decision in this regard will be final and binding.

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 10 years from the date of supply.

3.3 Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/spares to enable the end user for placement of order for spares and services.

4.0 SITE CONDITIONS

Transformer shall be suitable for installation and satisfactory operation in tropical, humid and corrosive atmospheres found in refineries, Petrochemical and Fertiliser Plants or as specified in the Material Requisition / Tender. The transformer shall be designed to operate under site conditions as specified in data sheet. If not specifically mentioned therein, design ambient temperature of 40°C and altitude not exceeding 1000 m above MSL shall be considered.

5.0 CONSTRUCTION

- 5.1** The transformers shall have core type construction. The core shall be assembled out of low-loss, nonageing, high permeability cold rolled grain oriented steel laminations.
- 5.2** The windings shall be of high-grade electrolytic copper. The insulation system for cast resin transformers shall comprise of windings cast under vacuum, free of voids in a homogenous uniform laminate of epoxy resin/ polyester resin. The totally assembled core and coil assembly, for resin impregnated transformers, shall be vacuum pressure impregnated to effectively make it impermeable to moisture, dirt, salt, air and other industrial contaminants.
- 5.3** The entire core assembly shall be covered with a resin-based lacquer for corrosion protection.
- 5.4** Lifting lugs shall be provided for core and winding assemblies.
- 5.5** The HV and MV windings shall have class 'F' or better insulation. The temperature rise of windings under continuous full load shall not exceed the maximum allowable temperature for the appropriate class of insulation as per IS 11171/ IS 2026-11, above the design temperature specified in the data sheet.
- 5.6** The insulation material used shall be non-hygroscopic, non- inflammable and self-extinguishing if ignited by direct flame or arc. No toxic or harmful gases shall form during heating and /or burning. The insulation materials shall be sufficiently resistant to ageing.
- 5.7** The transformers shall be capable of withstanding the thermal and mechanical effects of a dead short circuit on any or all winding terminals with full voltage maintained on other windings as per IS. The transformers shall sustain a symmetrical short circuit on secondary terminals for 2 seconds without damage or impairment.
- 5.8** Each limb shall have two solid state winding temperature monitoring elements to initiate an alarm and trip for winding over temperature.
- 5.9** The transformers for Indoor & outdoor location shall have minimum degree of protection as IP 23 & IP 43 respectively. However the marshalling box, cable termination box, bus-duct termination chamber etc. shall have a degree of protection not less than IP-55.
- 5.10** All fasteners and bolts shall be galvanised.
- 5.11** The transformers shall be spray-painted or powder coated with epoxy paint. Colour shade of final paint shall be as specified in the data sheet.
- 5.12** The transformer shall be provided with a rating plate of weatherproof material, fixed in a visible position mentioning Tag Number and Transformer details as per IS 11171/ IS 2026-11.

6.0 TERMINAL AND MARSHALLING BOX

- 6.1** Windings shall be brought out on suitable nickel-plated copper terminals for cable termination. HV side termination shall be from the bottom. Suitable disconnection chambers shall be provided to permit the transformer to be removed without disconnecting the cable termination. The MV side termination shall be by bus-duct or cable as defined in datasheet / job specification.
- 6.2** The high voltage and medium voltage cable termination arrangement shall be complete with cable box and bolted type undrilled cable gland plates. Non-magnetic gland plate shall be provided for single core cables.

- 6.3 Primary cable box shall be able to withstand specified primary system fault level for 0.2 secs.
- 6.4 Terminal chamber for busduct termination shall have a gasketed cover plate, bolted to it. Separate inspection covers shall be provided to facilitate connection and inspection.
- 6.5 All protection, alarm and indication devices and neutral CTs shall be wired by means of PVC/XLPE insulated cables upto the marshalling box. There shall be two gland plates, one for internal wiring to the marshalling box from various devices which shall be glanded and pre-wired, while the second gland plate shall be removable and undrilled for glanding outgoing cables.
- 6.6 One neutral terminal inside the cable box/ MV bus-duct connection chamber and a separate neutral terminal outside shall be provided for earthing of transformer winding neutral on the secondary side. The neutral terminal shall be complete with connector block assembly for easy termination of GI earth strip/cable.
- 6.7 The neutral CT shall be mounted as below:-
- CT for 51G shall be located in the earth path after bifurcation of neutral.
 - CT for 64 R can be located before bifurcation of neutral.
- 6.8 Two earthing terminals shall be provided on the transformer frame for transformer body earthing. Suitable lifting arrangement shall be provided in the transformer frame. The transformer shall be supported on flat rollers.
- 6.9 Phase identification markings shall be provided for the terminals in HV and MV side terminal boxes.

7.0 COOLING

Type of Cooling shall be in accordance with the datasheet.

8.0 TAPPINGS AND CONTROLS

Primary off-circuit rotary type tap changer shall be provided and shall have a range as specified in the data sheet. Tap changing arrangement through links is not acceptable. Under conditions of external short circuit, the tap changing device shall be capable of carrying the same current as the windings.

9.0 ACCESSORIES

- 9.1 Accessories as specified on data sheet shall be included in the scope of supply. All protective, alarm and indicating devices shall have minimum 1 no. potential free contact each for alarm and trip. All transformers must be provided with at least the following:

- Bi-directional flat rollers
- Rating and terminal marking plate
- Marshalling box
- Lifting hooks and jacking pads, towing holes
- Earthing terminals
- Neutral CT (as per data sheet)
- Off-circuit tap changer
- Temperature monitoring system (For rating 500 KVA & above)

- 9.2** Temperature monitoring system shall be supplied with temperature sensors fitted in each limb. Temperature monitoring system shall initiate alarm and trip for winding over temperature. Alarm and trip temperatures shall be site settable. The monitoring system shall also have an indicating device.

10.0 NOISE LEVEL

The average audible sound level for the transformers at a distance of 30 cm shall be as below:

KVA	AVERAGE SOUND LEVEL (DECIBEL)
0-50	50
51-150	55
151-300	58
301-500	60
501-700	62
701-1000	64
1001-1500	65
1501-2000	66
2001-3000	68
3001-4000	70
4001-5000	71

11.0 INSPECTION AND TESTING

- 11.1** During fabrication, the transformer shall be subject to inspection by EIL / Owner, or by an agency authorized by the Owner, to assess the progress of work, as well as to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to EIL / Owner's inspectors.
- 11.2** For testing requirements, refer Inspection & Test Plan doc. no. 6-81-1044. Prior notice of minimum 4 weeks shall be given to EIL/ Owner for witnessing the final testing of the complete assembly to ensure satisfactory operation of all components. All testing shall be carried out at manufacturer's works under his care and expense.
- 11.3** Test certificates of bought out components shall be submitted to the inspection agency, as per Inspection and Test Plan no. 6-81-1044.

12.0 PACKING AND DESPATCH

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for the selected mode of transportation i.e. by ship/ rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in the crates/ cases to prevent damage to the finish. Crates / cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's particulars', 'P.O. numbers' etc., shall be clearly marked on the package together with other tag numbers etc.

The equipment may be stored outdoors for long periods before erection. The packing shall be suitable for outdoor storage in areas with heavy rains and high ambient temperature. A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be supplied duly enclosed in a waterproof cover along with the shipment.

स्टेशनरी निकल केडमियम बैटरीज के लिए विनिर्देश

SPECIFICATION FOR STATIONARY NICKEL CADMIUM BATTERIES

4	19.08.2021	REVISED AND ISSUED AS STANDARD SPECIFICATION	SS	RS	PG	SM
3	14.07.2016	REVISED AND ISSUED AS STANDARD SPECIFICATION	PB/MHR	RS	BRB	RN
2	11.04.2011	REVISED AND ISSUED AS STANDARD SPECIFICATION	CS	PG	UAP	DM
1	27.08.2007	REVISED AND ISSUED AS STANDARD SPECIFICATION	AP	NS	JMS	VC
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
						Approved by

Abbreviations:

AC	Alternating current
Ah	Ampere hour
BIS	Bureau of Indian Standards
CEA	Central Electricity Authority
DC	Direct current
EIL	Engineers India Limited
IEC	International Electrotechnical Commission
IS	Indian Standard
MSL	Mean Sea Level
PO	Purchase Order
PVC	Polyvinyl Chloride
UPS	Uninterrupted Power Supply
V	Volt

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1.0 SCOPE

This specification covers the design, Manufacture, testing and supply requirements of stationary vented type Nickel Cadmium cell/batteries for DC power system /AC UPS system application.

2.0 CODES AND STANDARDS

- 2.1** The equipment shall comply with the requirements of the latest revision of the following standards issued by BIS:

IS-10918 Specification for Vented type Nickel Cadmium batteries

- 2.2** In case of imported equipment, standards of the country of origin shall be applicable if these standards are equivalent or more stringent than the applicable Indian standards.

- 2.3** The equipment shall also conform to the provisions of CEA regulations with latest amendments and other statutory regulations currently in force in the country.

- 2.4** In case Indian standards are not available for any equipment, standards issued by IEC or equivalent agency shall be applicable.

- 2.5** In case of any conflict between various referred standards/ specifications/ datasheets and statutory regulations, the most stringent requirement shall prevail and Owner's/ EIL's decision in this regard shall be final and binding.

3.0 GENERAL REQUIREMENTS

- 3.1** The offered equipment shall be brand new with state of the art technology and proven field track record. No prototype equipment shall be offered.

- 3.2** Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 10 years from the date of supply.

- 3.3** Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/ spares to enable the end user to place order for spares and services.

4.0 SITE CONDITIONS

Stationary Nickel Cadmium cell/battery shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in refineries, petrochemical and gas processing plants, metallurgical plants and other industrial plants. Service conditions shall be as specified in the data sheets/job specification. If not specifically mentioned therein, a design ambient temperature of 40°C and an altitude not exceeding 1000m above MSL shall be considered, with a minimum temperature of 10°C for battery sizing.

5.0 TECHNICAL REQUIREMENTS

- 5.1** The Nickel Cadmium cell/battery shall be suitable for float duty operation with a constant voltage permanently applied to its terminals which is sufficient to maintain it in a state close to full charge and shall be designed to supply load in the event of normal power supply failure. Type of plate construction for batteries shall be as per the data sheet.

- 5.2** The standard rated ampere hour capacity of the cell/ battery shall be at a reference temperature of 27°C, constant current discharge at 5 hours rate (C5) and an end cell voltage of 1.0 V/cell.

- 5.3** Ampere hour of the battery shall be selected based on the following criteria:
- Minimum site ambient temperature of 10°C
 - Discharge duty cycle
 - End cell voltage
 - Ageing factor of 0.8
 - Capacity rating factor
- 5.4** Number of cells and end cell voltage shall be decided by the vendor on the basis of maximum permissible voltage to the load when batteries are float charged while feeding the load and minimum DC system voltage. However, the minimum number of cells and end cell voltage shall be as per the data sheet.
- 5.5** The battery shall be suitable for being quick charged to fully charged condition from fully discharged condition within 10 hours.
- 5.6** Battery assembly shall be supplied empty, dry and uncharged. Packed unused liquid electrolyte with 10% extra shall be delivered with the battery in suitable non returnable sealed containers.
- 5.7** Each cell/battery shall have a separate container of 1.2V (nominal voltage). The cell container shall be of high strength alkali resistant material and designed to withstand mechanical stresses, shocks and vibrations. The cell container shall be translucent/ transparent and shall have minimum & maximum levels markings.
- 5.8** The terminal posts shall be of nickel plated steel. The terminals shall be suitable for short circuit current and specified discharge current without damage to the cell as a result of terminal heating.
- 5.9** Stationary Nickel Cadmium cells/battery shall be designed to withstand the mechanical stresses encountered during normal transportation and handling.
- 5.10** Flame arrestor with venting device and cap shall be mounted on the cell so that all the vented gases diffuse through the arrestor to the outside environment. The construction of the arrestor shall be such that hydrogen burning on the external surface of the arrestor shall not propagate back into the cell to cause explosion.
- 5.11** The following information shall be permanently marked on the cell.
- Nominal voltage
 - Name of manufacturer/model reference
 - Rated capacity in ampere hours (Ah) with End Cell Voltage
 - Voltage for float operation at 27°C with tolerance of $\pm 1\%$
 - Month and year of manufacture
 - Polarity Marking
- 5.12** Each set of battery shall be supplied with all the accessories, including, but not limited to the following:
- Battery stand in formation as per data sheet. Mild steel stand pretreated and epoxy painted epoxy powder coated / PVC coated.
 - Inter cell, inter row and inter bank connectors and end take offs. These shall be of nickel plated copper/flexible insulated copper cable/completely insulated solid copper connectors.
 - Cell insulator as applicable.
 - Stand insulator.
 - Cell number plates/permanent stickers, Lugs for cable termination, as required.
 - Other accessories and their quantity as per data sheet.

6.0 PERFORMANCE

Nickel Cadmium batteries shall have been type tested to meet the performance requirements for each design and Ah rating of cells as per Indian Standard referred in clause 2.1 above.

7.0 INSPECTION, TESTING AND ACCEPTANCE

7.1 Batteries shall be subject to inspection by EIL / Owner, or by an agency authorized by the Owner, to assess the progress of work, as well as to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to EIL / Owner's inspectors.

7.2 For Testing requirements, refer Inspection & Test Plan for Stationary Nickel cadmium battery (Standard no. 6-81-1047). EIL / Owner's inspector shall be given free access in the works from time to time for stage wise inspection and progress reporting. Prior notice of minimum 4 weeks shall be given to EIL/Owner for witnessing the final tests of battery. Tests shall be carried out at manufacturer's works under his care and expense.

7.3 Test certificates of bought out components shall be submitted to the inspection agency, as per Inspection and Test Plan no. 6-81-1047.

7.4 Battery load test shall also be performed at site after installation as part of commissioning.

8.0 PACKING AND DESPATCH

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to finish. Crates/cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's particulars', 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature. A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be enclosed in a waterproof cover along with the shipment.

वाल्व रेगुलेटिड स्टेशनरी लैड एसिड बैटरीज के लिए विनिर्देश

SPECIFICATION FOR STATIONARY VALVE REGULATED LEAD ACID BATTERIES

4	03.09.2021	REVISED & RE-ISSUED AS STANDARD SPECIFICATION	SS	RS	PG	SM
3	05.09.2016	REVISED & RE-ISSUED AS STANDARD SPECIFICATION	PB/MHR	RS	BRB	RN
2	11.04.2011	REVISED & RE-ISSUED AS STANDARD SPECIFICATION	CS	PG	UAP	DM
1	27.08.2007	REVISED & RE-ISSUED AS STANDARD SPECIFICATION	AP	NS	JMS	VC
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

AC	Alternating Current
Ah	Ampere hour
BIS	Bureau of Indian Standards
CEA	Central Electricity Authority
DC	Direct Current
EIL	Engineers India Limited
IEC	International Electrotechnical Commission
IS	Indian Standard
MSL	Mean Sea Level
PO	Purchase Order
PVC	Poly Vinyl Chloride
UPS	Uninterrupted Power Supply
V	Volt

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1.0 SCOPE

This specification covers the design, manufacture, testing and supply requirements of Valve Regulated stationary Lead Acid cell/batteries for DC Power System/ AC UPS application.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of the latest revision of the following standards issued by BIS/other standard bodies:

IS-15549	:	Stationary valve regulated lead acid batteries
ANSI T1 330	:	Valve Regulated Lead-Acid Batteries used in the telecommunication Environment.
ASTM D2863	:	Test method for measuring the minimum oxygen concentration to support candle like combustion of plastics (Oxygen Index).
IEC 60896-21	:	Stationary lead-acid batteries - Part 21: Valve regulated types - Methods of test
IEC 60896-22	:	Stationary lead-acid batteries - Part 22: Valve regulated types - Requirements
IEC-60068-2	:	Environmental testing

2.2 In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or more stringent than the applicable Indian standards.

2.3 The equipment shall also conform to the provisions of CEA regulations with latest amendments and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC or equivalent agency shall be applicable.

2.5 In case of any conflict between various referred standards/ specifications/ datasheets and statutory regulations, the most stringent requirement shall prevail and Owner's/ EIL's decision in this regard shall be final and binding.

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of the art technology and proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 10 years from the date of supply.

3.3 Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/ spares to enable the end user to place order for spares and services.

4.0 SITE CONDITIONS

Valve Regulated stationary Lead Acid cell/battery shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in fertilizer plants, refineries, petrochemical and gas processing plants, metallurgical plants and other industrial plants. Service conditions shall be as specified in the data sheets/job specification. If not specifically mentioned therein, a design ambient temperature of 40°C and an altitude not exceeding 1000m above MSL shall be considered, with minimum temperature of 10°C for battery sizing.

5.0 TECHNICAL REQUIREMENTS

- 5.1** The Valve Regulated cell/battery shall be suitable for float duty operation with a constant voltage permanently applied to its terminals which is sufficient to maintain it in a state close to full charge and shall be designed to supply load in the event of normal power supply failure.
- 5.2** The standard rated ampere hour capacity of the cell/ battery shall be at a reference temperature of 27°C, constant current discharge at 10 hours rate (C10) and an end cell voltage of 1.8V/cell.
- 5.3** Ampere hour of the battery shall be selected based on the following criteria:
- Minimum site ambient temperature of 10°C
 - Discharge duty cycle
 - End cell voltage
 - Ageing factor of 0.8
 - Capacity rating factor
- 5.4** Number of cells and end cell voltage shall be decided by the vendor on the basis of maximum permissible voltage to the load when batteries are float charged while feeding the load. The system output voltage at the end of design duty cycle shall not be less than 95% for nominal system voltage up to 48V DC and 90% for nominal system voltage of 110V DC and above. However, the minimum number of cells and end cell voltage shall be as per datasheet.
- 5.5** On float, the cell/battery shall be suitable for being recharged to 90% of ampere hours within 24 hours and to 100% within 4 days.
- 5.6** The components such as containers, lids, covers and seals used in manufacture shall meet the Fire, flame and smoke resistance rating as defined in IS 15549 and have an oxygen Index of at least 28 in accordance with ASTM D-2863.
- 5.7** Each cell/battery shall have a separate container of 2.0V (nominal voltage). The cell container shall be made of high strength acid resistant material and designed to withstand mechanical stresses, shocks, vibrations and shall be consistent with the life of the battery.
- 5.8** The design of valve regulated cell shall be such that regulating valve shall not allow the gas (air) to enter into the cell but shall allow the gas to escape from the cell above certain internal pressure which shall not lead to deformation or cause container to crack or cause failure of seals or shall not cause bulging/ cracking of cell cover.
- 5.9** The hydrogen released from valve regulated lead acid cells shall be sufficiently low to make these cells suitable for use in office, control rooms and equipment environments. The gas leakage rate of the cell shall not exceed 0.05cm³/hr at 27°C and 101.3kpa.
- 5.10** Valve Regulated stationary Lead Acid cells/battery shall be designed to withstand the mechanical stresses encountered during normal transportation and handling.
- 5.11** Venting device shall be provided with Flame arrestor and shall be mounted on the cell so that all the vented gasses diffuse through the arrestor to the outside environment. The construction of the arrestor shall be such that hydrogen burning on the external surface of the arrestor shall not propagate back in to the cell to cause explosion.
- 5.12** The terminal posts shall be casted of lead alloy with copper/brass insert for enhancement of conductivity. The terminals shall be suitable for maximum discharge current and short circuit current without damage to the cell as a result of terminal heating.

- 5.13** The temperature of the valve regulated lead acid cells shall be sufficiently low to prevent thermal runaway (critical condition arising due to constant voltage charging).
- 5.14** The following information shall be permanently marked on the cell.
- Nominal voltage
 - Name of manufacturer/model reference
 - Rated capacity in ampere hours (Ah) with end cell voltage
 - Voltage for float operation at 27°C with tolerance of $\pm 1\%$
 - Month and year of manufacture
 - Polarity marking
 - Batch No. and Serial No. of Cells
- 5.15** Each set of battery shall be supplied with all the necessary accessories, including, but not limited to the following:
- a. Battery stand in formation / steel modules for multi tier stacking as per data sheet. Mild steel stand/module pretreated and epoxy painted /epoxy powder coated/ PVC coated.
 - b. Inter cell, inter row and inter bank connectors and end take offs. These shall be of lead plated copper or flexible insulated copper cable or completely insulated solid copper connectors.
 - c. Cell insulator as applicable.
 - d. Stand insulator.
 - e. Cell number plates/permanent stickers, Lugs for cable termination, as required.
 - f. Other accessories and their quantity as per data sheet.

6.0 PERFORMANCE

Valve regulated Stationary Lead Acid batteries shall have been type tested to meet the performance requirements for each design and Ah rating of cells as per the relevant Indian standard referred in clause 2.1 above.

7.0 INSPECTION, TESTING AND ACCEPTANCE

- 7.1** Batteries shall be subject to inspection by EIL / Owner, or by an agency authorized by the Owner, to assess the progress of work, as well as to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to EIL / Owner's inspectors.
- 7.2** For Testing requirements, refer Inspection & Test Plan for Stationary valve regulated lead acid battery (Standard no. 6-81-1048). EIL / Owner's inspector shall be given free access in the works from time to time for stage wise inspection and progress reporting. Prior notice of minimum 4 weeks shall be given to EIL/Owner for witnessing the final tests of battery. Tests shall be carried out at manufacturer's works under his care and expense.
- 7.3** Test certificates of bought out components shall be submitted to the inspection agency, as per Inspection and Test Plan no. 6-81-1048.
- 7.4** Battery load test shall also be performed at site after installation as part of commissioning.

8.0 PACKING AND DESPATCH

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to finish. Crates/cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's

particulars', 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature.

A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be supplied along with the shipment duly enclosed in a waterproof cover.

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वैद्युत कार्यों के लिए
विनिर्देश

**SPECIFICATION
FOR
ELECTRICAL WORKS
AS PART OF PAVING WORKS**

4	16.12.2019	REVISED AND REISSUED AS SPECIFICATION	RM/DK	RS	SA	RKT
3	16.10.2014	REVISED AND REISSUED	AKG	SA	BRB	SC
2	23.12.2009	REVISED AND REISSUED	RKS	SA	NS/JMS	ND
1	07.02.2005	REVISED AND ISSUED AS STANDARD SPECIFICATION	SSM	RR	AAN	SKG
0	06.01.2000	ISSUED AS STANDARD SPECIFICATION	BLC	RR	VPS	AS
Rev No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

BIS	Bureau of Indian Standards
GI	Galvanised Iron
IS	Indian Standard
NB	Nominal Bore
PVC	Poly Vinyl Chloride
SWG	Standard Wire Gauge

Electrical Standards Committee

Convenor: **Ms. Sumita Anand**

Members: Mr. Parag Gupta
 Mr. M.K.Sahu
 Ms. ANP Singh
 Mr. Harish Kumar
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 Mr. Raman Sood
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 Mr. Rajesh Sinha (Inspection)
 Ms. N.P. Guha (Projects)

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1.0 SCOPE

This specification defines the requirements for supply and installation of materials such as earth electrode, earth strip, GI conduit sleeves etc. by contractor in the areas to be paved.

2.0 CODES AND STANDARDS

The work shall be carried out in the best workman like manner in conformity with this specification, EIL Installation standards, latest edition of codes of practice of Bureau of Indian Standards and the regulations laid down by the Electrical Inspectorate and other concerned authorities as applicable.

IS : 3043	Code of practice for earthing
IS : 1239 Part-I	Mild steel tube, tubular and other wrought steel fittings.
IS : 1239 Part-II	Mild steel sockets tubular and other wrought steel pipe fittings.
IS : 4736	Hot dip zinc coating on mild steel tubes.
SP-30(BIS)	Special publication-National electrical code

3.0 MATERIAL SPECIFICATIONS

All materials and hardware to be supplied by the contractor shall be new, unused and of best quality and shall conform to the specifications given hereunder and installation standards attached with the tender. Contractor shall bring material samples to site and get it approved by Engineer-in-charge before installation.

3.1 Earth Grid

The main earth grid conductor shall be hot dip galvanised mild steel flat/as specified in design basis. Sizes for main conductors shall be as indicated on the layout drawing.

3.2 Earth Electrodes

Earth electrodes shall be of hot galvanised medium grade mild steel pipe, 65 mm NB diameter as per EIL installation standard unless otherwise specified as per job specification.

3.3 Earth Plate

This shall be of size 400 x 75 x 10 mm GI Earth plate (hot dip galvanised) as per installation standard unless other wise specified.

3.4 GI Pipes Sleeves

These shall be of galvanised medium grade mild steel pipe of standard diameters viz. 40, 50, 65, 80, 100, 125, 150 mm NB as required.

3.5 Galvanising

The amount of galvanizing for material shall be minimum 610 gm. per sq. meter unless otherwise specified in job specification

4.0 INSTALLATION

4.1 Earth Electrode in Test Pit

- 4.1.1 Earth Electrode shall be installed as shown on installation standard.
- 4.1.2 The location of earth pit shown on the layout drawings is indicative. The exact location of earth electrodes in the field shall be determined by the contractor in consultation with the site Engineer-in-charge.
- 4.1.3 Earth electrodes shall be located avoiding interference with road, building foundation, column, pipelines etc. to the extent possible. The civil area drawings shall be referred for this.
- 4.1.4 The distance between two electrodes shall preferably not be less than twice the depth of electrode.
- 4.1.5 Electrodes shall preferably be located in a moist soil which has a fine texture, grain size and distribution. Wherever practicable the soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes and soil packed by watering and ramming as tight as possible.
- 4.1.6 The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.
- 4.1.7 The disconnect facility shall be provided for the individual earth electrode to check its earth resistance periodically.
- 4.1.8 Location of earth electrode shall be marked by permanent markers for easy identification. Top cover of electrode shall be serial numbered and also marked on "As built drawing" for reference.
- 4.1.9 Each earth plate shall be connected to main earth grid by two vertical risers (earth strip) from earth grid. Where earth plates are not indicated on the drawing, vertical riser (earth strip) from earth grid upto 300 mm above finish level of pavement/floor shall be provided as per layout.

4.2 Earthing Network

- 4.2.1 This consists of main earth conductor (grid conductor) forming a closed ring network with required number of earth electrodes to provide a common earth path for electrical devices and metallic structures. From each earth electrode two distinct connections shall be made to the main earth conductor.
- 4.2.2 The earth conductor shall be laid as indicated on the earthing layout drawing and exact route may be modified at site to suit site conditions.
- 4.2.3 Earthing conductors shall be buried in both longitudinal and transverse directions to facilitate the earthing of various equipments.
- 4.2.4 The reinforcement of pavement shall also be connected to the plant earthing grid by means of welding/clamping at an interval of 25m (max.).
- 4.2.5 Earth conductor running along lined trenches shall be firmly cleated on the structure surface using GI spacers and clamps at intervals of approximate 1000mm unless specified otherwise and also clamps shall be installed near to termination ends.
- 4.2.6 Earth conductor, in case laid underground, shall be at a depth of 300mm below finished pavement level.

- 4.2.7 Joints and tappings in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured.
- 4.2.8 All joints below grade shall be welded on all four sides and shall be suitably protected by giving two coats of bitumen and covering with hessian tape.
- 4.2.9 Earth strip laid above ground shall be welded across straight through joints and joints shall be suitably protected by giving two coats of bitumen. Welding shall be done with an overlapping of strip equivalent to double the width of the strip and all four sides (Three on top and one on bottom) shall be continuously welded.
- 4.2.10 Earth plates shall be provided for taking earth connections to different equipment. For this, earth strips (two nos.), welded to earth network, below ground shall be extended above grade level and connected to earth plate.
- 4.2.11 Earth Electrodes for lightning protection shall be dedicated. These shall be bonded atleast at two points below ground, with the main earthing network.

4.3 GI Pipe Sleeves

All GI Pipes shall be laid as per layout drawings for the purpose of taking electrical cables to electric Motor/Other equipment. Fabrication of various profiles shall be made by hydraulically operated bending machine (which is to be arranged by the contractor) and all the burrs in the pipes shall be removed. The number of bends made in each pipe length shall be restricted to one. GI Pipes, buried in soil shall have bitumen coating on the buried portion. Installation of GI Pipes shall be undertaken well before paving is done. GI lids or PVC bushes (size to suit pipe) shall be provided at both the ends of pipe. Pull wire (16 SWG steel wire) shall be provided inside pipe having length more than 3 meters for ease of cable pulling by other agency at later stage.

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SPECIFICATION FOR ELECTRICS OF PACKAGE EQUIPMENT

5	21.03.18	Revised and issued as standard specification	NV/GK	VKJ	BRB	RN
4	21.11.13	Revised and issued as standard specification	VB	VKJ	UAPJMS	SC
3	25.04.08	Revised and issued as standard specification	RS	IKG	JMS	VC
2	28.03.03	Revised and issued as standard specification	LS	AAN	VPS	SKG
1	03.04.97	Re-firmed and issued as standard specification	VCB	VPS	SG	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

AC	:	Alternating current
ASB	:	Auxiliary Service Board
BASEEFA	:	British Approval Service for Electrical Equipment's in Flammable Atmosphere
BIS	:	Bureau of Indian Standard
CEA	:	Central Electricity Authority
CIMFR	:	Central Institute of Mines and Fuel Research
CRCA	:	Cold Rolled Cold Annealed
CT	:	Current Transformer
DC	:	Direct current
DCDB	:	Direct Current Distribution Board
DGMS	:	Directorate General of Mines Safety
EIL	:	Engineers India Limited
ELCB	:	Earth Leakage Circuit Breaker
FM	:	Factory Mutual
GI	:	Galvanised Iron
HRC	:	High Rupturing Capacity
IE	:	Indian Electricity
IEC	:	International Electrotechnical Commission
IEEE	:	Institute of Electrical & Electronics Engineer
IP	:	Ingress Protection
KW	:	Kilo Watt
LCIE	:	Laboratoire Central des Industries Electriques
LDB	:	Lighting Distribution Board
LED	:	Light Emitting Diode
MCB	:	Miniature Circuit Breaker
MCC	:	Motor Control Centre
MCCB	:	Moulded Case Circuit Breaker
MDB	:	Main Distribution Board
MS	:	Mild Steel
MV	:	Medium Voltage
NEC	:	National Electric Code
NEMA	:	National Electrical Manufacturers Association
PCC	:	Power Control Centre
PMCC	:	Power- Cum- Motor Control Centre
PTB	:	Physikalisch- Technische Bundesanstalt
PVC	:	Poly Vinyl Chloride
SWG	:	Standard Wire Gauge
UL	:	Underwriter's Laboratories
V	:	Volt
VDE	:	Verband Deutscher Elektrotechniker

Electrical Standards Committee

Convener: Mr. B R Bhogal

Members: Ms. S. Anand
Mr. Parag Gupta
Ms. N S Bhattacharya
Mr M K Sahu
Mr. Saeed Akhtar (Inspection)
Ms. N. P. Guha (Project)

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1.0 SCOPE

- 1.1** This specification defines the requirements for design, engineering, shop-supervision, testing, supply, installation, testing and commissioning of electrical equipment and facilities for package equipment as covered in the job Specifications and data sheets.
- 1.2** For the purpose of this specification, the term 'package equipment' or 'package' denotes the complete integrated equipment to be supplied by the vendor comprising of all main and auxiliary equipment and associated local panel(s). The package equipment may be mounted on a common skid and/or installed on a common platform/area in the field, as specified elsewhere. Unless otherwise specified, the local panel shall include the power distribution to various loads along with the necessary controls, interlocks, indications and alarms. The local panel may either be mounted on the equipment skid/platform or separately but not very far from the main equipment.
- 1.3** It is not intended to cover all aspects of design but to indicate the basic requirements only. Vendor shall ensure that the design and installation on the skid is carried out as per good engineering practice, relevant codes and shall meet the requirements of safety, reliability, ease of maintenance and operation, aesthetics, scope of future expansion and maximum interchangeability of the equipment. Vendor shall acquaint himself with EIL standards, specifications, inspection test plans and field testing procedures as deemed necessary for proper execution of work.
- 1.4** Compliance with this specification and /or review of any of the vendor documents shall not relieve the vendor of his responsibility and his contractual obligations with regard to the completeness and satisfactory operation of the package.

2.0 STATUTORY REQUIREMENTS

- 2.1** All electrical equipment and the complete package shall meet the requirements of this specification and enclosed data sheets, in addition to the relevant Publications and Codes of Practice of Bureau of Indian Standards, EIL Standards, statutory regulations and good engineering practices. Complete system must also conform to the latest revisions of the following:
- a) CEA Regulations
 - b) Fire Insurance Regulations
 - c) Petroleum Rules and any other regulations laid down by Chief Controller of Explosives
 - d) The Factory Act and regulations laid down by Factory Inspectorate
 - e) Regulations laid down by local statutory authorities and Electrical Inspectorate
- 2.2** In case of imported equipments, standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian standards.
- 2.3** Vendor shall provide all assistance required for obtaining approvals from statutory authorities for materials, plant design/ drawings and complete installation.
- 2.4** Where Indian Standards do not exist, the relevant IEC/ BS/ VDE/ IEEE/ NEMA standards shall apply. Any other international standard may also be followed provided it is equivalent to or more stringent than the standards specified above.
- 2.5** In case of any contradiction between various referred standard / specification /datasheet and statutory regulations, most stringent requirement shall prevail. However owner's /EIL's decision in this regard will be final and binding.

3.0 GENERAL REQUIREMENTS

- 3.1** The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.
- 3.2** Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply.
- 3.3** Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/ spares to enable the end user for placement of order for spares and services.

4.0 SITE CONDITIONS

The equipment shall be suitable for continuous operation under the site conditions specified elsewhere. If not specifically mentioned, a design ambient temperature of maximum 40°C and an altitude not exceeding 1000 meters above mean sea level shall be considered for design purpose.

5.0 AREA CLASSIFICATION AND EQUIPMENT SELECTION

- 5.1** In case of storage, handling or processing of flammable materials within the battery limits of the package, area classification shall be carried out in line with IS: 5572, Indian Petroleum Rules, OISD standard-113 and DGMS guidelines where applicable. Where specified, the vendor shall furnish an 'Area Classification Drawing' indicating the zones of hazardous area and the applicable gas groups and temperature class (T rating). A list of flammable materials handled along with their properties like flash point, ignition temperature, explosive limits etc. shall also be furnished.
- 5.2** All the electrical equipment installed in hazardous areas shall be selected as per IS-5571, where applicable, and shall meet the requirements of relevant IS, IEC or NEC Standards and statutory regulations. However, electrical equipment for Zone-2 areas as a minimum shall be Ex 'e'/ Ex 'n' type as specified in data sheet, subject to the same being acceptable to the concerned statutory authorities. Increased safety (Type Ex 'e') equipment shall not be used in zone-1 areas. Ordinary industrial electrical equipment (even though permitted for use in Div.2 area as per NEC, USA) shall not be used in Zone-2 areas.
- 5.3** Electrical equipments for hazardous areas shall be certified by CIMFR/ ERTL/ Karandikar Lab or equivalent recognised independent test house of country of origin such as BASEEFA / ATEX/ LCIE / PTB / UL / FM. All equipment (indigenous and imported) shall also have valid statutory approvals i.e. PESO as applicable for use in the specified hazardous area. All indigenous flameproof equipments shall have valid BIS license and marking as required by statutory authorities
- 5.4** Electrical equipment for hazardous areas shall, generally, be suitable for gas groups IIA and IIB and temperature Class -T3 as applicable to the selected type of explosion protection. In case of hydrogen or hydrogen-hydrocarbon mixtures having more than 30% hydrogen, the gas group to be considered, shall be IIC.
- 5.5** All electric motors for agitators/mixers and metering pumps handling flammable materials and oil sump pumps, shall be flameproof (Type Ex-de), irrespective of the area being classified as Zone-2 or Zone-1.
- 5.6** In case the package equipment is to be located in a classified hazardous area, the same shall be indicated in the data sheet. In such a case, the offered equipment/package shall conform to whichever are the more stringent requirements, i.e. either due to materials being handled in the package or hazardous location in which package is installed.

6.0 EQUIPMENT SPECIFICATIONS

6.1 General Requirements

- 6.1.1 Specifications of all equipments/items, shall be furnished by the vendor for owner's review. However, certain minimum requirements for the major equipment are highlighted in this section.
- 6.1.2 All equipments and components shall be new and supplied by approved reputed manufacturers. Equipment requiring specialised maintenance or operation shall be avoided as far as possible and prototype equipment shall not be accepted. All equipments shall be complete with all necessary weather and anticorrosion protection including tropicalization to prevent damage due to climate, saline atmosphere, dust and corrosive vapours.
- 6.1.3 All equipment / material shall be protected for inland / marine transport, carriage at site and outdoor storage during transit and at site. Vendor shall be responsible for any damage to the equipment during transit. All packages shall be clearly, legibly and durably marked with uniform block letters giving the relevant equipment/ material details. Each package shall contain a packing list in a waterproof envelope.
- 6.1.4 All electrical components and equipment shall be sized to suit the maximum load under the most severe operating conditions. Rated voltage and frequency for the equipment shall be as indicated in enclosed data sheet.
- 6.1.5 All spares required for testing and commissioning the package shall be included by vendor in his scope of supply along with any special tools and tackles required for operation and maintenance.

6.2 Medium Voltage Motors

All medium voltage induction motors shall meet the requirements of the enclosed data sheet and EIL standard specification.

6.3 Power Distribution Board/Local Panel

- 6.3.1 This shall meet the requirements of data sheets and the following specific requirements.
- 6.3.2 Unless otherwise specified, the Power Distribution Board (PDB) may be incorporated as part of the Local Panel. The PDB shall include necessary power distribution equipment as applicable for the package equipment in addition to the associated controls, interlocks, indications and alarms. All motor starters shall be Direct-on-line type unless specified otherwise. In case of skid-mounted package equipment located in hazardous area, this panel shall also be installed on skid unless specified otherwise to install elsewhere in a safe area and the emergency stop push buttons to be provided near the equipment.
- 6.3.3 The panel shall be free standing, metal enclosed, dust and vermin proof type having minimum IP-42 degree of protection as per IS:13947 (Part-I). Panels for outdoor locations shall be weatherproof and supplied with a sheet steel kiosk or have internal and external doors with a rain shelter. The panel shall be designed to ensure maximum safety during operation, inspection, connection of cables and maintenance with energised busbars and without any special precautions. Ample space shall be provided inside the panel for any future addition of components in the panel. Power and control equipment shall be segregated inside the panel as far as practicable. The maximum height of the operating handle/switches shall not exceed 1800mm and the minimum height shall not be below 300mm.

- 6.3.4 The panel shall have an integral base frame and shall be sheet steel clad, fabricated out of 14 SWG CRCA sheet steel except that doors and covers may be of 16 SWG thickness. Necessary stiffeners shall be provided on doors / covers to prevent buckling. Large size doors and covers or those on which substantial relays/meters are mounted shall be fabricated out of 14 SWG CRCA sheet steel. All doors shall be hinged type, and all covers, doors, openings and gland plates shall be provided with neoprene gaskets. All hardware shall be corrosion resistant. All bolts, nuts and washers shall be secured against loosening and shall be made of galvanized, zinc passivated or cadmium plated high quality steel. Unless otherwise specified, the panel shall be suitable for bottom cable entry. The gland plate and cable glands shall be provided with the panel.
- 6.3.5 The panels, to be installed in a hazardous area, shall be of flameproof type Ex(de). All hazardous area equipment (except motors) shall be provided with cast light metal alloy enclosure.
- 6.3.6 Outgoing motor feeders shall be provided with switch, fuse, thermal overload relay with single phasing preventor or Motor Protection Relay and contactors for operation / safety isolation. All switches shall be load-break, heavy duty, air-break type with the operating handle mounted on the compartment door. Load break switch or MCCB shall be provided as main incoming switch complete with necessary mechanical interlocks, door interlock and defeat mechanism. Motor duty switches of AC-23 duty are also acceptable for outgoing motor feeders.
- 6.3.7 All fuses shall be non-deteriorating HRC cartridge, pressure fitted, link type. The contactors shall be air-break having AC-3 duty rating. Power contactors shall be rated for 100% of the maximum continuous current (e.g. rated current of motor) with a minimum rating of 16 Amperes with AC-3 duty. Contactor coils shall be suitable for 240V AC control supply.
- 6.3.8 Thermal overload relays shall be three element, positive acting, ambient temperature compensated type with adjustable setting range and built-in protection feature against single phasing which can operate even with 50% rated current. The relays shall be manual reset type with the reset push button provided on the cubicle door.
- 6.3.9 All indicating instruments shall be moving iron, flush mounting type of 72mm x 72mm square pattern of at least 1.5 accuracy class. LEDs provided for indication shall be cluster type with adequate brightness and minimum 2Nos LEDs chips per light. LEDs shall be connected in parallel and each LED chip having diameter not less than 3mm.
- 6.3.10 All control/selector switches shall be rotary back connected type having a cam-operated contact mechanism with knob type handle. Ammeter selector switches shall have contacts with make before break feature and additional locking facility shall be provided where required.
- 6.3.11 All motor feeders shall be provided with a STOP (red) push button and necessary START (green) push button and control/interlock switches. STOP push buttons shall have stay put feature and additional locking facility shall be provided where required.
- 6.3.12 Current transformer fed ammeter shall be provided for all motors, which may have variable loading or are required for process control. Feeders of 30 Amperes rating and above shall be provided with a CT and ammeter as a standard. The current transformers shall have an accuracy class 1.0 and instrument security factor not greater than 5.
- 6.3.13 All auxiliary devices for control, indication, measurement and alarm such as push buttons, control and selector switches, indicating lamps, metering instruments, annunciators etc. shall be mounted on the front door of the panel. Components requiring frequent inspection shall be easily accessible.

- 6.3.14 Control supply for the equipment shall normally be derived from an adequately sized transformer in the panel connected across two phases.
- 6.3.15 Adequate number of potential-free contacts shall be provided in the control panel for any remote control monitoring of the package equipment.
- 6.3.16 The panel shall be provided with an anti-condensation heater controlled through a switch fuse /MCB and an adjustable thermostat.
- 6.3.17 Inside the panel, the wiring for power, control and signaling circuits shall be done with BIS approved flame retardant PVC insulated copper conductors having 660/1100V grade insulation. Power wiring shall be sized for the nominal rating of associated switch/contacter. Minimum size of control wires shall be 1.5mm² copper for control circuits having fuse rating 10 amperes or lesser. For control circuits with higher fuse rating, minimum 2.5mm² copper conductor shall be used. Wiring for AC and DC circuits shall have different colour coding. Clamp type terminals shall be acceptable for direct termination of wires upto 10mm² size. For conductors larger than 10 mm², bolted type terminals with crimping lugs shall be provided. Each wire shall be terminated at a separate terminal. A minimum of 10% spare terminals shall be provided on each terminal block. All incoming and outgoing wires from the panel shall terminate on a suitable terminal strip/block. No such wire shall terminate/emanate directly from a panel component. However, in case power supply connections are to be looped, the loop wires are to be crimped together before fixing on terminal strip, such that loop continuity is not lost in case wire is removed from terminal strip.
- 6.3.18 An adequately sized earth bus shall be provided in the panel for connection to the main earth grid. All non-current carrying metallic parts of the mounted equipment shall be earthed. Doors and movable parts shall be earthed using flexible copper connections. The earth bus shall be provided with alternate bands of yellow and green. All earth connection wires shall be suitably colour coded.
- 6.3.19 Engraved nameplates shall be provided for all auxiliary devices mounted on the front of the panel. Nameplate or polyester adhesive stickers shall be provided for each equipment inside the panel.
- 6.3.20 All metal parts shall be thoroughly cleaned degreased and made free from rust. After application of the primer, the panel shall be spray painted with two coats of final paint. Colour shade of the final paint shall be RAL 7032 for indoor Electrical Equipment and RAL 7031 for Outdoor Electrical equipment, unless otherwise specified. Powder coating of panel shall also be acceptable.
- 6.3.21 At least one outgoing feeder of each rating and type shall be provided as spare in the PDB.

7.0 CABLING SYSTEM

- 7.1 Unless otherwise specified, a single point power supply shall be provided by the owner through an aluminium/copper conductor, PVC insulated, armoured cable terminated at the Power Distribution Board/Local Panel. The vendor shall provide all power and control cabling between the PDB/ Local panel and the package equipments.
- 7.2 Power and control cables for 415V system shall be of 1100V grade Fire retardant low smoke type PVC insulation with copper conductors up to 16mm² and aluminum conductors beyond 16mm², PVC inner sheath, armouring and overall PVC sheath as per IS: 1554 (Part-I). The conductor size shall be minimum 2.5mm² copper. All power and control cables shall have extruded inner and outer sheaths. Outer sheath of cables shall be black in colour and the minimum value of oxygen index shall be 29 at 27± 2 °C. In addition, suitable chemicals shall be added into the PVC compound of the outer sheath to protect the cable against rodent and

termite attack. Adequate derating factors shall be used for sizing the cables. At least one spare core shall be provided in all control cables. All cable / wire shall be BIS approved. XLPE insulation, if specified in the data sheet shall be provided for 1100V grade power and control cables instead of PVC.

7.3 All cabling on the equipment skid/platform shall be in GI cable trays/conduits. All cable trays and accessories shall be prefabricated and hot dip galvanised. The minimum amount of galvanising shall be 610g/m². All cables shall be identified close to their termination point by cable number punched on 2mm thick aluminium straps securely fastened to each cable. In case of control cables, all cores shall be identified at both ends by their terminal numbers using PVC ferrules as per interconnection diagrams. All equipments shall be supplied with double compression type nickel plated-brass cable glands and tinned copper lugs.

7.4 In case, PDB/Local Panel installed away from the equipment skid/platform, necessary cable trenches/trays between panel and equipment shall be in owner's scope, unless otherwise specified.

8.0 EARTHING SYSTEM

8.1 Earthing system design and installation shall generally be as per IS: 3043. One or more number of G.I. earth plates shall be provided for the package equipment depending upon its size. All metallic non-current carrying parts of electrical apparatus, current and potential transformer secondaries, structural steel, vessels etc. shall be connected by at least two distinct separate earth conductors to an earth plate. All earth plates shall be bonded together and shall have the provision for interconnection to owner's main earth grid at two points. Earth plates shall be of 360x80x10mm size and shall be provided with adequate number of tapped holes. Earth continuity bonding shall be provided across all pipe flange joints.

8.2 All hardware used for earthing installation shall be hot dip galvanised or zinc passivated. The amount of galvanizing shall be min. 610 g/m². Specially provided bolts, lugs and spring washers shall be used for all earthing connections of equipment.

8.3 Unless specified otherwise in data sheet, equipment earthing shall be as per standard equipment earthing schedule.

8.4 Earthing connections to equipment shall be made by means of bolts, lugs and spring washers provided specifically for this purpose.

9.0 LIGHTING SYSTEM

9.1 General lighting for area in which package is to be installed shall be provided by purchaser, unless specified otherwise in data sheet.

9.2 Any other lighting requirements such as Local panel lighting shall be provided by vendor and shall be with LED fixtures. Power for such local lighting shall be obtained from a suitable feeder in PDB/Local Panel. All lighting circuits shall have provision for isolation in both phases and neutral for packages to be installed in hazardous areas.

10.0 INSPECTION, TESTING AND COMMISSIONING

10.1 All equipment shall be tested and inspected at vendor's works before dispatch to ensure compliance with the relevant specifications and agreed quality assurance/ testing plan. The owner or his authorized representative may visit the works during manufacture of various electrical equipment / materials to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given full assistance to carry out the inspection. Purchaser's representative shall be given minimum two weeks' advance notice for witnessing the final testing. The minimum testing / inspection requirements for all

components /equipments shall conform to the requirements stipulated in applicable codes and standards. Test certificates including test records and performance curves etc. shall be furnished by the vendor.

- 10.2** Vendor shall submit the field testing procedures for purchaser's approval. Field tests as per the approved procedures shall be performed on the electrical system/ equipment before its being put into service. All test equipment required for this purpose shall be arranged by the vendor, in case testing and commissioning at site is included in his scope, and test reports shall be approved by the site-in-charge before acceptance of the complete package.

उच्च वोल्टेज केपेसिटर बैंकों के लिए

निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR HIGH VOLTAGE CAPACITOR BANKS

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4	01.05.2020	Revised and Reissued	JA	RS	RKS	SKS
3	21.11.2013	Revised and Reissued	MJ	RS	SCG	SC
2	29.06.2012	Revised and Reissued	RKP	HVJ	AKC	DM
1	24.12.2007	Revised and Re-issued	AKG	CRM	MVKK	VC
0	12.08.2002	Issued for implementation	RB	AKC	AKB	GRR
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
						Approved by

INSPECTION AND TEST PLAN FOR HIGH VOLTAGE CAPACITOR BANKS

Abbreviations

BIS	:	Bureau of Indian Standard	MTC	:	Material Test Certificate
CE	:	Carbon Equivalent	NEMA	:	National Electrical Manufacturers Association
DFT	:	Dry Film Thickness	PO	:	Purchase Order
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FM	:	Factory Mutual	PCB	:	Printed Circuit Board.
FLP	:	Flame Proof	QC	:	Quality Control
ITP	:	Inspection and Test Plan	TPI or TPIA	:	Third Party Inspection Agency
IP	:	Ingress Protection	EPC	:	Engineering Procurement Constuction
IC	:	Inspection Certification	UL	:	Under writer Laboratories
RVT	:	Residual Voltage Transformer	APFC	:	Automatic Power Factor Correction
MCCB	:	Moulded Case Circuit Breaker	MCB	:	Miniature Circuit Breaker
AC	:	Alternating Current	DC	:	Direct Current

Inspection Standards Committee

Convenor :	Mr. R.K. Singh		
Members :	Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar
	Mr. R. Muthuramalingam	Mr. Avdhesh Agrawal	Mr. Mahendra Mittal
	Ms. Arvind NP Singh (Electrical)		

INSPECTION AND TEST PLAN FOR HIGH VOLTAGE CAPACITOR BANKS

STANDARD SPECIFICATION NO.

6-81-1020 Rev. 4

Page 3 of 8

1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of High Voltage Shunt Capacitor Banks along with Series Reactor and RVT.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/Job specifications/Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS.

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	Procedures	--	--	--	--	--	--
2.0	Material Inspection						
2.1	Incoming material : 1. Capacitor Container, dielectric material polypropylene, Non PCB Impregnation material, Discharge resistor, Bushings, Aluminum Plates and bus bar. 2. Series Reactors & RVT: Tank/Enclosure, Copper windings, Laminations, Paper Insulation, Lightning arrestor, relays, Frame, etc.	Physical, Chemical, Dielectric properties, Purity Review of Manufacturer's test certificates, As per PR & relevant specifications	100%	Material TC's/ Manufacturer's Test reports.	H	H	R

**INSPECTION AND TEST PLAN
FOR
HIGH VOLTAGE CAPACITOR BANKS**

STANDARD SPECIFICATION NO.

6-81-1020 Rev. 4

Page 4 of 8

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
	3. APFC System: Cabinets, MCCB, MCB, Control Units, Control Relays/Contactors, Capacitor Contactors, Indicators/Meters, Switches, Display Units etc 4. Other Bought out components: Circuit Breaker, Relays Lightning Arrestor, Isolator, Discharge resistors , Insulators, Bushings, Power Fuses etc.						
3.0	In process Inspection						
3.1	Fabrication of Tanks for series reactor and RVT, fabrication of Relay& Control Panels/Desk, Cable boxes.	<ul style="list-style-type: none"> • Visual • Dimensional • Paint shade and surface finish • Cable entry, Cable lugs, Cable Glands size, Lifting Hooks 	100%	Suppliers Test Records	--	H	R
4.0	Final Inspection						

**INSPECTION AND TEST PLAN
FOR
HIGH VOLTAGE CAPACITOR BANKS**

STANDARD SPECIFICATION NO.

6-81-1020 Rev. 4

Page 5 of 8

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	Capacitor Units (Acceptance Tests)	<ul style="list-style-type: none"> Visual arrangement/rating plate details Sealing test Test for capacitance measurement Insulation resistance DC Voltage test between terminals AC Voltage test between terminals and container for capacitor unit and banks. Measurement of tangent of dielectric loss angle ($\tan \delta$) Efficiency of Discharge Device. Checks for control panel, Relays etc. Verification of Make/Model of components. 	100% by supplier and on random basis by EIL/TPIA	Test Records / Inspection Witness Record	-	H	H

**INSPECTION AND TEST PLAN
FOR
HIGH VOLTAGE CAPACITOR BANKS**

STANDARD SPECIFICATION NO.

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Page 6 of 8

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	Series Reactor, RVT	<ul style="list-style-type: none"> Visual Dimensional Paint Shade/surface finish Oil leakage. Measurement of winding resistance Measurement of reactance/Inductance Measurement of Load loss at ambient temperature and Impedance Measurement. Dielectric tests (Separate Source, Induced Over voltage etc) Wet lightning Impulse test on Dry type reactor(If specified) Ratio check for RVT Dielectric tests for RVT 	100% by supplier and on random basis by EIL/TPIA	Test Records / Inspection Witness Record	H	H	H
4.3	APFC System	<ul style="list-style-type: none"> Visual Checks on Panel, BOM verification Wiring Check Functional check. HV and IR. Paint shade/Thickness 	100%	Test Records / Inspection Witness Record	H	H	H
4.4	Structural steel /Panel	<ul style="list-style-type: none"> Dimensional Galvanizing check Paint thickness (in panel) 	100% by supplier and on random basis by EIL/TPIA	Test Records / Inspection Witness Record	H	H	H
4.4	Type Tests	Capacitor Units: <ul style="list-style-type: none"> Thermal stability tests Capacitor loss tangent (tan δ) at elevated temperature 	1 Sample / Rating	Inspection witness record/Test certificates from Test agencies	-	H	H/R**

**INSPECTION AND TEST PLAN
FOR
HIGH VOLTAGE CAPACITOR BANKS**

STANDARD SPECIFICATION NO.

6-81-1020 Rev. 4

Page 7 of 8

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		<ul style="list-style-type: none"> Lightning impulse voltage test between terminals and container Short circuit discharge test Reactors/RVT(As applicable) :Temperature rise Lightning impulse test Switching Impulse(if specified) Short Circuit Withstand capability(If Specified) Q factor measurement Determination of errors as per accuracy 					
5.0	Painting						
5.1	Painting and Packing	<ul style="list-style-type: none"> Visual Suitable protection to prevent entry of foreign material. Proper packing to prevent any damage during transportation and storage. 	100%	Packing list / Supplier's Records	-	H	-
6.0	Documentation and IC						
6.1	Documentation and IC	<ul style="list-style-type: none"> Review of Internal Test Reports & MTCs and TCs for Components and Accessories as applicable. IC issuance. 	100%	Supplier's Test Records / Inspection Certificate	-	H	H

INSPECTION AND TEST PLAN FOR HIGH VOLTAGE CAPACITOR BANKS

STANDARD SPECIFICATION NO.

6-81-1020 Rev. 4

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** Witness if called for in job specifications. In such cases specified Type test will be considered as part of Acceptance Test.

Legends: H- Hold (Do not proceed without approval), Random 10%, R-Review, RW-Random witness, W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents
3. For EPC jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise

अग्निरोधक टेलीफोन प्रणाली
के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
FLAMEPROOF TELEPHONE SYSTEM

3.	20.05.2020	Revised and Reissued	JA	RS	RKS	SKS
2.	21.11.2013	Revised and Reissued	MJ	RS	SCG	SC
1.	29.06.2012	Revised and Reissued	AB	RJD	AKC	DM
0.	01.12.2008	Issued for implementation	RB	SKD	SKP	VC

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Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
						Approved by

INSPECTION AND TEST PLAN FOR FLAMEPROOF TELEPHONE SYSTEM

Abbreviations

ATEX	:	Atmosphere Explosive	:	MTC	:	Material Test Certificate
BIS	:	Bureau of Indian Standard	:	MFR	:	Manufacturer
BOM	:	Bill Of Material.	:	MOC	:	Material of Construction
BASEEFA	:	British Approval Services for Electrical Equipment in Flammable Area	:	PESO	:	Petroleum and Explosive Safety Environment
				IR	:	Insulation Resistance
CIMFR	:	Central Institute of Mining & Fuel Research	:	VDR	:	Vendor Data Requirement.
CE	:	Carbon Equivalent	:	NEMA	:	National Electrical Manufacturers Association
DGMS	:	Directorate General Of Mines Safety	:	PR	:	Purchase Requisition
ERTL	:	Electronic Regional Test Lab	:	PTB	:	Physikalisch Technische Bundesanstalt
EPC	:	Engineering Procurement Construction				
FM	:	Factory Mutual		PMI	:	Positive Material Identification
FLP	:	Flame Proof		PVC	:	Poly Vinyl Chloride
HT	:	Heat Treatment		QC	:	Quality Control
ITP	:	Inspection and Test Plan		TPI or TPIA	:	Third Party Inspection Agency
IC	:	Inspection Certification		UL	:	Under writer Laboratories

Inspection Standards Committee

Convenor : Mr. R.K.Singh

Members: Mr. Rajesh Sinha
Mr. R. Muthuramalingam
Ms. Arvind N P Singh (Electrical)

Mr. Himangshu Pal
Mr. Avdesh Agrawal

Mr. Chandrashekhar
Mr. Mahendra Mittal

1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Flameproof Telephone System

2.0 REFERENCE DOCUMENT

PO/PR/ Standards referred there in/Job specifications/Approved documents.

3.0 INSPECTION AND TEST REQUIREMENT

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	Procedures	--	--	--	--	--	--
2.0	Material Inspection						
2.1	Incoming Material like hooters, Beacons, Speakers, flashers, fasteners, telephone, Gaskets, Cable Glands, Enclosures etc.	<ul style="list-style-type: none"> Physical and Functional Checks Mechanical checks for Enclosures. 	100%	Test Certificates	H	H	R
3.0	In process Inspection						
3.1	Telephone assembly	Visual, Dimensional , Bill of Materials	100%	Supplier's Test Records	-	H	-
3.2	Enclosures	Pressure Test	100%	Supplier's Test Records	-	H	R
4.0	Final Inspection						


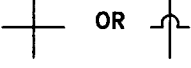
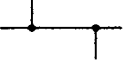
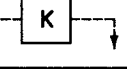
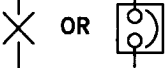






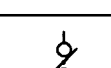

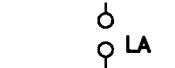


INSPECTION AND TEST PLAN
FOR
FLAMEPROOF TELEPHONE SYSTEM

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	Final Inspection	<ul style="list-style-type: none"> Physical, Dimensional and BOM Verification. Functional test/ Simulation test. Single digit/Multi digit dialing. IR test 	100%	Supplier's Records	-	H	R
4.2	Submission of Certificates & Documents	<ul style="list-style-type: none"> Certificate from testing agency like BASEEFA, FM/UL, ATEX, PTB, and CIMFR/ERTL etc. for suitability in specified hazardous area. Degree of protection certificate for housing, as per latest valid IS/IEC PESO/DGMS approval certificates Valid BIS license for Indigenous supply 	Samples	Certificates from test agencies	-	H	R
5.0	Painting						
5.1	Painting and Packing	<ul style="list-style-type: none"> Visual Suitable protection to prevent entry of foreign material. Proper packing to prevent any damage during transportation 	100%	Packing list / Supplier's Records	-	H	-
6.0	Documentation and IC						
6.1	Documentation and IC	<ul style="list-style-type: none"> Review of Suppliers Internal test reports Issuance of IC 	100%	Internal test reports and Inspection Certificate	-	H	H
6.2	Final Document submission	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include minimum 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents
3. For EPC jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.

	BUS
	CROSSING OF CONDUCTORS—NOT CONNECTED
	CONNECTIONS OF CONDUCTORS
	KEY INTERLOCK, K—KEY, ARROW TERMINATES AT DEVICE
	SF6 / VACUUM CIRCUIT BREAKER
	AIR CIRCUIT BREAKER
	DRAWOUT FEATURE
	CABLE GLAND
	AIR BREAK ISOLATOR/DISCONNECT SWITCH
	OIL IMMERSED ISOLATOR/DISCONNECT SWITCH
	FUSE
	AIR CIRCUIT BREAKER WITH INHERENT RELEASES
	DOUBLE BREAK ISOLATOR
	ISOLATOR WITH EARTH SWITCH
	LIGHTNING ARRESTOR
	CONTACTOR

6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
					Approved by	

Format No. 8-00-0001-F4 Rev.0

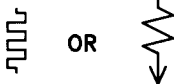
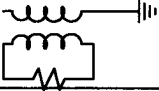


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	CURRENT TRANSFORMER
	SUMMATION CT
	INTERPOSING CT
	CORE BALANCE CURRENT TRANSFORMER
	POTENTIAL TRANSFORMER
	POWER/DISTRIBUTION TRANSFORMER—DESCRIPTION AS NOTED (PRIMARY DELTA CONNECTED, SECONDARY STAR CONNECTED. STAR POINT SOLIDLY EARTHED)
	TRANSFORMER WITH OLTC
	INSTRUMENT, A— AMMETER, V— VOLTMETER, W— WATTMETER, KWH— KILOWATT HOUR METER, F— FREQUENCY METER, pf— POWER FACTOR METER, HM— HOUR RUN COUNTER MF — MULTI FUNCTION METER
	AS— AMMETER SELECTOR SWITCH, VS— VOLTMETER SELECTOR SWITCH
	FREQUENCY RECORDER
	VOLTAGE RECORDER
	TRI VECTOR METER
	INDICATING LIGHT R— RED, W— WHITE, B— BLUE, Y— YELLOW G— GREEN AND A— AMBER
	415V, 3 PHASE POWER/WELDING RECEPTACLE
	BUS DUCT
	BATTERY

6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
Approved by						

	PERMANENT MAGNET GENERATOR
	GENERATOR—DESCRIPTION AS INDICATED
	INDUCTION MOTOR
	SYNCHRONOUS MOTOR
	MINIATURE CIRCUIT BREAKER (MCB)
	MINIATURE CIRCUIT BREAKER WITH EARTH LEAKAGE CIRCUIT BREAKER (MCB + ELCB)
	MOULDED CASE CIRCUIT BREAKER (MCCB)
	RECTIFIER
	INVERTER
	DC - DC CONVERTER
	STATIC VOLTAGE REGULATOR
	AUTOMATIC VOLTAGE REGULATOR
	PUSH BUTTON STATION / LOCAL CONTROL STATION
	PUSH BUTTON STATION WITH AMMETER
	PUSH BUTTON STATION WITH INDICATING LAMP
	CAPACITOR, VARIABLE CAPACITOR


6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
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	NEUTRAL GROUNDING RESISTOR
	NEUTRAL GROUNDING TRANSFORMER
	TWO WAY SELECTOR SWITCH
	THREE WAY SELECTOR SWITCH
(2)	TIME DELAY RELAY
(21)	DISTANCE PROTECTION RELAY
(25)	CHECK SYNCHRONISING RELAY
(27)	27 - UNDER VOLTAGE RELAY 27R - RESIDUAL VOLTAGE CHECK RELAY 27M - UNDER VOLTAGE RELAY (MOTOR PROTECTION) 27C - VOLTAGE HEALTHY CHECK RELAY
(32)	REVERSE POWER RELAY
(37)	LOW FORWARD POWER RELAY
(40)	LOSS OF EXCITATION RELAY
(46)	NEGATIVE PHASE SEQUENCE RELAY
(49)	THERMAL OVERLOAD RELAY
(50)	INSTANTANEOUS OVER CURRENT RELAY
(50N)	INSTANTANEOUS EARTH FAULT RELAY

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51	IDMTL OVER CURRENT RELAY
51G	STANDBY EARTH FAULT RELAY
51N	IDMTL EARTH FAULT RELAY
51V	VOLTAGE RESTRAINED IDMTL OVER CURRENT RELAY
59	OVER VOLTAGE RELAY
60	NEUTRAL DISPLACEMENT RELAY
63TX	AUX. RELAY FOR TRANSFORMER TROUBLE/TRIP
64F	ROTOR EARTH FAULT RELAY
64G 1,2	STATOR EARTH FAULT MAIN AND BACKUP RELAY
64R	RESTRICTED EARTH FAULT RELAY
67	DIRECTIONAL OVER CURRENT RELAY
67N	DIRECTIONAL EARTH FAULT RELAY
78	OUT OF STEP RELAY
80	CONTROL SUPPLY SUPERVISION RELAY
81	UNDER FREQUENCY / df/dt RELAY
86	LOCKOUT RELAY

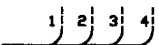
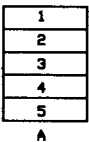
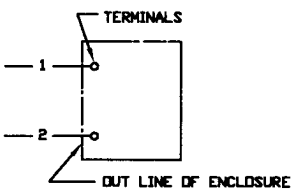









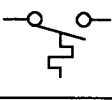
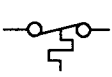
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(87CH)	CHECK DIFFERENTIAL RELAY
(87F)	DIFFERENTIAL RELAY F- FEEDER, G- GENERATOR, T- TRANSFORMER, M- MOTOR, GT- GENERATOR+TRAFORMER COMBINED
(95)	TRIP CIRCUIT SUPERVISION RELAY
(97)	PT MONITORING RELAY
(98)	DEAD BUS RELAY
(99)	OVERFLUXING RELAY
(MPR)	MOTOR PROTECTION RELAY
(ELR)	EARTH LEAKAGE RELAY
	THERMAL OVERLOAD RELAY

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	GROUPING OF CONDUCTORS, LINE BEND INDICATES DIRECTION OF CONDUCTOR JOINING CABLE, NUMERAL INDICATES WIRE NUMBER	
	TERMINAL BLOCK 'A', NUMERAL INDICATES TERMINAL NUMBER	
	WIRES DESIGNATED 1 & 2 ARE CONNECTED TO TERMINALS OF AN APPARATUS	
	HOOTER	H - HORN S - SIREN LSP - LOUDSPEAKER
	RELAY COIL, 2 - INDICATES RELAY NUMBER	
	BREAK CONTACT DELAYED BREAK	
	MAKE CONTACT DELAYED MAKE	
	BREAK CONTACT DELAYED MAKE	
	MAKE CONTACT DELAYED BREAK	
	OPEN CONTACT - THE POSITION OF THE CONTACT IN A RELAY IS SHOWN WITH COIL DE-ENERGISED	
	CLOSED CONTACT - THE POSITION OF THE CONTACT IN A RELAY IS SHOWN WITH COIL DE-ENERGISED	
	MOTOR, 3 PHASE	
	NORMALLY OPEN	TEMPERATURE ACTUATED SWITCH
	NORMALLY CLOSED	

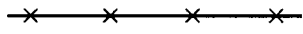
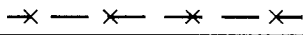
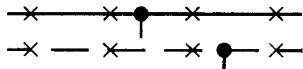






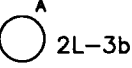
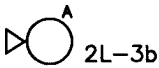
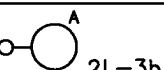
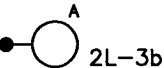
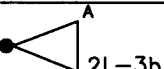
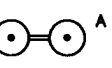

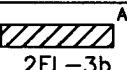

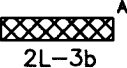
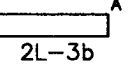



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	HELD CLOSE	LIMIT SWITCH
	HELD OPEN	
	NORMALLY OPEN (OPEN ON LOW PRESSURE)	VACUUM/ PRESSURE SWITCH
	NORMALLY CLOSE (CLOSED ON LOW PRESSURE)	
	PUSH BUTTON - CLOSING, SINGLE CIRCUIT, MOMENTARY OR SPRING RETURN	
	PUSH BUTTON - OPENING, SINGLE CIRCUIT, MOMENTARY OR SPRING RETURN	
	PUSH BUTTON, TWO CIRCUIT, MOMENTARY OR SPRING RETURN	
	PUSH BUTTON, TWO CIRCUIT, MAINTAINED OR NON-SPRING RETURN	
	SEMICONDUCTOR DIODE	
	SILICON CONTROL RECTIFIER	
	FULL WAVE RECTIFIER	
	FUSE	
	EMERGENCY STOP (MUSHROOM HEAD)	
	STAY PUT EMERGENCY STOP (MUSHROOM HEAD) PUSH BUTTON WITH RESETTING FEATURE	
	EARTH CONNECTION	

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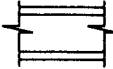
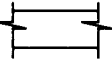
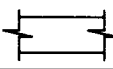
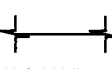
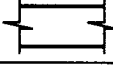
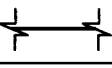




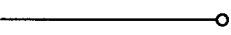
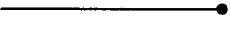
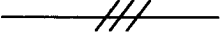











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	EARTH CONDUCTOR-EXPOSED] SIZE AS SHOWN OR SPECIFIED ON PLANS
	EARTH CONDUCTOR-BURIED	
	EARTH STRIP / WIRE TAP, SIZE AS SHOWN OR SPECIFIED ON PLANS	
	EARTH ELECTRODE IN TEST PIT	
	DIRECTLY BURIED EARTH ELECTRODE	
	EARTH PLATE	
	LIGHTNING ARRESTOR	
	POLE MOUNTED LIGHTING FIXTURE (IN ELEVATION)	
	LIGHTING FIXTURE (IN ELEVATION)	
	CEILING MOUNTED LIGHTING FIXTURE	
	BRACKET MOUNTED LIGHTING FIXTURE	
	POLE MOUNTED LIGHTING FIXTURE	
	POLE MOUNTED STREET LIGHTING FIXTURE	
	POLE MOUNTED FLOOD LIGHTING FIXTURE	
	DOUBLE OBSTRUCTION AVIATION LIGHTING FIXTURE	
		EMERGENCY LIGHTING FIXTURE
		
	FLUORESCENT FIXTURE	
	A - FIXTURE TYPE (AS PER DATASHEET FOR LIGHTING FIXTURE SCHEDULE) 2L - LIGHTING PANEL NO. 2, 3 - CIRCUIT NO., b - CONTROLLING SWITCH	
	LP - LIGHTING PANEL 2L - LIGHTING PANEL NO.	
	PP - POWER PANEL 2P - POWER PANEL NO.	
	ELP - EMERGENCY LIGHTING PANEL 2EL - EMERGENCY LIGHTING PANEL NO.	

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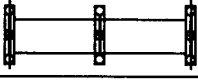

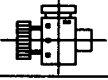



MDB-501 	MDB – MAIN DISTRIBUTION BOARD MDB-501 – MAIN DISTRIBUTION BOARD NO.
FLM-1 	FLOOD LIGHT MAST-LATTICE STRUCTURE FLM-1 – FLOOD LIGHT MAST NO.
HM-1 	HM – HIGH MAST HM-1 – HIGH MAST NO.
	5A, 240V SINGLE POLE SWITCH 2 – CIRCUIT NO., e – SWITCH NUMBER
	5A, 240V DOUBLE POLE SWITCH
	5A, 240V SINGLE POLE 2 WAY SWITCH
	15A, 240V SINGLE POLE SWITCH
	20A, DP MCB UNIT FOR WINDOW TYPE AC
	CEILING FAN
	AIR CIRCULATOR
	EXHAUST FAN
	5A, 240V, 3/5 PIN SOCKET/RECEPTACLE
	15/5A, 240V, 6 PIN SOCKET/RECEPTACLE
	10A, 240V, 3 PIN INDUSTRIAL TYPE SOCKET/RECEPTACLE
	20A, 240V, 3 PIN INDUSTRIAL TYPE SOCKET/RECEPTACLE
	5A, 24V, 3 PIN SOCKET/RECEPTACLE
	15A, 240V, 3 PIN SOCKET /RECEPTACLE
	415V, 3 PHASE POWER/WELDING RECEPTACLE
	PUSH BUTTON STATION
	LIGHTING JUNCTION BOX (3WAY)
	LIGHTING JUNCTION BOX (4WAY)

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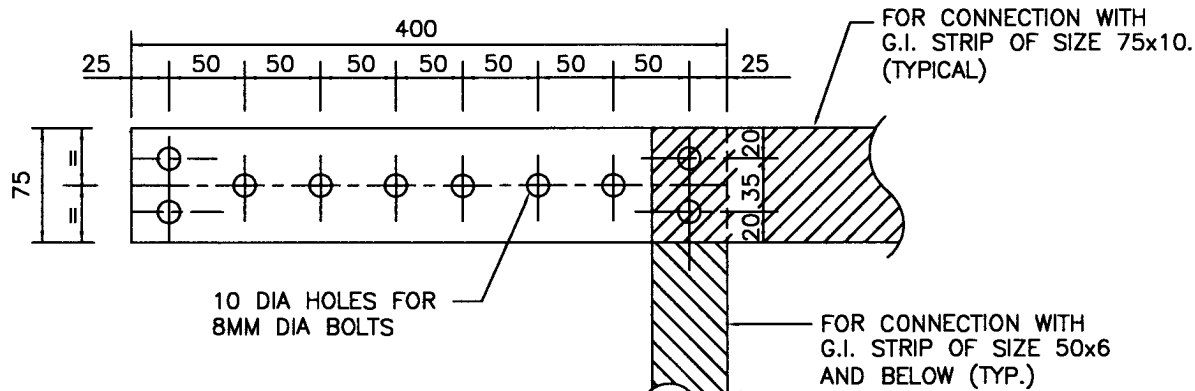
 OR 	LINED (RCC) CABLE TRENCH
 OR 	DIRECTLY BURIED CABLE TRENCH
 OR 	CABLE TRAY
 ERC-1	ERC – ELECTRICAL ROAD CROSSING ERC-1 – ELECTRICAL ROAD CROSSING NO.
 SCRC-1	SCRC – STREET LIGHTING AND COMMUNICATION/FIRE ALARM CABLES ROAD CROSSING SCRC-1 – STREET LIGHTING AND COMMUNICATION/FIRE ALARM CABLES ROAD CROSSING NO.
	CONDUIT / CABLE RUN EXPOSED
	CONDUIT / CABLE RUN CONCEALED OR EMBEDDED
	CONDUIT / CABLE BEND UP
	CONDUIT / CABLE BEND-DOWN
	CONDUIT RUN, NUMBER OF OBLIQUE LINES INDICATING NUMBER OF WIRES
	HOME RUN OF CIRCUIT TO PANEL/DISTRIBUTION BOX/JUNCTION BOX
 LS	LIMIT SWITCH
 VS	VIBRATION SWITCH
 FC	MULTISENSOR FIRE ALARM DETECTOR FC – FALSE CEILING, TC – TRUE CEILING, FF – FALSE FLOORING
 R	RESPONSE INDICATOR
 BG	MANUAL BREAK GLASS UNIT
 H	HOOTER H – HORN S – SIREN
 FAJB	FAJB – FIRE ALARM JUNCTION BOX JUNCTION BOX TJB – TELEPHONE JUNCTION BOX PAJB – PLANT COMMUNICATION JUNCTION BOX
 EXIT	EXIT SIGN
	END OF LINE RESISTANCE
	TELEPHONE

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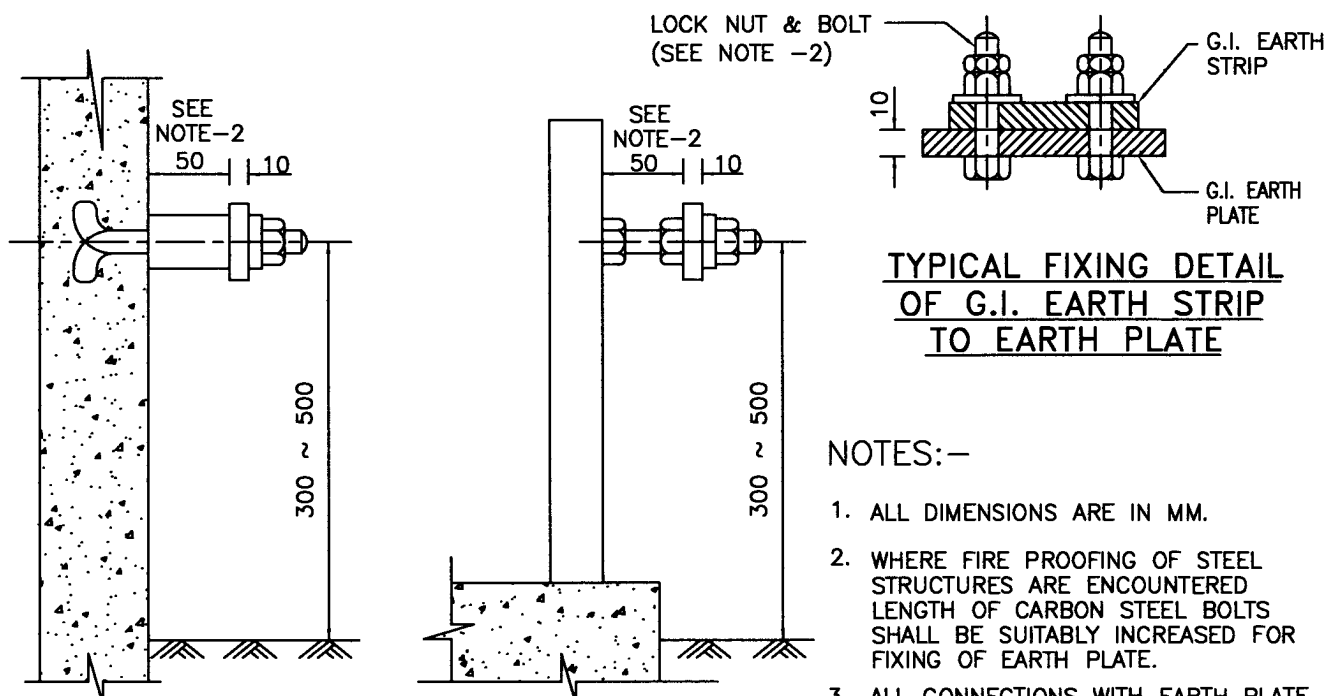
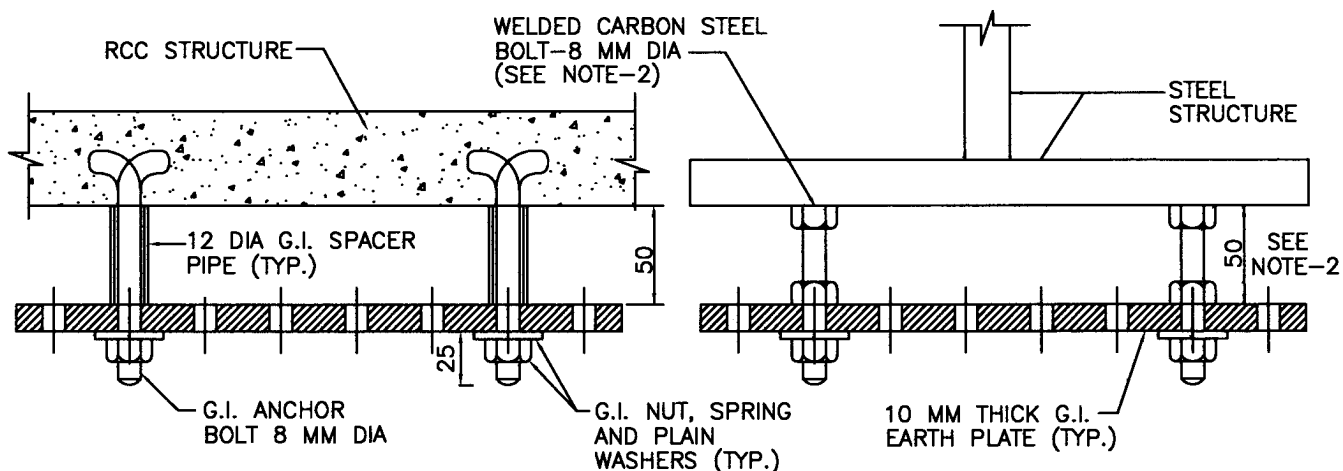
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	2 PIN SOCKET FOR TELEPHONE
	CIRCUIT BREAKER (SWITCHYARD)
	ISOLATOR (SWITCHYARD)
	GANTRY (SWITCHYARD)
	TRANSFORMER (SWITCHYARD)
	POTENTIAL TRANSFORMER (SWITCHYARD)
	CURRENT TRANSFORMER (SWITCHYARD)
	LIGHTNING ARRESTOR (SWITCHYARD)

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G.I. EARTH PLATE



TYPICAL FIXING DETAIL OF G.I. EARTH STRIP TO EARTH PLATE

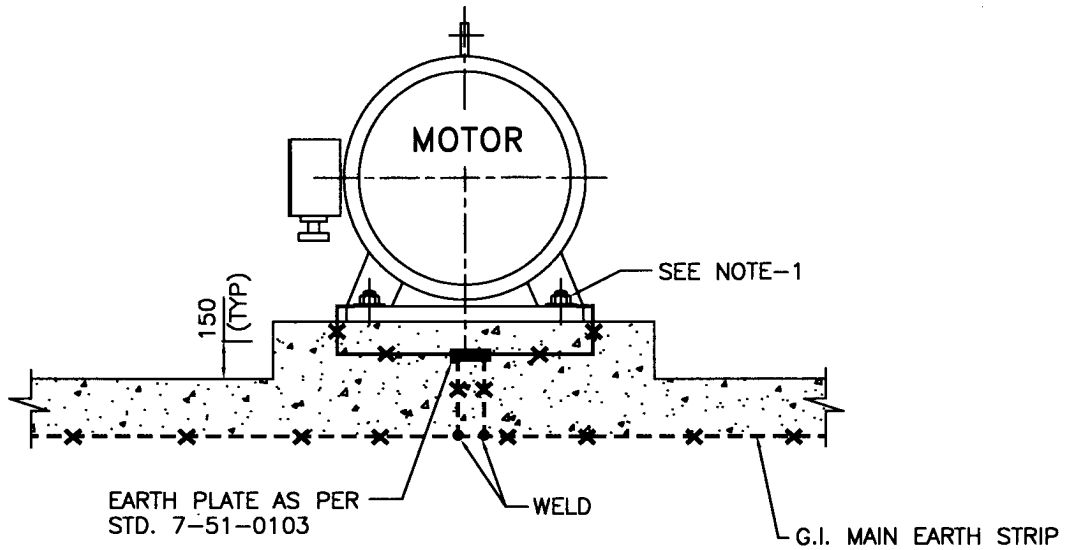
NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. WHERE FIRE PROOFING OF STEEL STRUCTURES ARE ENCOUNTERED LENGTH OF CARBON STEEL BOLTS SHALL BE SUITABLY INCREASED FOR FIXING OF EARTH PLATE.
3. ALL CONNECTIONS WITH EARTH PLATE SHALL BE MADE WITH 8MM DIA. G.I. BOLT, NUT, SPRING AND PLAIN WASHERS.
4. CRIMP TYPE CABLE LUGS SHALL BE USED FOR CONNECTION WITH G.I. WIRE ROPE/CU/AL CABLES.

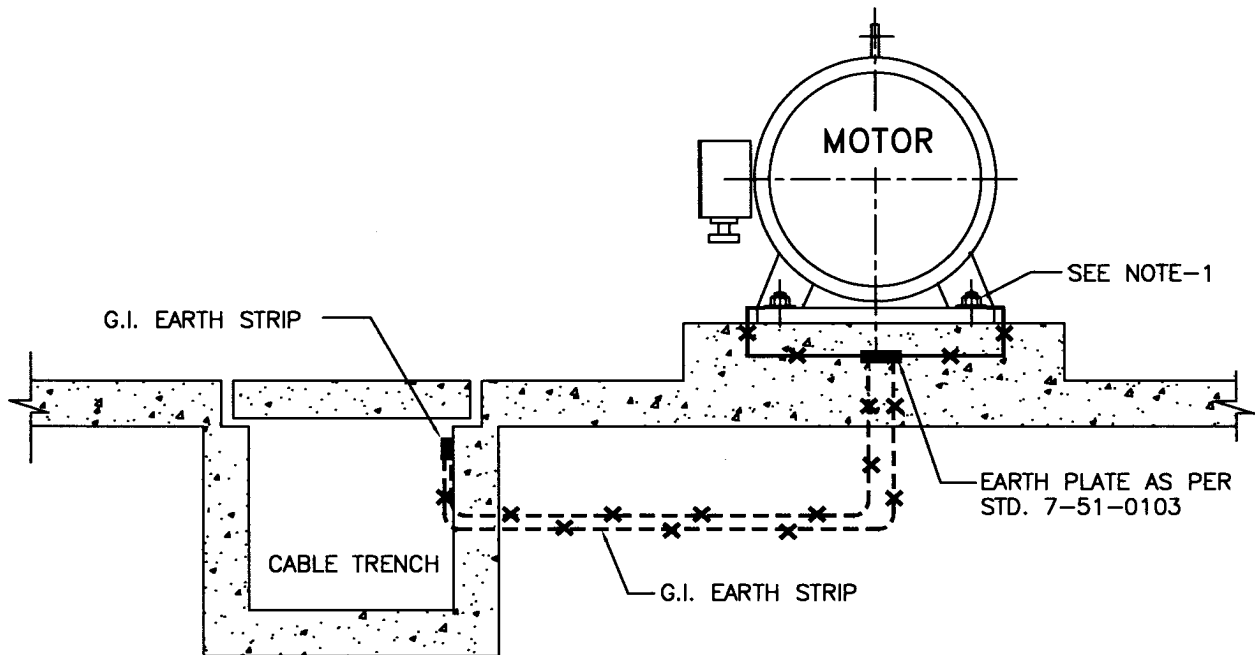
TYPICAL INSTALLATION OF EARTH PLATE ON R.C.C. STRUCTURES

TYPICAL INSTALLATION OF EARTH PLATE ON STEEL STRUCTURES

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DETAIL-1
CONNECTION WITH BURIED EARTH GRID

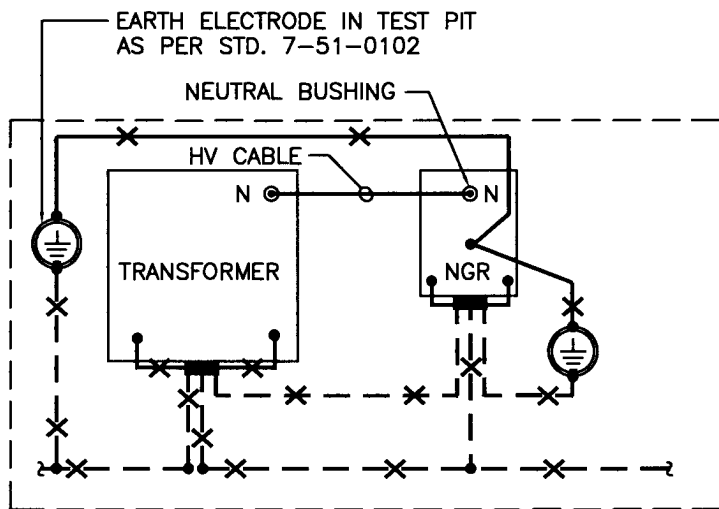
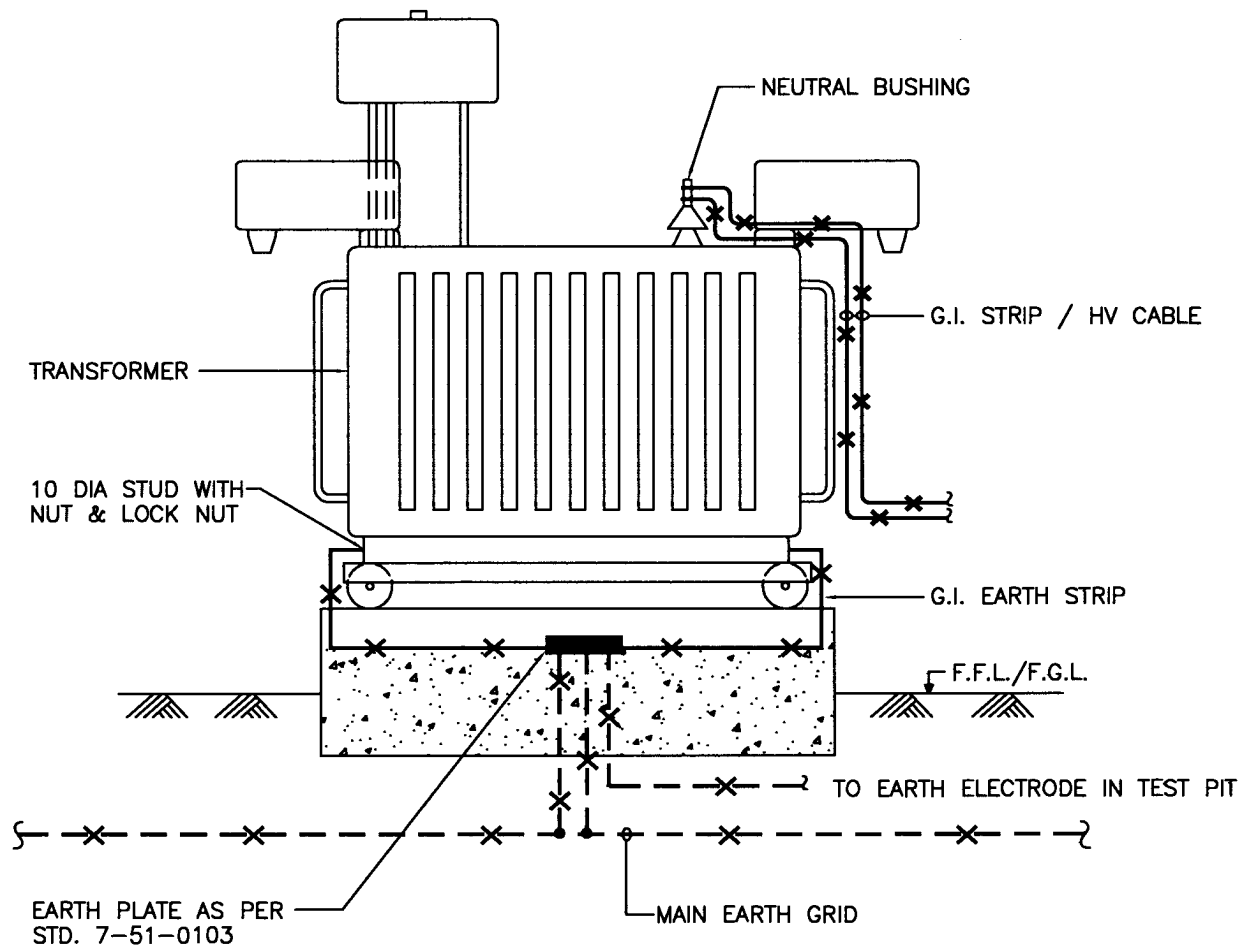


DETAIL-2
CONNECTION WITH EARTH GRID IN RCC TRENCH

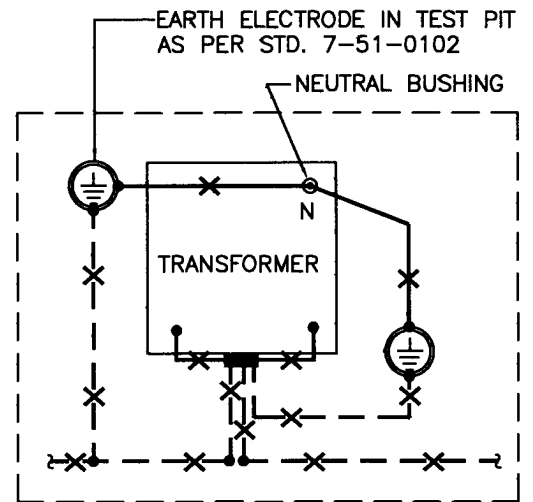
NOTE:-

1. MOTOR FOUNDATION BOLT SHALL NOT BE USED FOR EARTHING.
2. EARTHING OF P.B. STN. INSTALLED NEAR MOTOR FOUNDATION SHALL BE DONE BY TAPPING 8 SWG G.I. WIRE FROM EARTH PLATE.

6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
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LINE DIAGRAM
NEUTRAL EARTHING THROUGH NGR

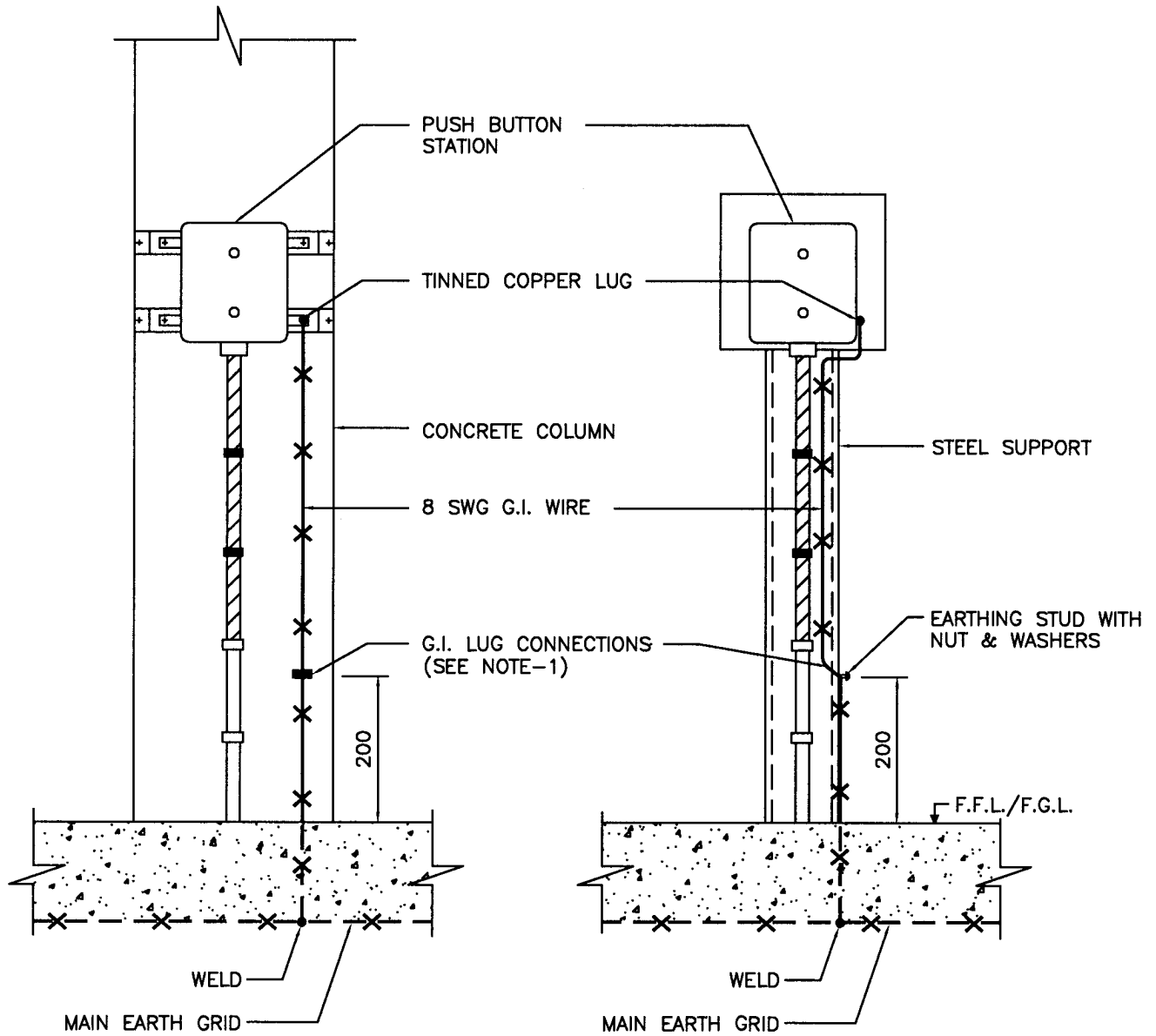


LINE DIAGRAM
SOLID NEUTRAL EARTHING

NOTES:—

1. EARTH ELECTRODE IN TEST PITS SHALL BE SO LOCATED THAT DISTANCE BETWEEN TWO PITS SHALL BE MINIMUM 6 METER.

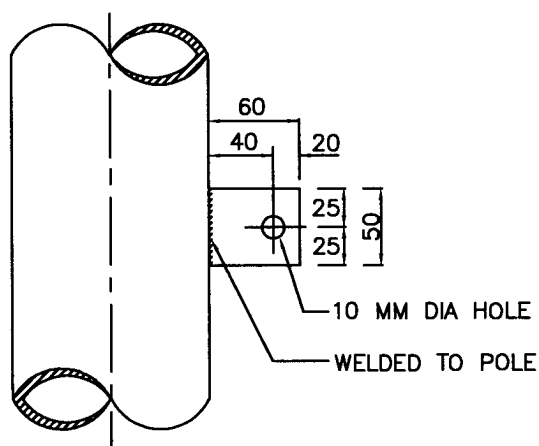
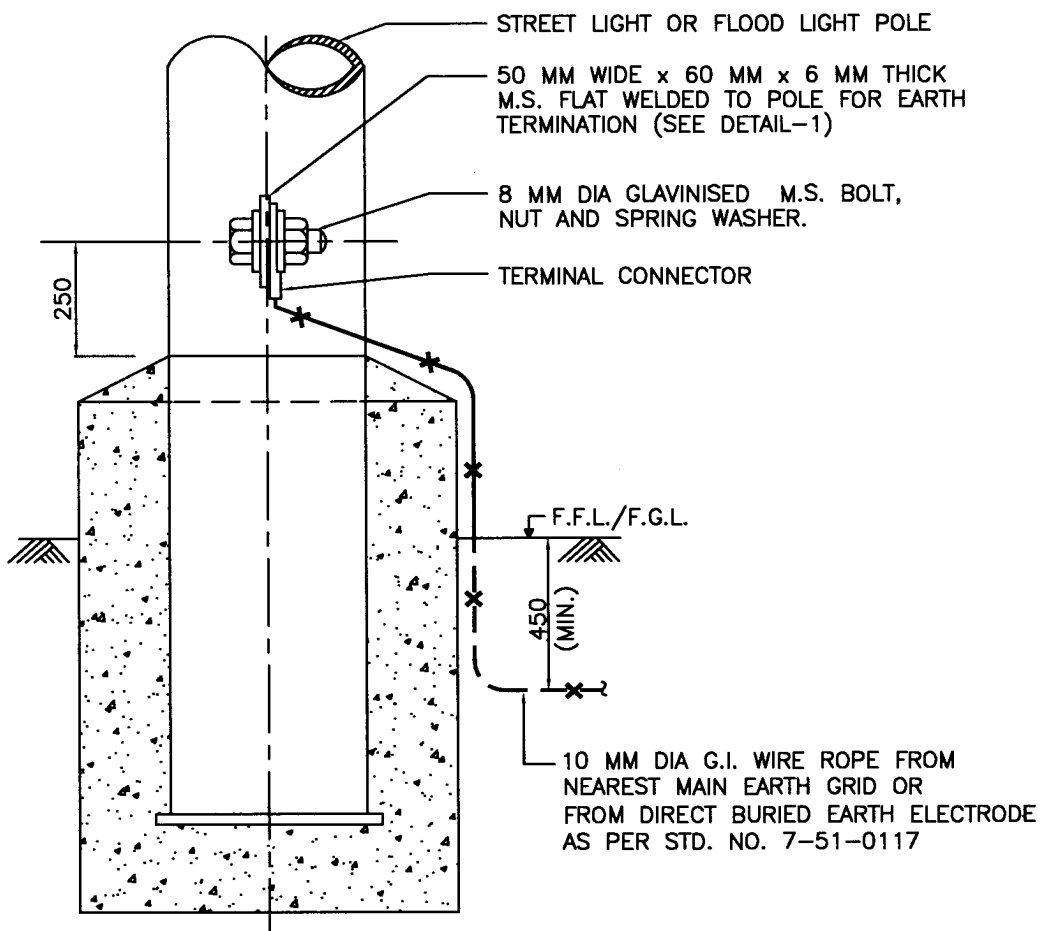
7	01.11.21	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
6	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
5	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
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NOTES:—

1. ALTERNATIVELY, CONNECTION SHALL BE TAKEN FROM THE NEAREST AVAILABLE EARTH PLATE

6	29.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
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DETAIL-1

NOTES:—

1. USE TWO WIRES ROPES IF VOLTAGE IN THE POLE JUNCTION BOX IS 415 VOLTS.

6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
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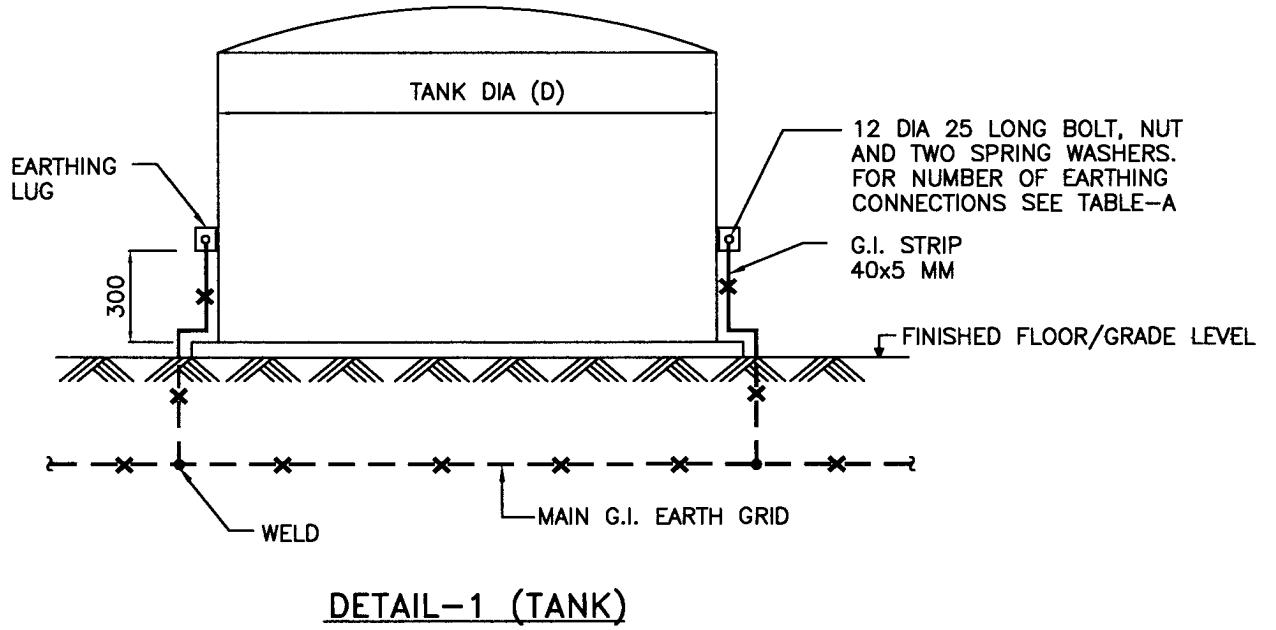
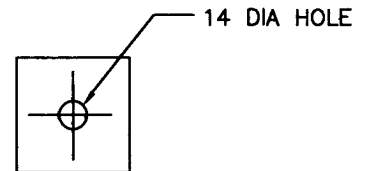


TABLE-A

TANK/SPHERE DIAMETER(D) (IN MTRS)	EARTHING CONNECTION
<15	2 AT 180°
15 ≤ D <25	3 AT 120°
25 ≤ D <35	4 AT 90°
35 ≤ D <45	5 AT 72°
45 ≤ D <55	6 AT 60°
55 ≤ D <65	7 AT 51.43°
65 ≤ D <75	8 AT 45°
75 ≤ D <85	9 AT 40°
85 ≤ D <95	10 AT 36°

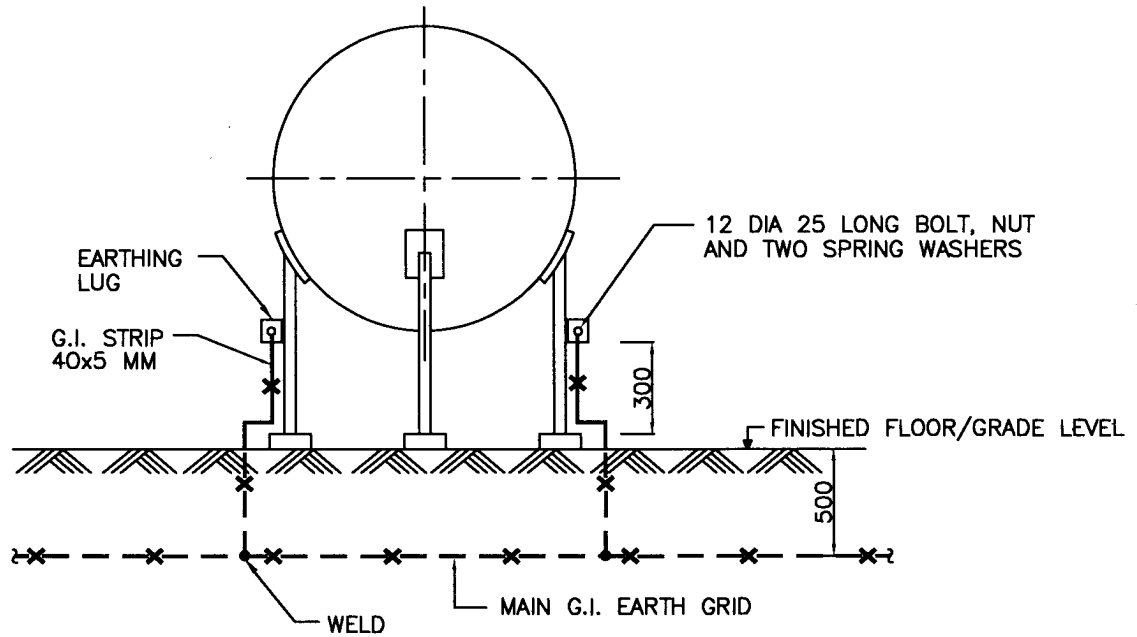


**EARTH LUG ON TANK
BY TANK FABRICATOR**

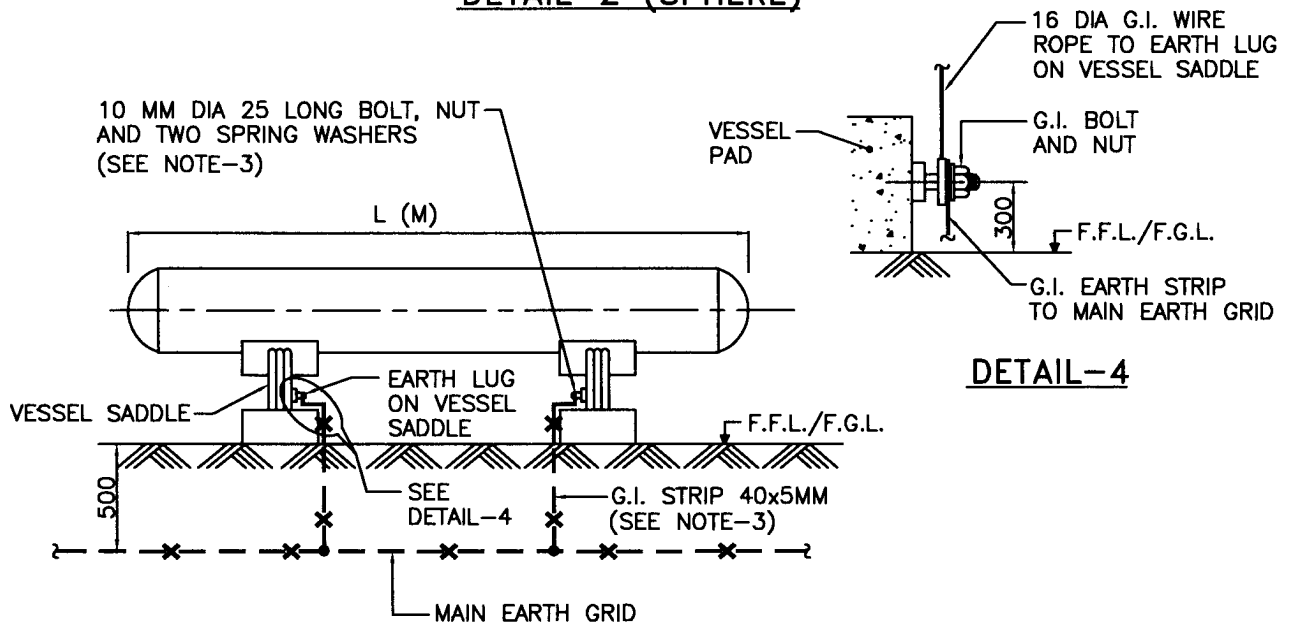
7	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
6	08.11.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
5	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
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DETAIL-2 (SPHERE)



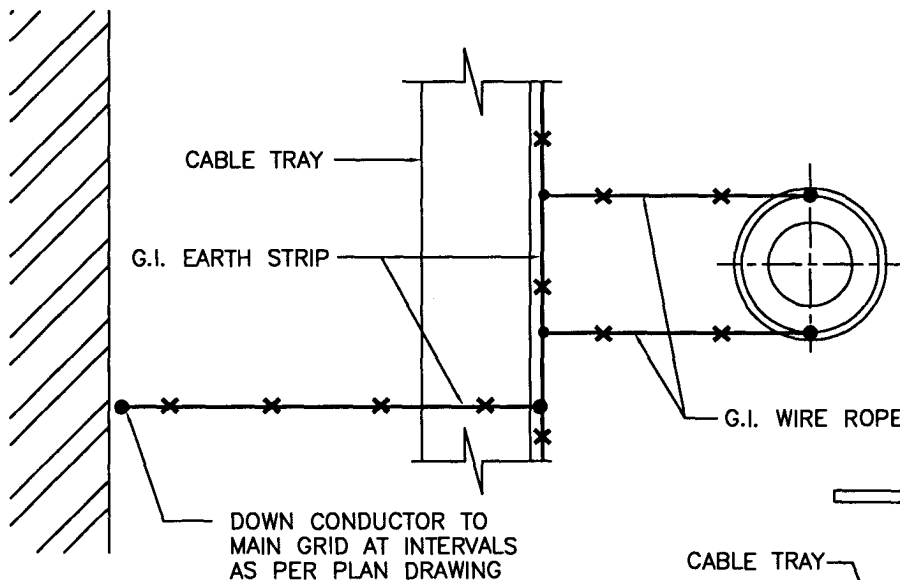
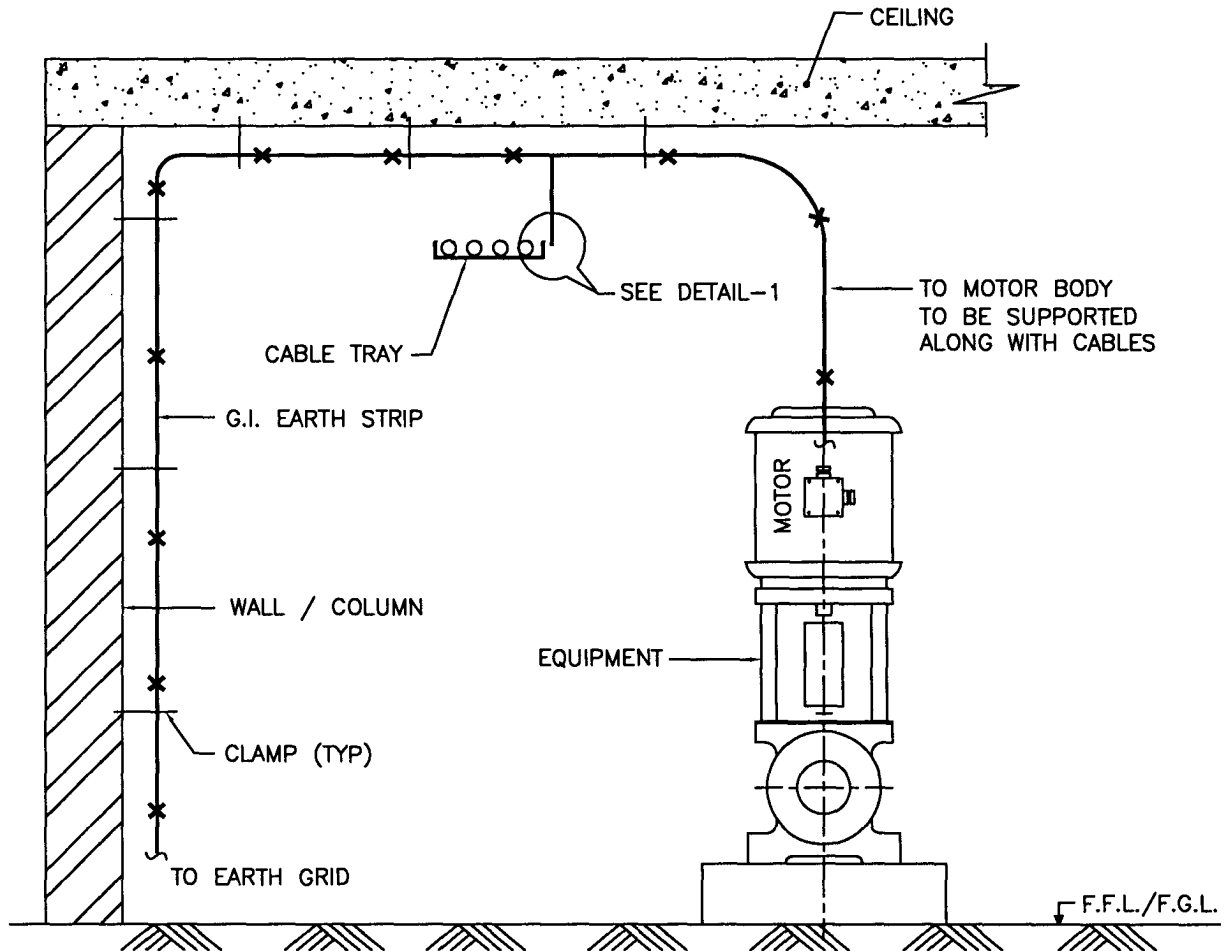
DETAIL-4

DETAIL-3 (HORIZONTAL VESSEL)

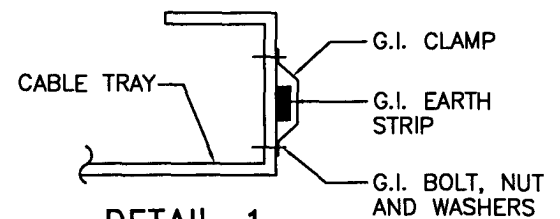
NOTES:-

- FOR VESSELS TWO NOS. OF DIAMETRICALLY OPPOSITE EARTHING LUGS WILL BE AVAILABLE ON LEG SUPPORTS OF EQUIPMENT FOR PROVIDING EARTH CONNECTION.
- ALL VESSELS SHALL HAVE TWO EARTH CONNECTIONS IN GENERAL.
- HORIZONTAL VESSEL OF LENGTH MORE THAN 20 METERS :-
TWO EARTH LUGS ARE PROVIDED ON EACH SADDLE OF HORIZONTAL VESSELS, ACCORDINGLY THERE SHALL BE TWO EARTH CONNECTIONS TO THE EARTH GRID FROM EACH SADDLE.

7	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
6	08.11.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
5	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
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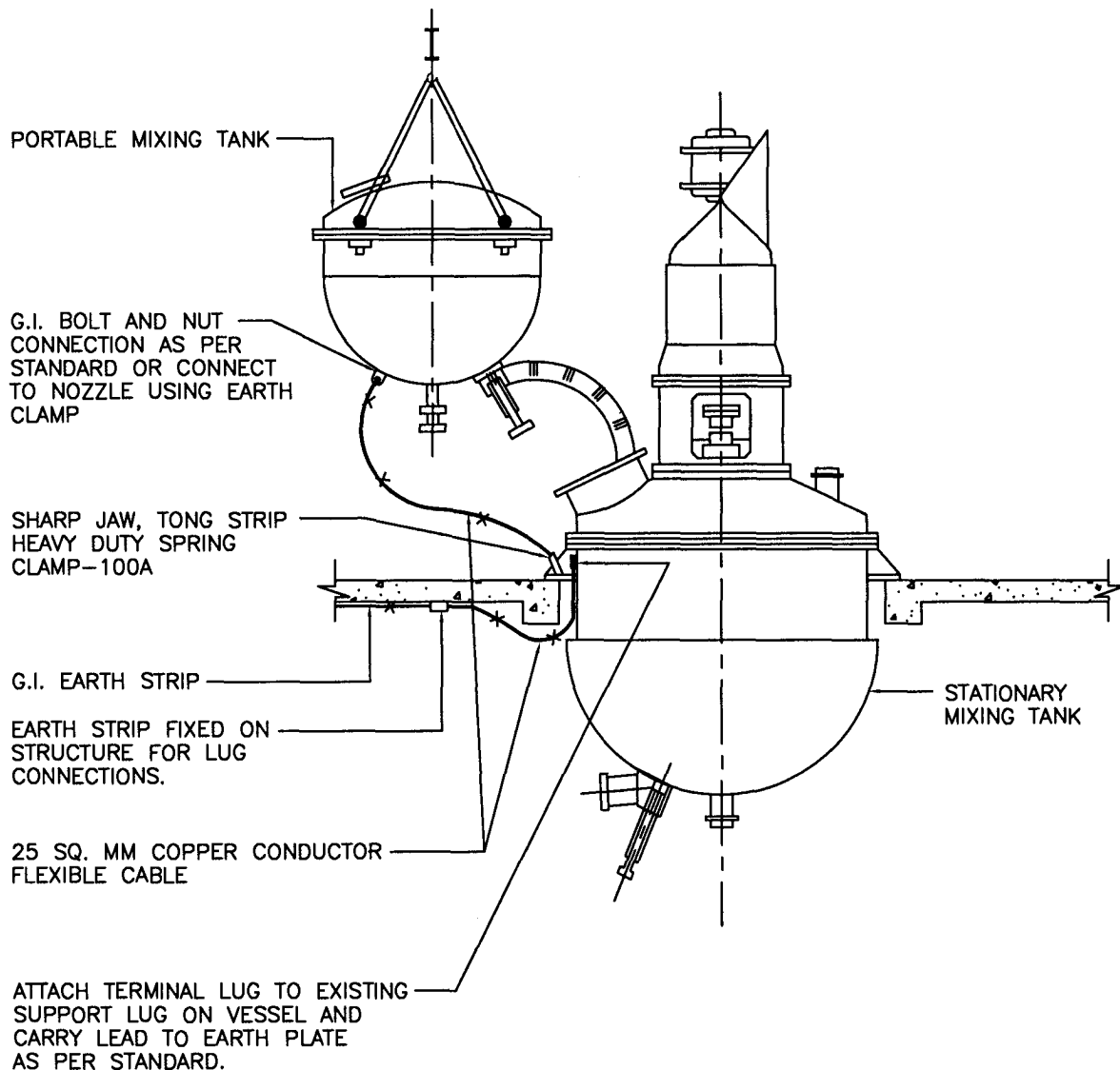


PLAN VIEW



DETAIL-1

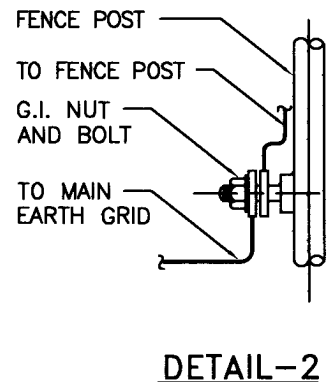
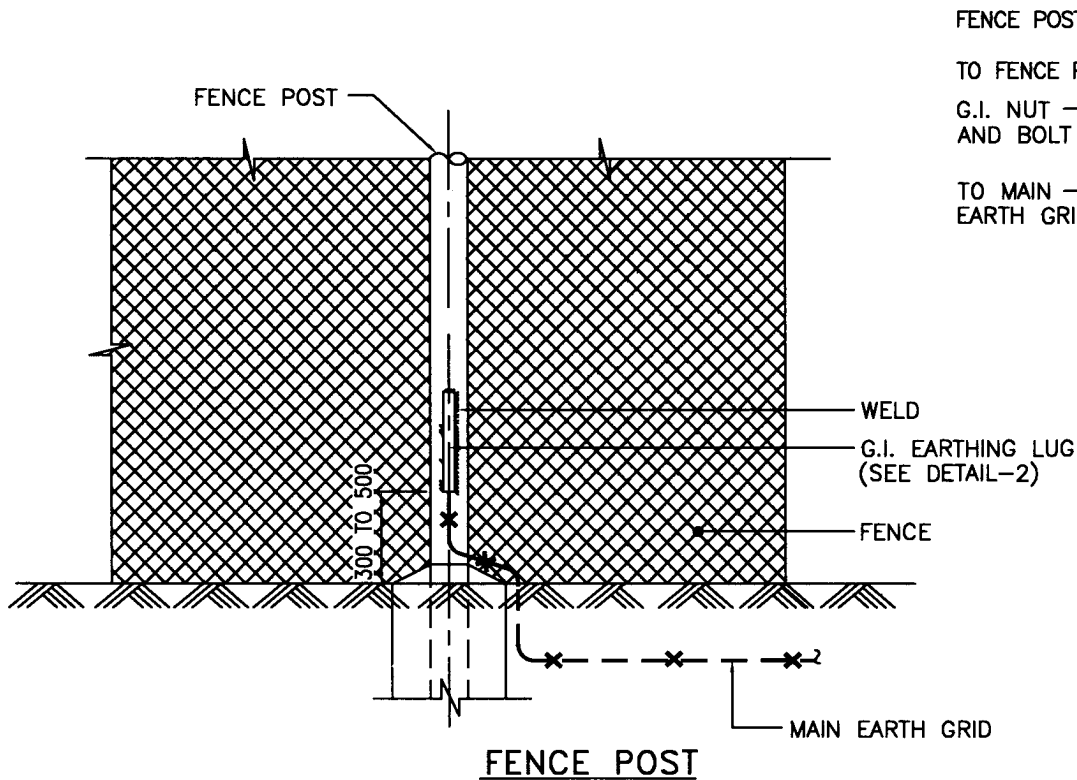
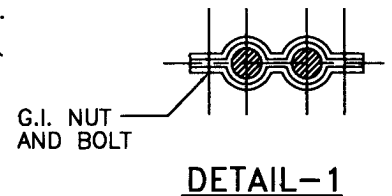
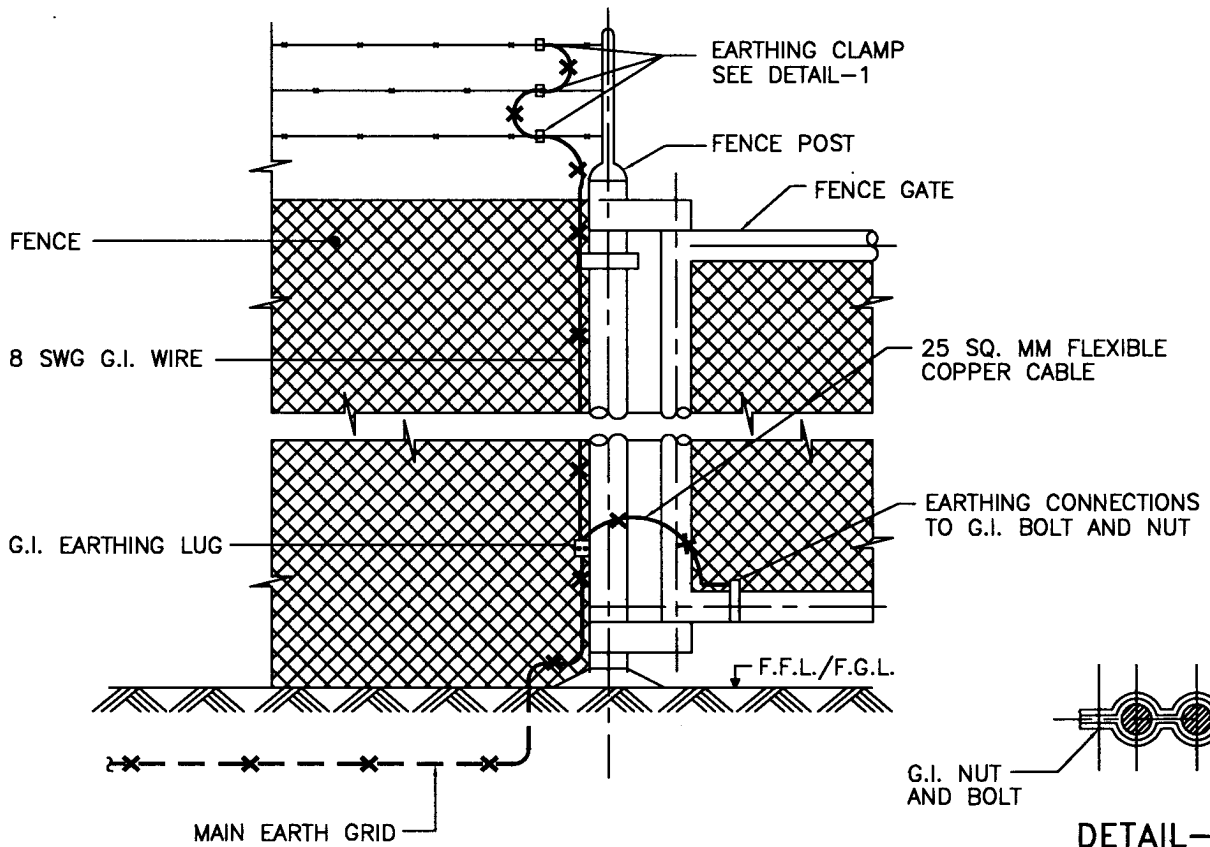
6	29.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
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NOTE:—

1. ALL PROCESSING EQUIPMENT SUCH AS MIXTURES, CHURNS, AUTOCLAVES, COLUMNS, CENTRIFUGES, FILTERS, PRESS PUMPS ETC. SHALL BE EARTHED, IF THESE ARE NOT IN DIRECT CONTACT WITH PROPERLY EARTHED STEEL MEMBERS.
2. ALL TEMPORARY EARTH CONNECTIONS SHALL BE MADE BEFORE OPENING THE VESSEL.

6	29.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM
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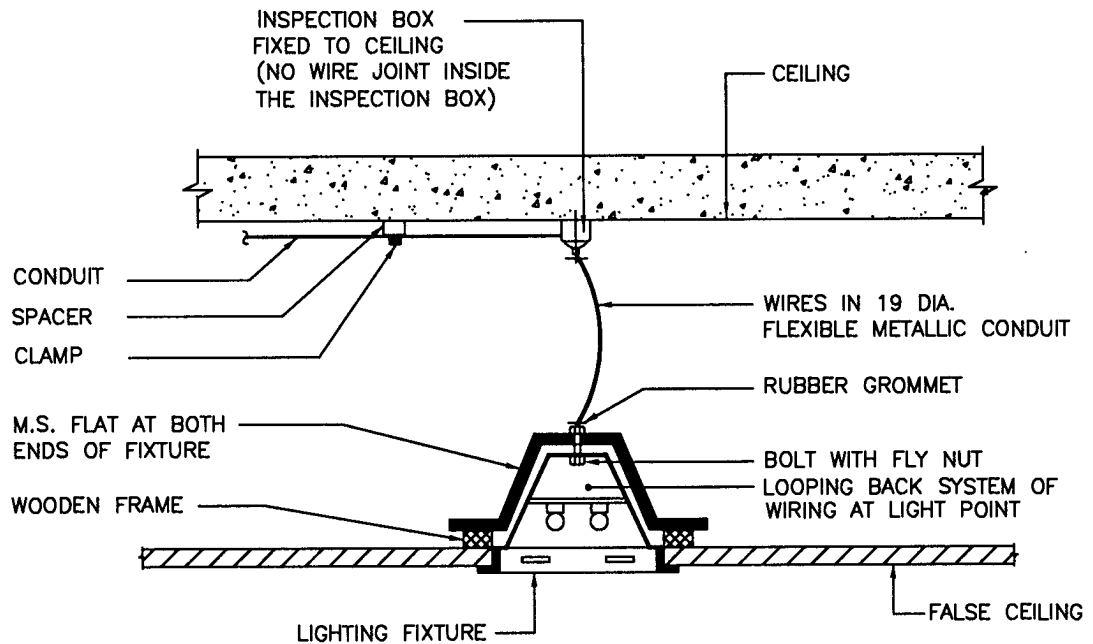
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TYPE OF EQUIPMENT	EARTH CONDUCTOR SIZE (SEE NOTE-1)
MOTORS UPTO 3.7KW	8 SWG SOLID G.I. WIRE
MOTORS FROM 5.5KW TO 30KW & WELDING RECEPTACLES	10 MM (3/8") DIA G.I. WIRE ROPE
MOTORS ABOVE 30KW INCLUDING HV MOTORS	16 MM (5/8") DIA G.I. WIRE ROPE/ 40x5 MM G.I. STRIP
BUILDING COLUMNS	40 x 5 G.I. STRIP
STORAGE TANKS (VERTICAL & HORIZONTAL)	40 x 5 G.I. STRIP
LOADING RACKS	40 x 5 G.I. STRIP
VESSELS & HEAT EXCHANGERS	40 x 5 G.I. STRIP
SMALL EQUIPMENT & INSTRUMENTS	8 SWG SOLID G.I. WIRE
LIGHTING, POWER & INSTRUMENT PANELS	10 MM (3/8") DIA G.I. WIRE ROPE
MAIN EARTH BUS / MV & HV SWITCH GEAR INTERCONNECTIONS/ POWER TRANSFORMER	AS SPECIFIED
EHV & HV SUB-STATIONS	AS SPECIFIED
PUSH BUTTON STATIONS	8 SWG SOLID G.I. WIRE
STREET LIGHT POLES	10 MM (3/8") DIA G.I. WIRE ROPE
LIGHTING TRANSFORMER	16 MM (5/8") DIA G.I. WIRE ROPE
PIPE RACK	40 X 5 G.I. STRIP
BONDING OF PIPE	25 SQ. MM INSULATED FLEXIBLE CU. CABLE
LIGHTNING PROTECTION	25 X 3 MM G.I. EARTH STRIP
CABLE TRAYS	40 X 5 G.I. STRIP

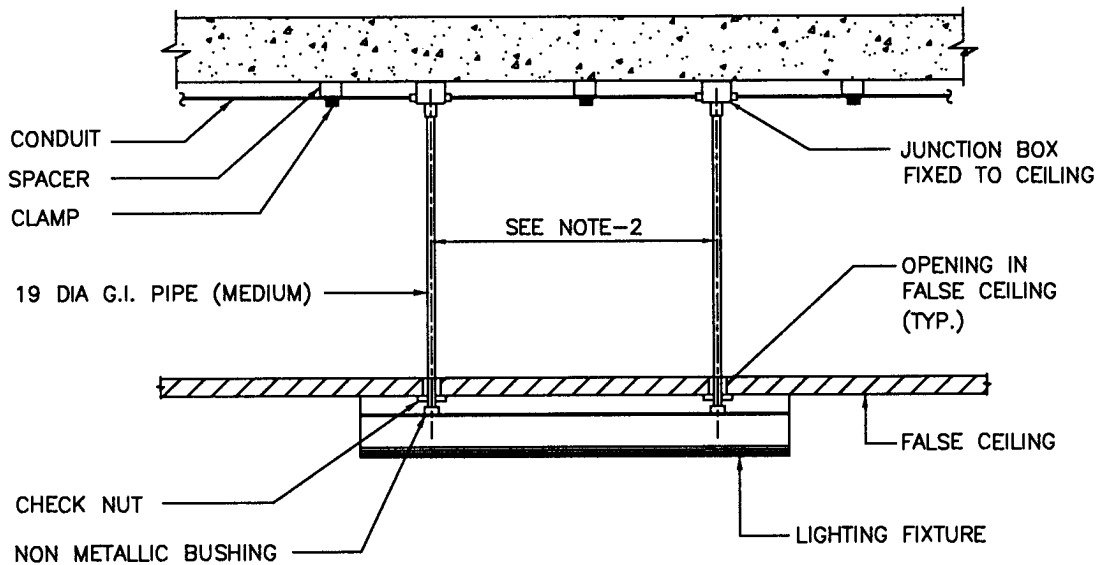
NOTE:—

- EARTH CONNECTIONS TO INDIVIDUAL EQUIPMENT FROM NEAREST EARTH PLATE / GRID MAY ALSO BE DONE ALTERNATIVELY USING ALUMINIUM / COPPER CONDUCTOR PVC/XLPE INSULATED CABLE OF SIZE AS MENTIONED IN PROJECT SPECIFICATION EQUIPMENT EARTHING SCHEDULE. CONNECTIONS SHALL BE MADE USING CRIMP TYPE OF LUGS.
- GREEN COLOUR SLEEVING (ABOUT 50 MM LENGTH) SHALL BE PROVIDED AT BOTH ENDS TO DENOTE EARTHING.

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DETAIL-1
RECESS MOUNTED FIXTURE
SUPPORTED ON WOODEN FRAME



DETAIL-2
FIXTURE MOUNTING BELOW FALSE CEILING

NOTES:-

- ALL DIMENSIONS ARE IN MM.
- SUSPENSION/FIXING CENTRES SHALL BE AS PER FIXTURE MANUFACTURER'S DETAILS.

6	29.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	21.10.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
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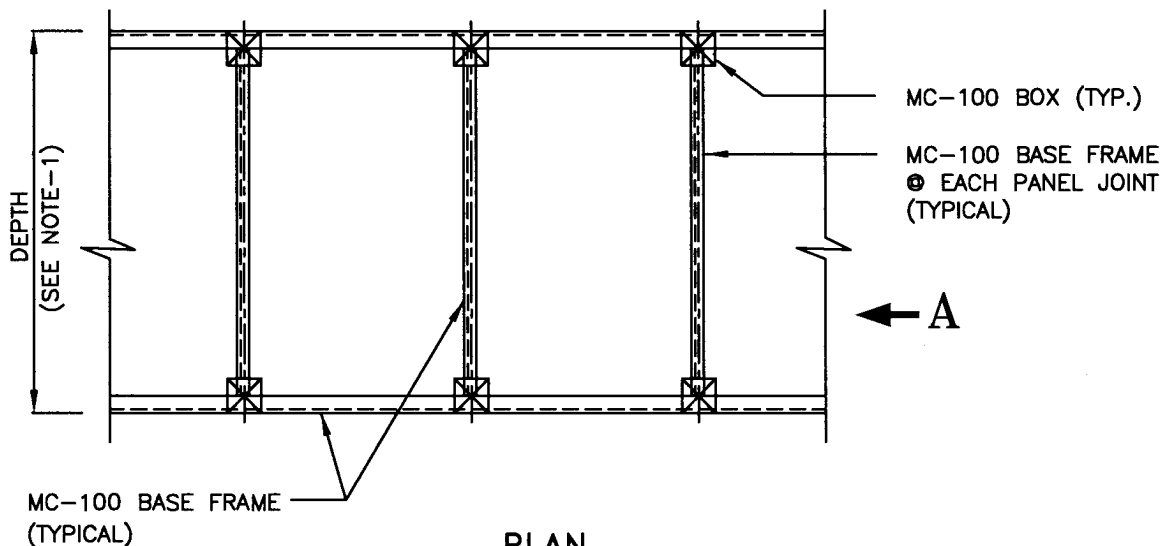
ELECTRICAL POWER IS THE MAINSTAY OF ANY CONSTRUCTION ACTIVITY. AT THE SAME TIME IT REQUIRES UTMOST CARE IN IT'S UTILISATION TO AVOID ACCIDENTS DUE TO ELECTRICAL SHOCK, FIRE INCIDENTS OR ELECTRIC SHORT CIRCUITS. EXPOSURE OF ELECTRICAL INSTALLATION TO ADVERSE ENVIRONMENTAL CONDITIONS INCREASE THE RISK OF SUCH ACCIDENTS. HENCE IT IS NECESSARY TO TAKE EXTRA PRECAUTIONS FOR SUCH INSTALLATIONS TO ENSURE SAFETY OF PERSONNEL AND EQUIPMENT. THIS STANDARD ADDRESSES THE SAFETY MEASURES REQUIRED TO BE ADOPTED FOR THE ELECTRICAL INSTALLATIONS BY ALL CONTRACTORS DURING CONSTRUCTION PHASE.

1. ALL ELECTRICAL CONNECTIONS/WORK FOR ELECTRICAL INSTALLATIONS SHALL BE CARRIED OUT AS PER PROVISIONS OF THE LATEST REVISION OF THE FOLLOWING CODES AND STANDARDS IN ADDITION TO THE REQUIREMENTS OF STATUTORY AUTHORITIES AND CEA REGULATIONS-2010.
OISD-STD-173 : FIRE PREVENTION AND PROTECTION SYSTEM FOR ELECTRICAL INSTALLATIONS.
OISD-STD-192 : SAFETY PRACTICE DURING CONSTRUCTION.
SP-30 (BIS) : NATIONAL ELECTRIC CODE.
THE INSTALLATION SHALL HAVE APPROVAL FROM CONCERNED STATUTORY AUTHORITIES.
2. ALL ELECTRICAL CONNECTIONS SHALL BE DONE BY AN ELECTRICIAN WITH VALID LICENCE AND TO THE SATISFACTION OF ENGINEER-IN-CHARGE.
3. ONE COMPETENT LICENCED ELECTRICIAN SHALL BE MADE AVAILABLE BY CONTRACTOR AT SITE ROUND THE CLOCK TO ATTEND TO THE NORMAL/EMERGENCY JOBS.
4. ALL SWITCH BOARDS/WELDING MACHINES SHALL BE KEPT IN WELL VENTILATED & COVERED SHED. THE SHED SHALL BE ELEVATED TO AVOID WATER LOGGING. NO FLAMMABLE MATERIALS SHALL BE USED FOR CONSTRUCTING THE SHED. ALSO FLAMMABLE MATERIALS SHALL NOT BE STORED IN AND AROUND ELECTRICAL EQUIPMENT/SWITCHBOARD. ADEQUATE CLEARANCES AND OPERATIONAL SPACE SHALL BE PROVIDED AROUND THE EQUIPMENT.
5. FIRE EXTINGUISHERS AND INSULATING MATS SHALL BE PROVIDED IN ALL POWER DISTRIBUTION CENTERS.
6. TEMPORARY ELECTRICAL EQUIPMENT SHALL NOT BE EMPLOYED IN HAZARDOUS AREAS WITHOUT OBTAINING SAFETY PERMIT.
7. PROPER HOUSE KEEPING SHALL BE DONE AROUND THE ELECTRICAL INSTALLATIONS.
8. ALL TEMPORARY INSTALLATIONS SHALL BE TESTED BEFORE ENERGISING, TO ENSURE PROPER EARTHING, BONDING, SUITABILITY OF PROTECTION SYSTEM, ADEQUACY OF FEEDERS/CABLES ETC.
9. ALL WELDERS SHALL USE HAND GLOVES IRRESPECTIVE OF HOLDER VOLTAGE.
10. MULTILINGUAL (ENGLISH, HINDI AND LOCAL LANGUAGE) CAUTION BOARDS, SHOCK TREATMENT CHARTS AND INSTRUCTION PLATE CONTAINING LOCATION OF ISOLATION POINT FOR INCOMING SUPPLY, NAME & TELEPHONE NO. OF CONTACT PERSON IN EMERGENCY SHALL BE PROVIDED IN SUBSTATIONS AND NEAR ALL DISTRIBUTION BOARDS/LOCAL PANELS.
11. OPERATION OF EARTH LEAKAGE DEVICE SHALL BE CHECKED REGULARLY BY PORTABLE ELCB/RCCB TESTER.
12. THE FOLLOWING DESIGN FEATURES SHALL BE ENSURED FOR ALL ELECTRICAL INSTALLATIONS DURING CONSTRUCTION PHASE.
- 12.1 EACH INSTALLATION SHALL HAVE A MAIN SWITCH WITH A PROTECTIVE DEVICE, INSTALLED IN AN ENCLOSURE ADJACENT TO THE METERING POINT. THE OPERATING HEIGHT OF THE MAIN SWITCH SHALL NOT EXCEED 1.5 M. THE MAIN SWITCH SHALL BE CONNECTED TO THE POINT OF SUPPLY BY MEANS OF ARMoured CABLE.
- 12.2 THE OUTGOING FEEDERS SHALL BE DOUBLE OR TRIPLE POLE SWITCHES WITH FUSES/MCBs. LOADS IN A THREE PHASE CIRCUIT SHALL BE BALANCED AS FAR AS POSSIBLE AND LOAD ON NEUTRAL SHOULD NOT EXCEED 20% OF LOAD IN THE PHASE.

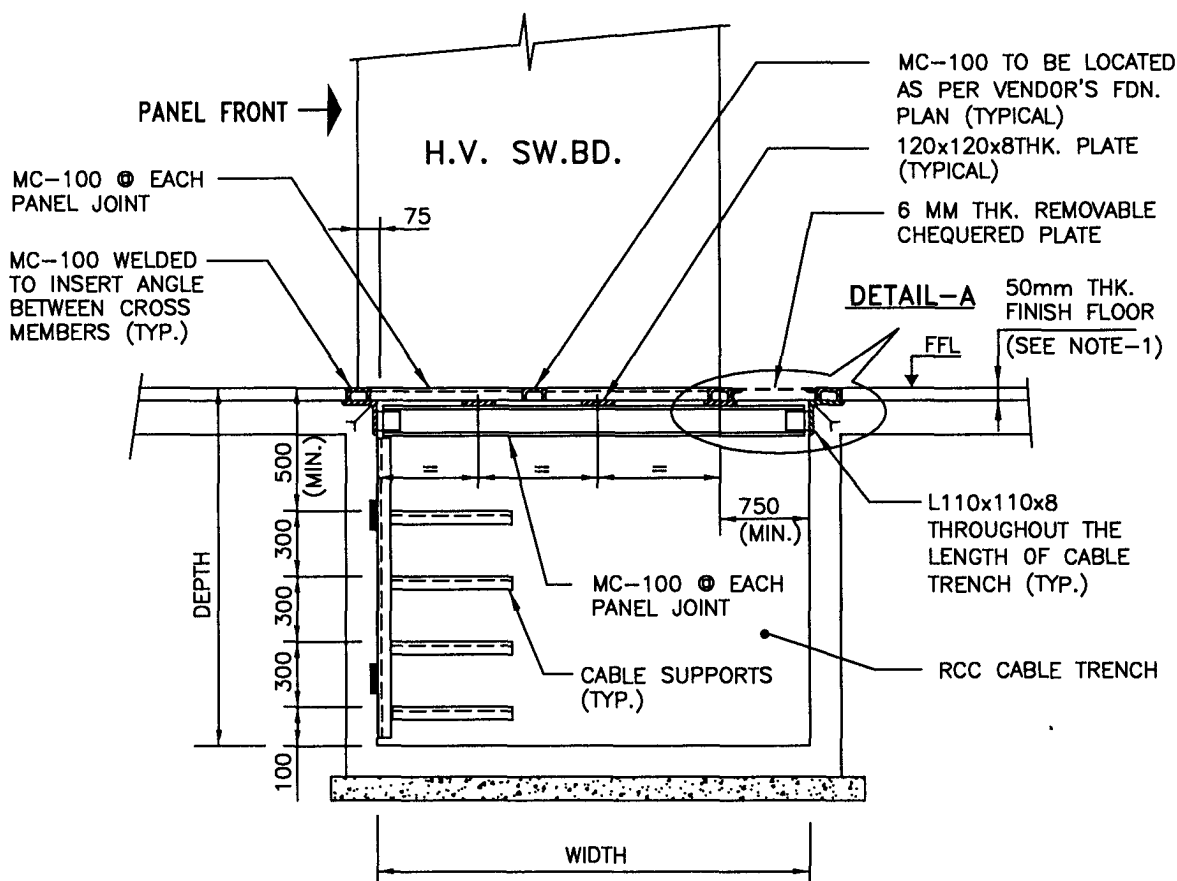
4	07.12.21	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
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- 12.3 THE INSTALLATION SHALL BE ADEQUATELY PROTECTED AGAINST OVERLOAD, SHORT CIRCUIT AND EARTH LEAKAGE BY THE USE OF SUITABLE PROTECTIVE DEVICES. FUSES WHEREVER USED SHALL BE HRC TYPE. USE OF REWIRABLE FUSES SHALL BE STRICTLY PROHIBITED. THE EARTH LEAKAGE DEVICE SHALL HAVE AN OPERATING CURRENT NOT EXCEEDING 30 mA.
- 12.4 ALL CONNECTIONS TO THE HANDTOOLS/WELDING RECEPTACLES SHALL BE TAKEN THROUGH PROPER SWITCHES, SOCKETS AND PLUGS.
- 12.5 ALL SINGLE PHASE SOCKETS SHALL BE MINIMUM 3 PIN TYPE ONLY. ALL UNUSED SOCKETS SHALL BE PROVIDED WITH SOCKET CAPS.
- 12.6 ONLY 3 CORE (P+N+E) OVERALL SHEATHED FLEXIBLE CABLES WITH MINIMUM CONDUCTOR SIZE OF 1.5 MM² COPPER SHALL BE USED FOR ALL HAND TOOLS.
- 12.7 ONLY METALLIC DISTRIBUTION BOXES WITH DOUBLE EARTHING SHALL BE USED AT SITE. NO WOODEN BOXES SHALL BE USED.
- 12.8 ALL POWER CABLES SHALL BE TERMINATED WITH COMPRESSION TYPE NICKEL PLATED BRASS CABLE GLANDS. LUGS OF COPPER/ALUMINIUM/BIMETALLIC MATERIAL, AS APPLICABLE SHALL BE USED FOR MULTISTRAND WIRES/CABLES HAVING MULTISTRAND/SOLID CONDUCTOR.
- 12.9 CABLES SHALL BE FREE FROM ANY INSULATION DAMAGE.
- 12.10 CABLES SHALL BE LAID IN UNDERGROUND AT A MINIMUM DEPTH OF 750 MM, FOR LV & CONTROLS AND 900MM FOR HV CABLES COVERED WITH SAND, BRICK AND SOIL FOR ENSURING MECHANICAL PROTECTION. CABLES SHALL NOT BE LAID IN WATER LOGGED AREA AS FAR AS PRACTICABLE. CABLE ROUTE MARKERS SHALL BE PROVIDED AT EVERY 25 M OF BURIED TRENCH ROUTE. WHEN LAID ABOVE GROUND, CABLES SHALL BE PROPERLY CLEATED OR SUPPORTED ON RIGID POLES OF ATLEAST 2.1 M HIGH. MINIMUM HEAD CLEARANCE OF 6 METERS SHALL BE PROVIDED AT ROAD CROSSING.
- 12.11 UNDER GROUND CABLES SHALL NOT BE ALLOWED TO CROSS THE ROADS WITHOUT PIPE SLEEVE.
- 12.12 ALL CABLE JOINTS SHALL BE DONE WITH PROPER JOINTING KIT. NO TAPED/TEMPORARY JOINTS SHALL BE USED.
- 12.13 AN INDEPENDENT EARTHING FACILITY SHOULD PREFERABLY BE ESTABLISHED WITHIN THE TEMPORARY INSTALLATION PREMISES. ALL APPLIANCES AND EQUIPMENT SHALL BE ADEQUATELY EARTHED. IN CASE ARMoured CABLES ARE USED, THE ARMOUR SHALL BE BONDED TO THE EARTHING SYSTEM.
- 12.14 ALL CABLES AND WIRE ROPE USED FOR EARTH CONNECTIONS SHALL BE TERMINATED THROUGH LUGS OF TINNED COPPER/ALUMINIUM/ BIMETALLIC MATERIAL, AS APPLICABLE.
- 12.15 IN CASE OF LOCAL EARTHING, EARTH ELECTRODES SHALL BE BURIED NEAR THE SUPPLY POINT AND EARTH CONTINUITY WIRE SHALL BE CONNECTED TO LOCAL EARTH PLATE FOR FURTHER DISTRIBUTION TO VARIOUS APPLIANCES. ALL INSULATED WIRES FOR EARTH CONNECTION SHALL HAVE INSULATION OF GREEN COLOUR.
- 12.16 SEPARATE CORE SHALL BE PROVIDED FOR NEUTRAL. EARTH/STRUCTURES SHALL NOT BE USED AS A NEUTRAL IN ANY CASE.
- 12.17 ON/OFF POSITION OF ALL SWITCHES SHALL BE CLEARLY DESIGNATED/PAINTED FOR EASY ISOLATION IN EMERGENCY.
13. ALL INSULATIONS AND ELECTRICAL INSTALLATIONS SHALL BE INSPECTED BY ENGINEER-IN-CHARGE ATLEAST ONCE IN A MONTH.

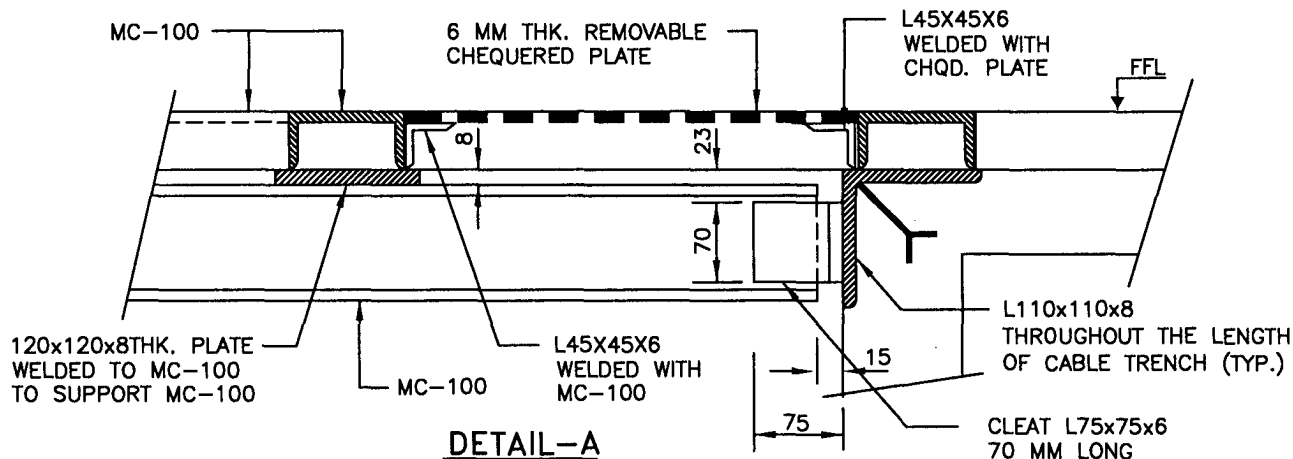
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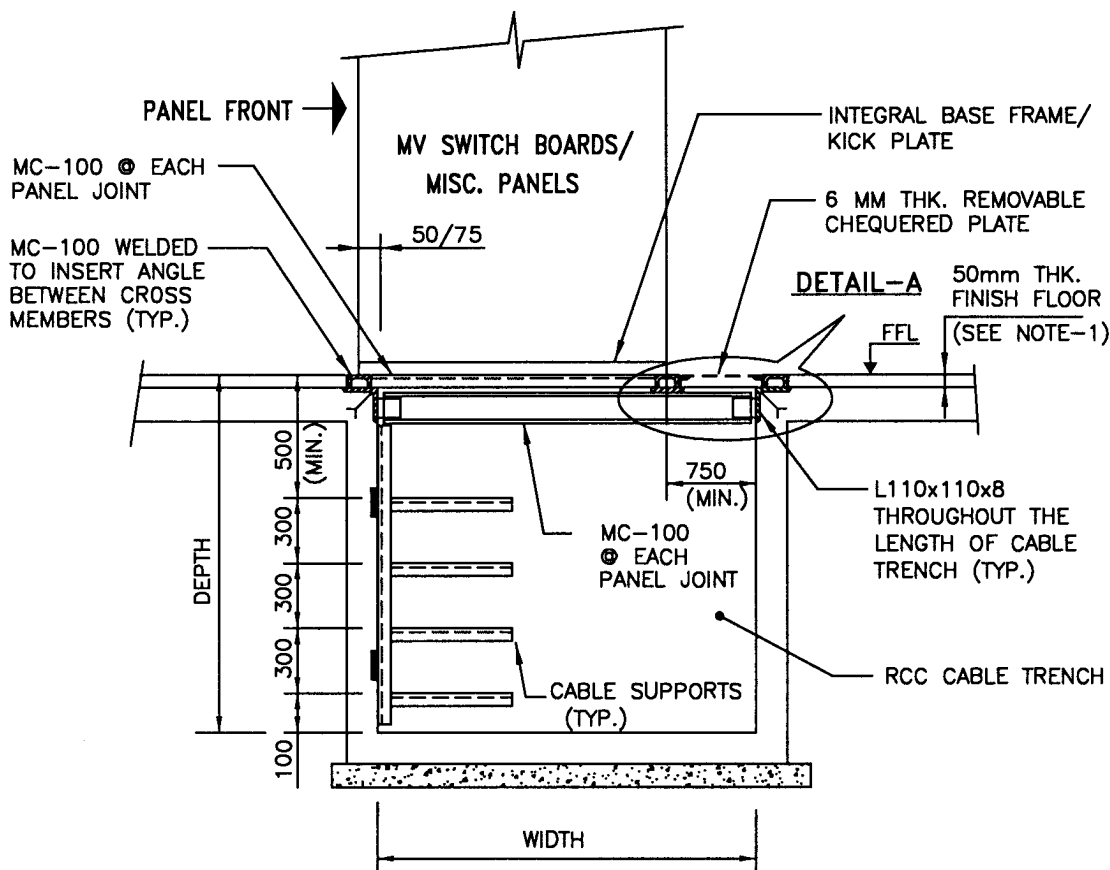
**TYPICAL INSTALLATION DETAIL OF H.V. SWITCHBOARD
(FOR REMOTE LOCATION SUB STATION)
(UPTO 11KV AND FOR MAXIMUM 3 CABLES PER PHASE)**



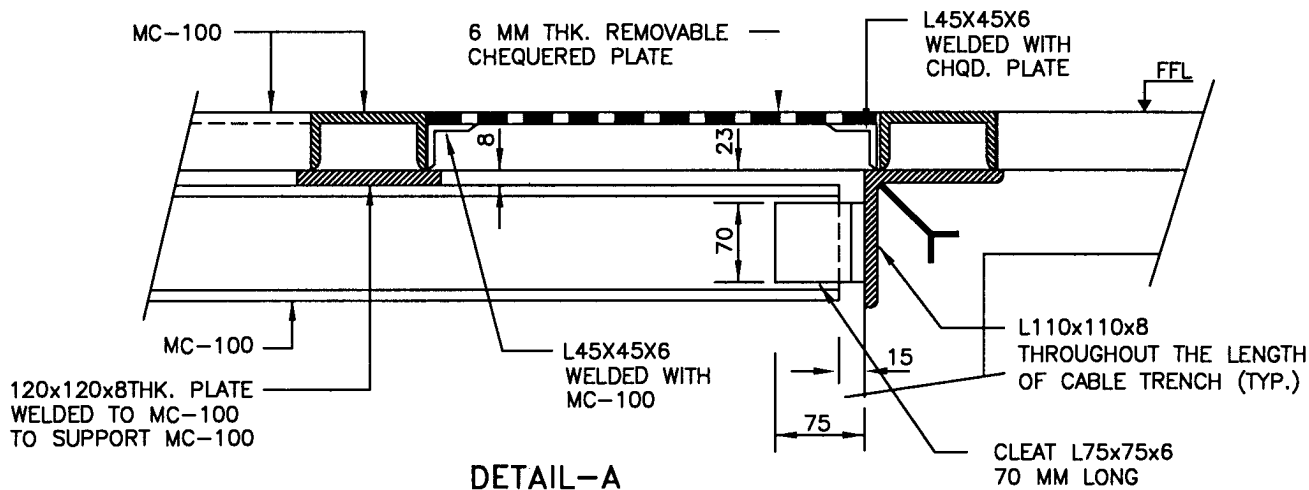
NOTES:-

- 50 THICK FINISH FLOORING SHALL BE DONE ONLY AFTER INSTALLATION OF BASE FRAME
- ALL PANELS SHALL BE TACK WELDED WITH BASE FRAME OF SWITCHBOARD.
- UNUSED PORTION OF CUTOUTS SHALL BE COVERED WITH 6 MM THICK CHEQUERED PLATES.
- WIDTH OF TRENCH TO SUIT THE DIMENSIONS OF SWITCHBOARD SHALL BE AS PER AFC DRAWING OF THE PROJECT.

4	29.11.21	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
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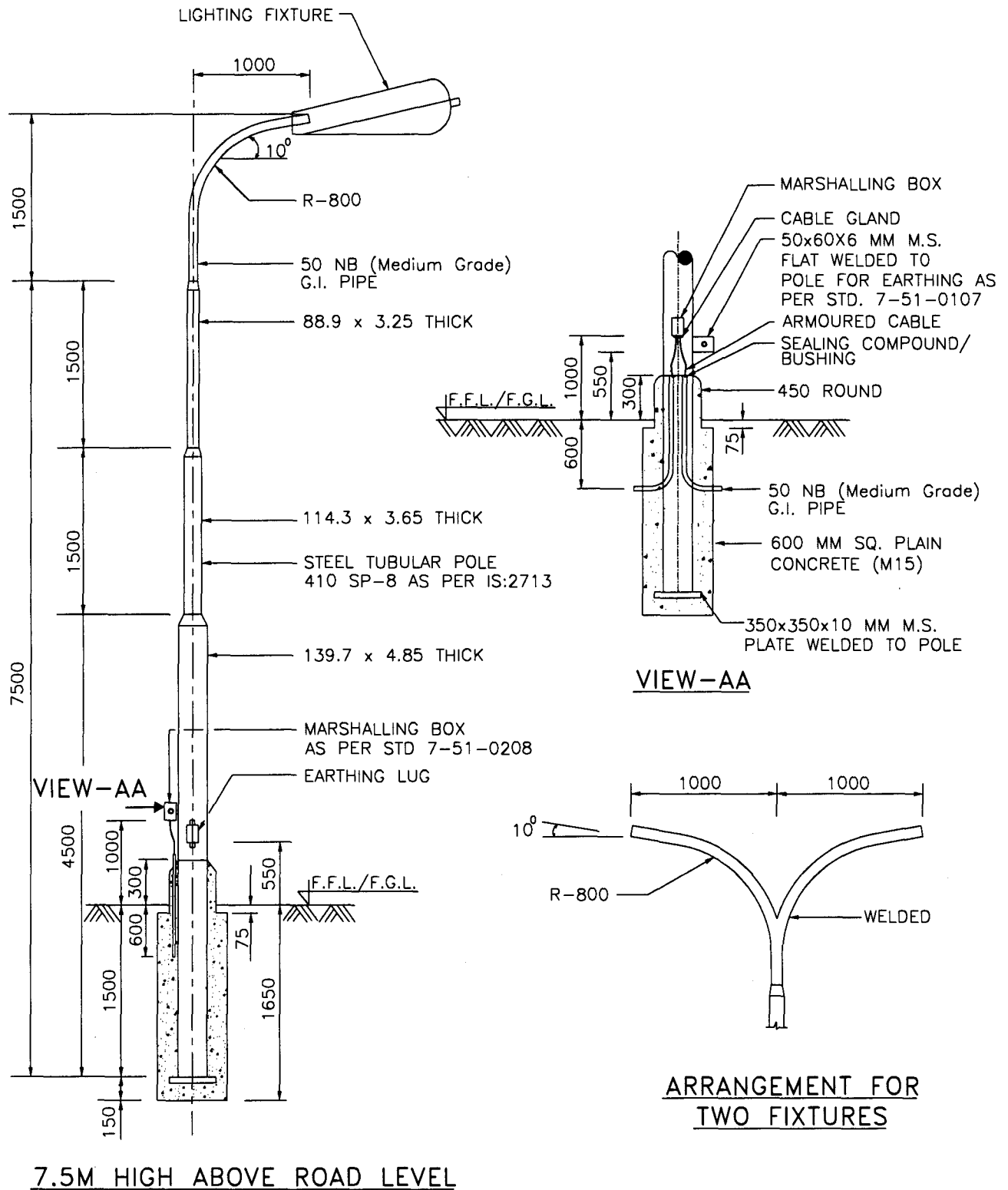
TYPICAL INSTALLATION DETAIL OF M.V. PANELS ON CABLE TRENCH



NOTES:—

1. 50 THICK FINISH FLOORING SHALL BE DONE ONLY AFTER INSTALLATION OF BASE FRAME
2. ALL PANELS SHALL BE TACK WELDED WITH BASE FRAME OF SWITCHBOARD.
3. UNUSED PORTION OF CUTOUTS SHALL BE COVERED WITH 6 MM THICK CHEQUERED PLATES.
4. WIDTH OF TRENCH TO SUIT THE DIMENSIONS OF SWITCHBOARD SHALL BE AS PER AFC DRAWING OF THE PROJECT.

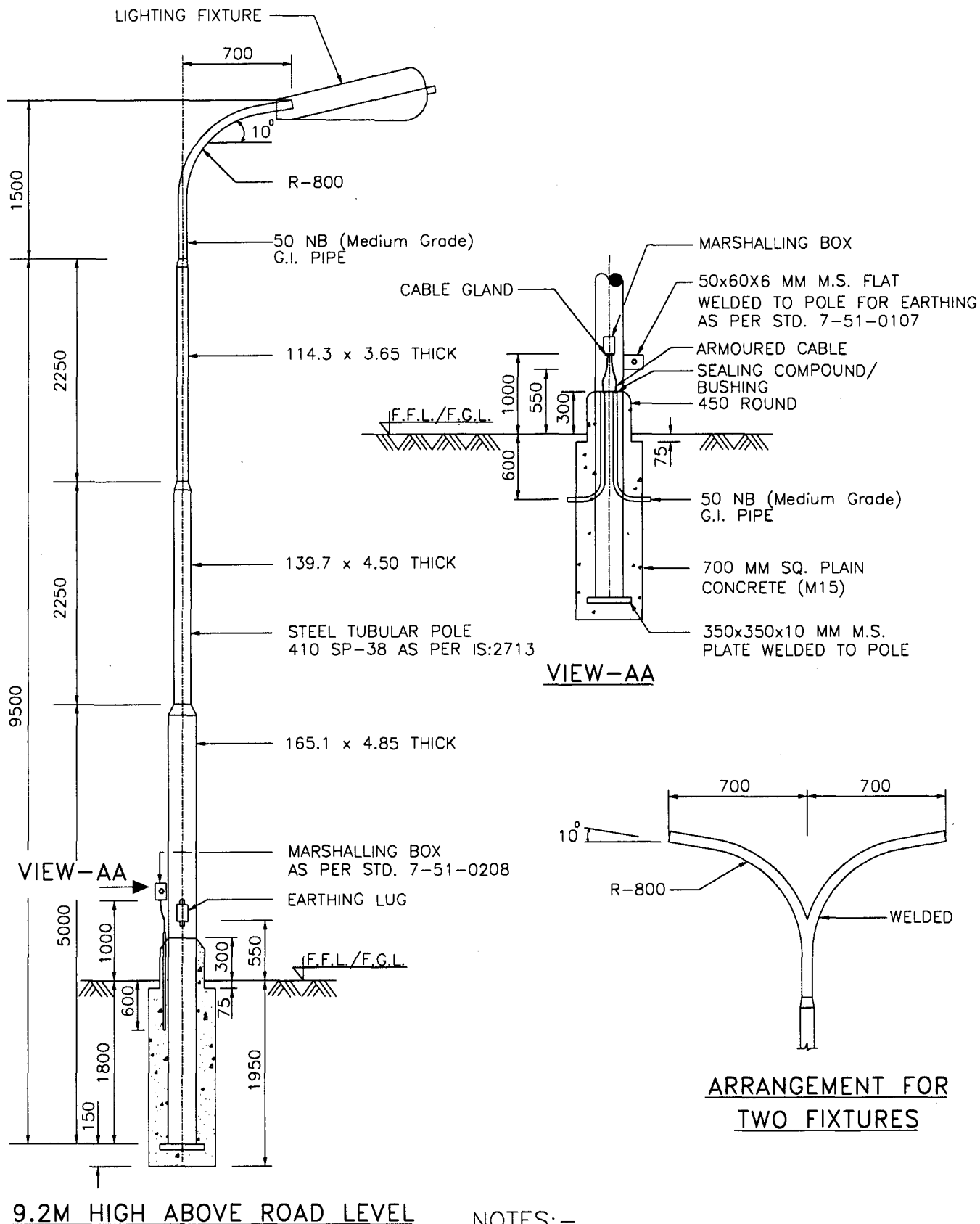
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NOTES:-

1. ALL G.I. PIPE SHALL BE MEDIUM GRADE.

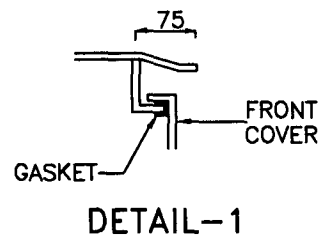
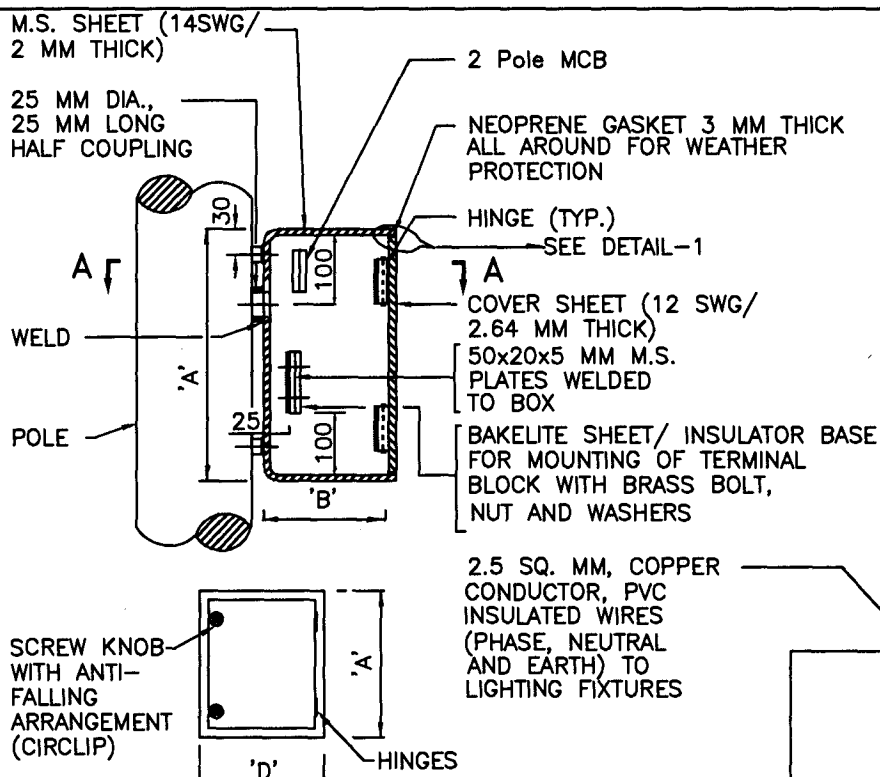
6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	10.07.17	REAFFIRMED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



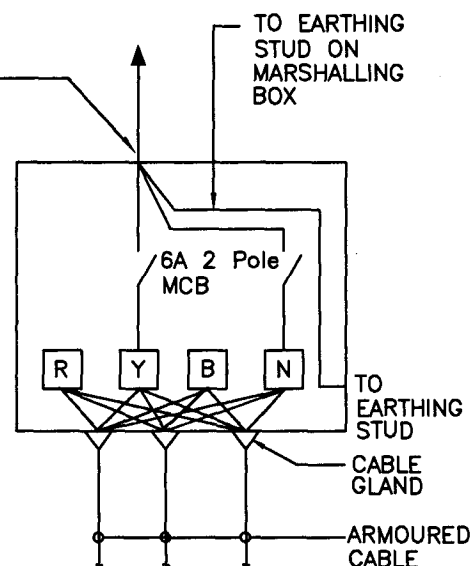
NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. ALL G.I. PIPES SHALL BE MEDIUM GRADE.

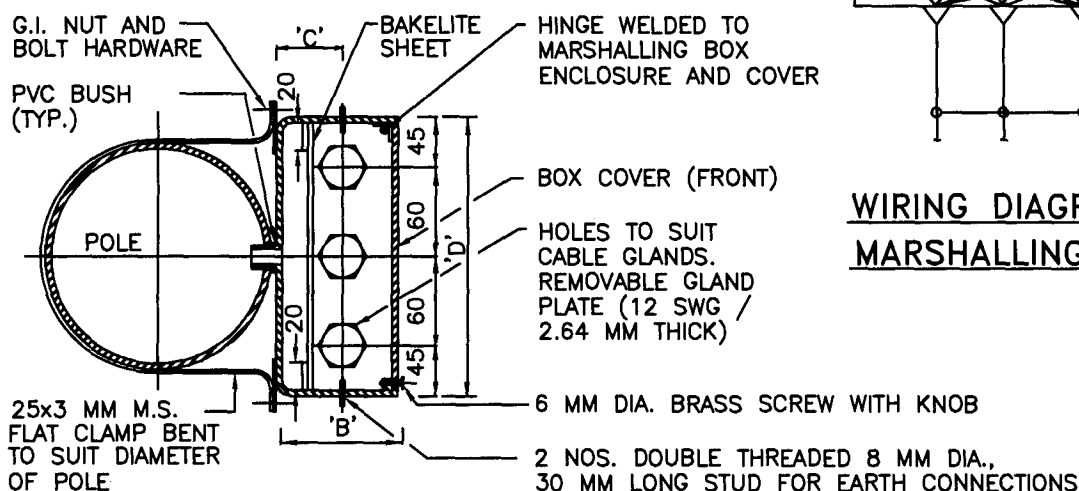
6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	10.07.17	REAFFIRMED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



BOX COVER



WIRING DIAGRAM OF
MARSHALLING BOX



SECTION-AA

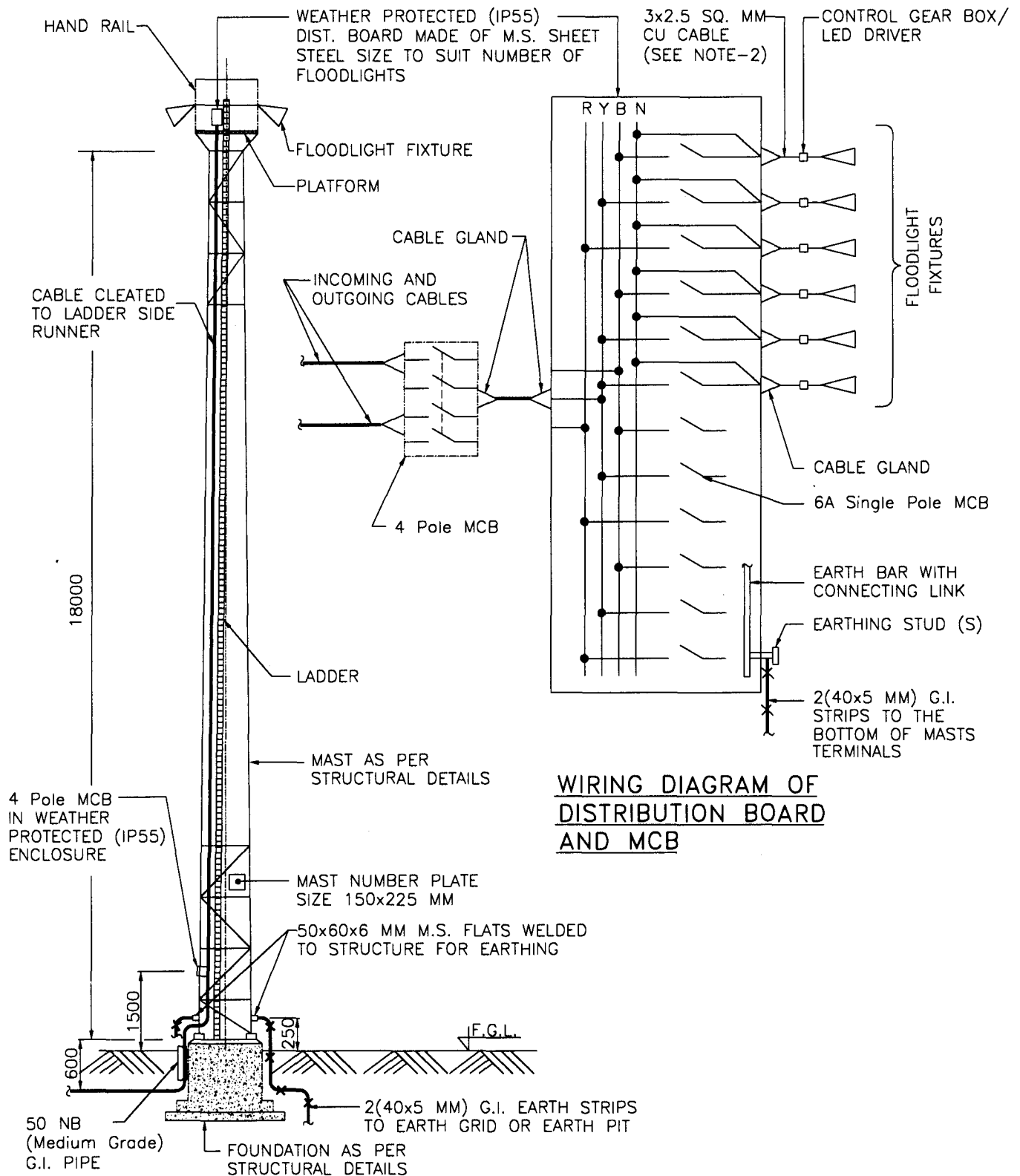
MARSHALLING BOX DIMENSIONS

CABLE SIZE (IN SQ. MM)	CABLE ENTRIES	DIMENSIONS IN MM				
		'A'	'B'	'C'	'D'	Terminal Bolt Size
UPTO 4 X 16	2	250	100	45	210	5
ABOVE 4 X 16 AND UPTO 3.5 X 50	3	300	150	75	210	10

NOTES:-

- ALL DIMENSIONS ARE IN MM.
- MARSHALLING BOX SHALL HAVE WEATHER PROOF (IP55) ENCLOSURE PROTECTION, WITH DOUBLE COMPRESSION CABLE GLANDS WITH CHECK NUTS & LUGS.
- THE BOX WITH ALL WELDED ATTACHMENTS, SHALL BE THOROUGHLY CLEANED AFTER FABRICATION AND SHALL BE PAINTED WITH EPOXY PAINT.

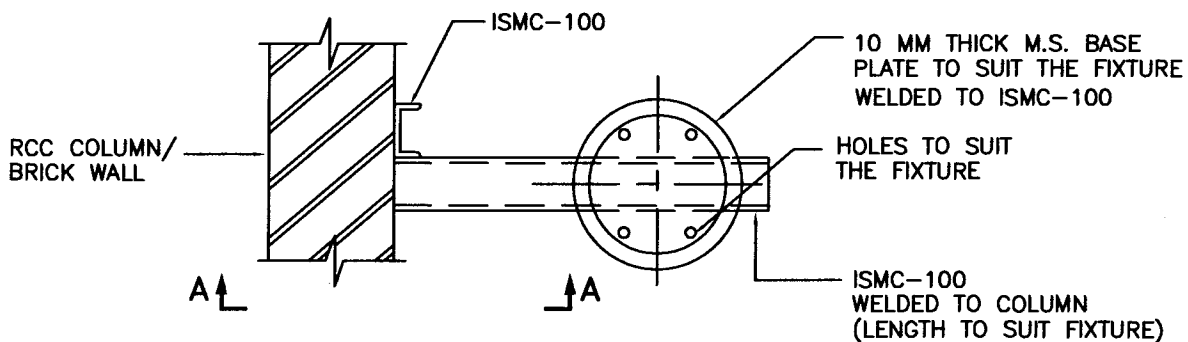
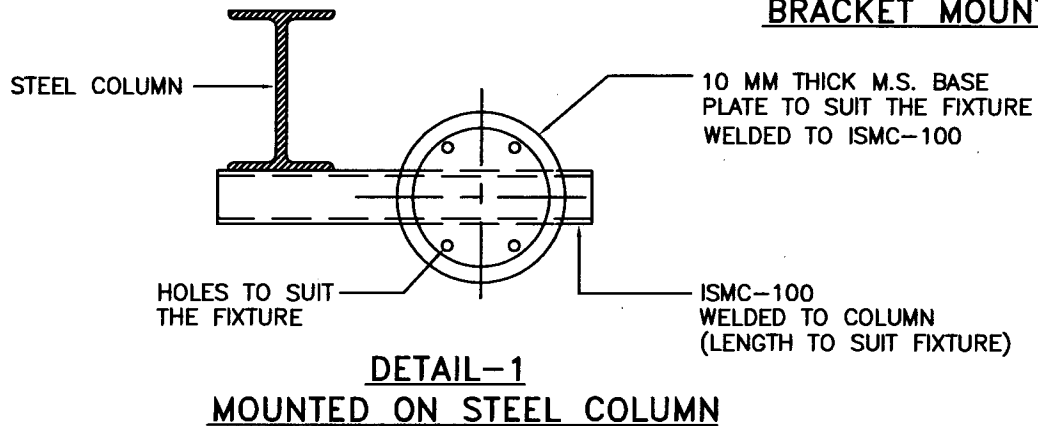
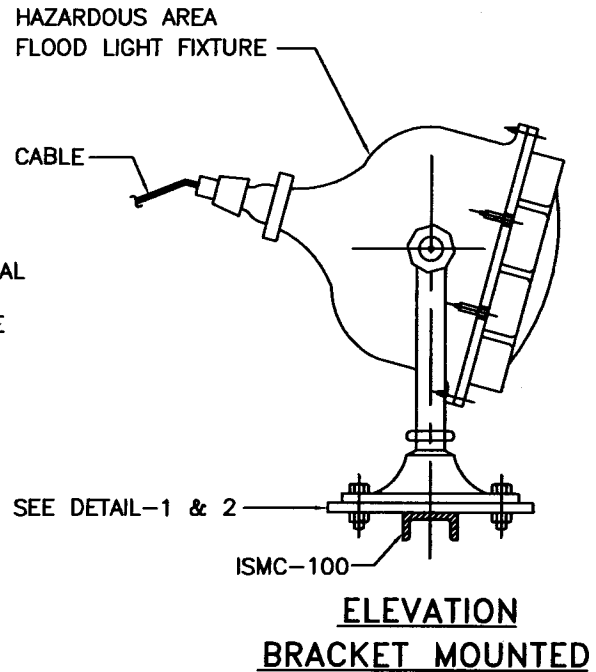
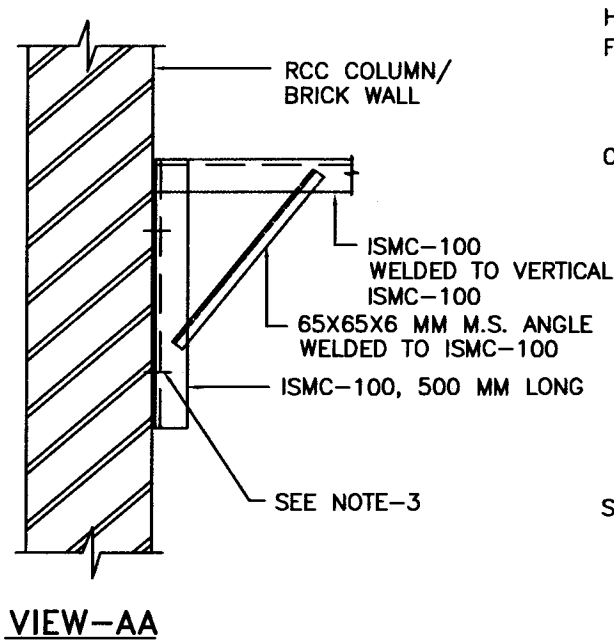
7	12.10.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
6	10.07.17	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. ALL CABLES FROM DISTRIBUTION BOARD TO CONTROL GEAR BOX/ LED DRIVER/ LIGHTING FIXTURE SHALL BE NEATLY CLAMPED TO THE HANDRAIL STRUCTURE.

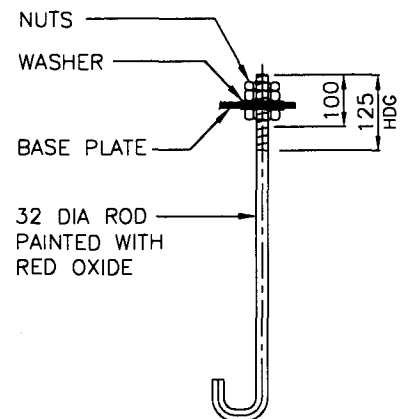
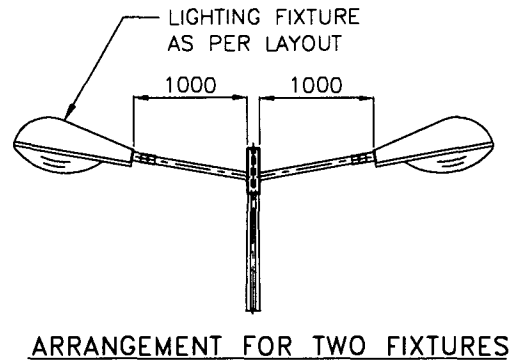
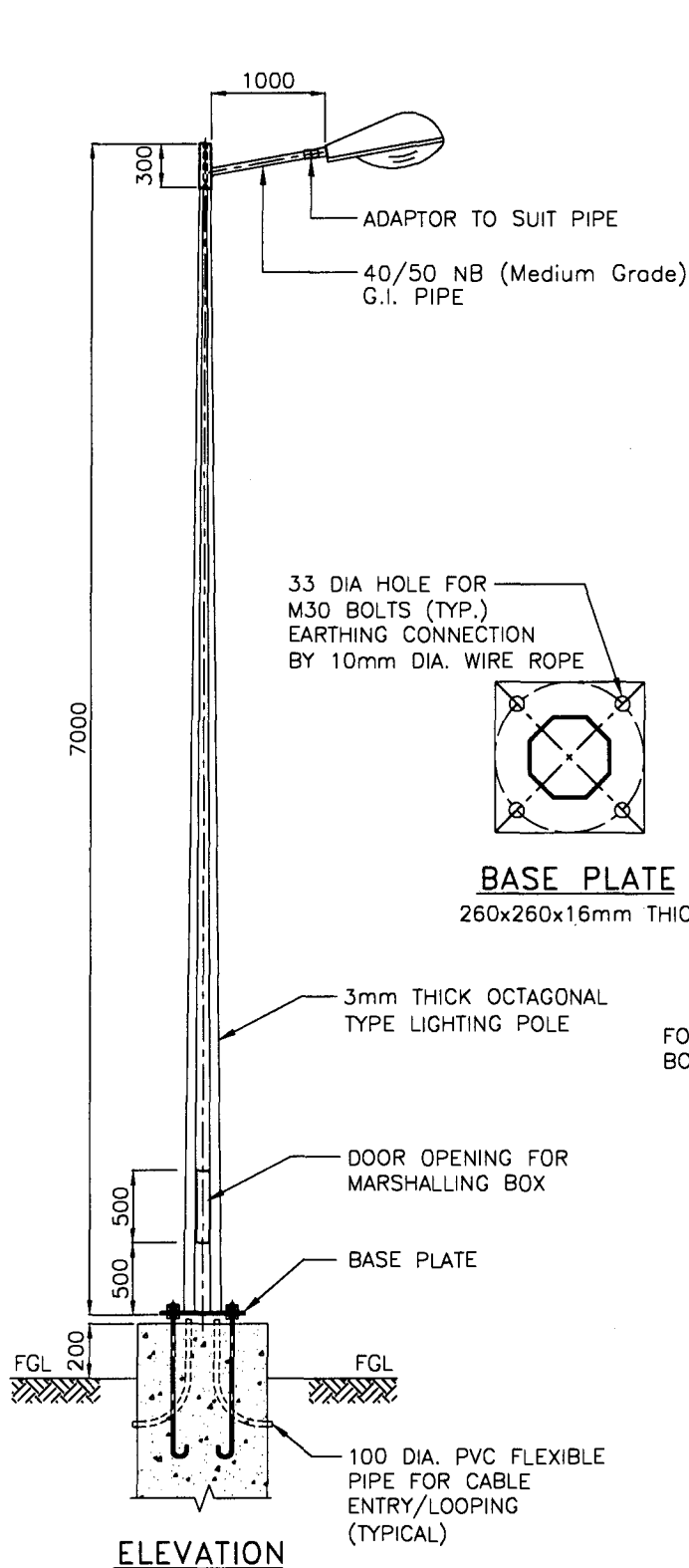
6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	10.07.17	REAFFIRMED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



NOTES:-

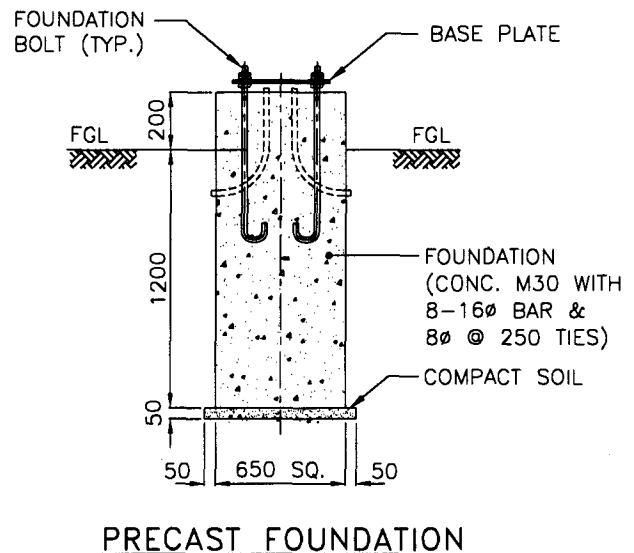
1. ALL DIMENSIONS ARE IN MM.
2. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED FIXTURE/JUNCTION BOX AND CABLE/CONDUIT SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.
3. SUPPORT FOR FLOOD LIGHT FIXTURE SHALL BE SUITABLY FIXED TO RCC COLUMN/BRICK WALL BY USING ANCHOR FASTENER.

5	22.02.18	UPDATED & ISSUED AS STANDARD	BP	VKS/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



BASE PLATE
260x260x16mm THICK

FOUNDATION BOLT
4-M30x750 LONG
(HDG-HOT DIP GALVANISED)

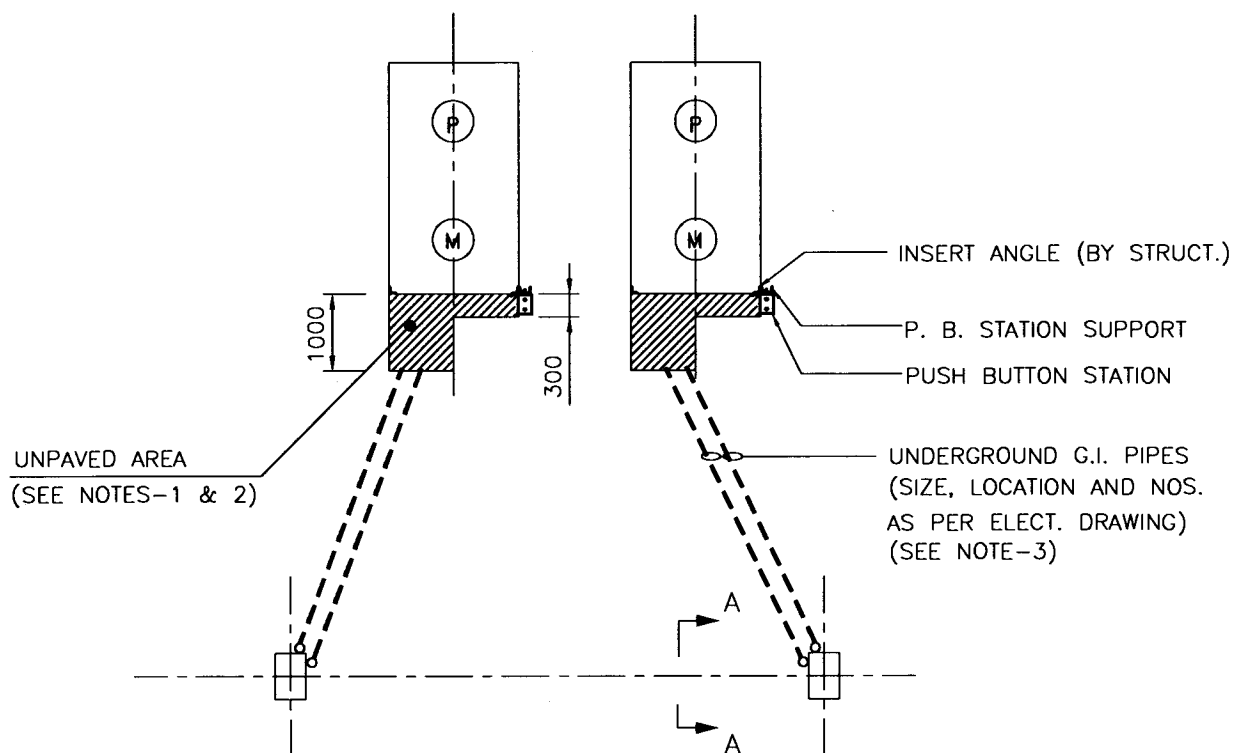


NOTES :

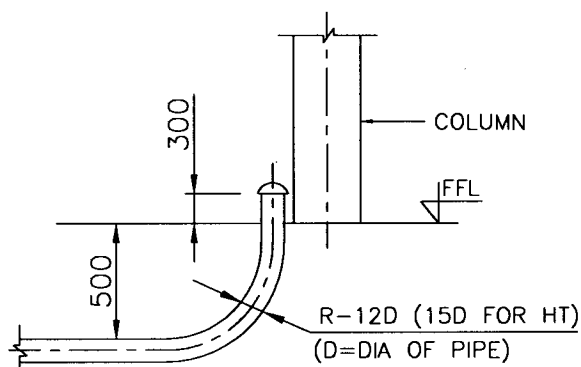
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. THE LIGHTING POLE AND ACCESSORIES DETAILS SHOWN HERE ARE INDICATIVE ONLY.
ACTUAL DESIGN & ARRANGEMENT SHALL BE AS PER MANUFACTURER'S DETAILS.

1	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HR	SA	SM
0	18.03.16	ISSUED AS STANDARD	BP	FA/SA	BRB	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman





PLAN

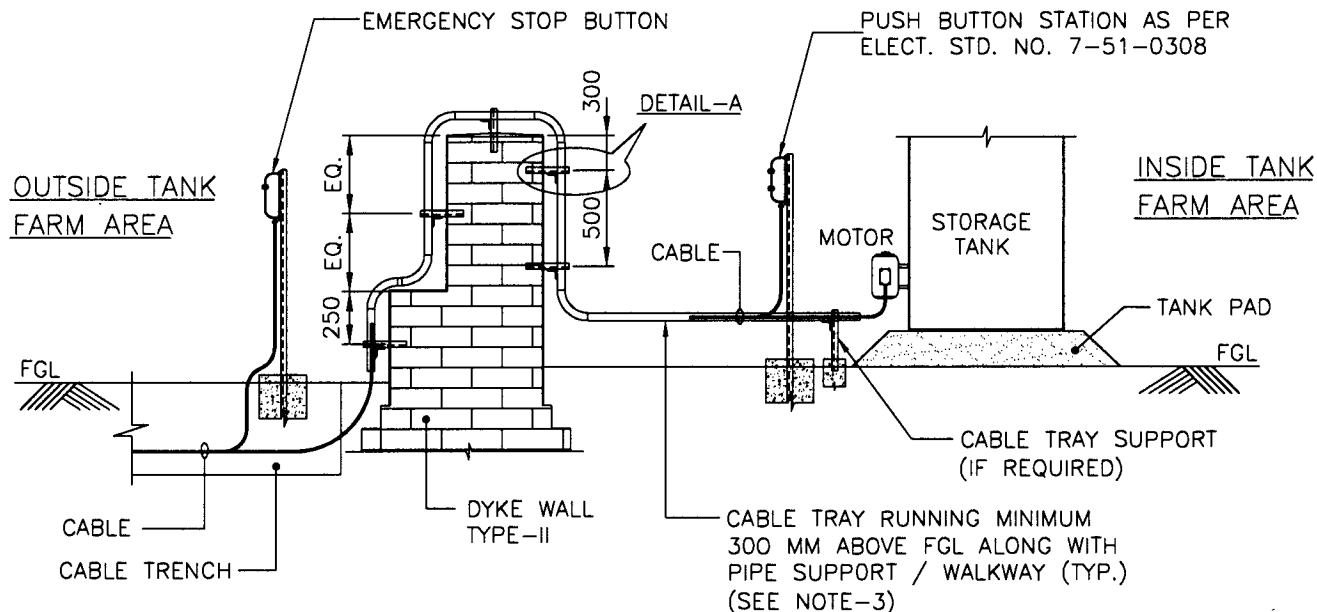


SECTION A-A

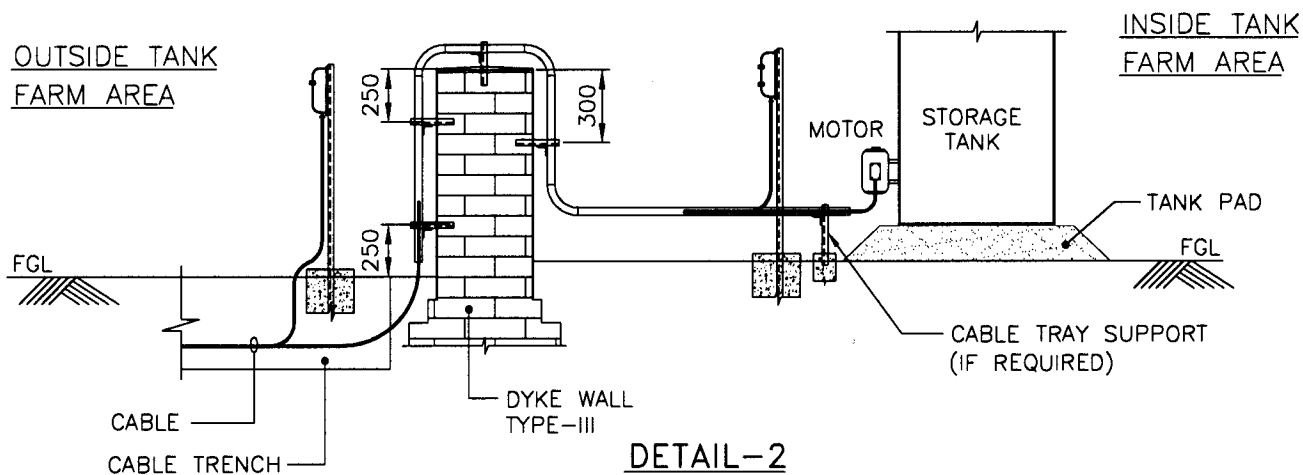
NOTES: -

1. AREA SHOWN AS HATCHED NEAR EACH PUMP MOTOR FOUNDATION SHALL BE LEFT UNPAVED BY PAVEMENT CONTRACTOR.
2. CABLE LAYING & SAND / LEAN CONCRETE FILLING IN THIS UNPAVED AREA SHALL BE DONE BY ELECTRICAL CONTRACTOR.
3. CIVIL CONTRACTOR SHALL PROVIDE G.I PIPES AND PLUG AT BOTH ENDS OF THE PIPES WITH PVC BUSHINGS.

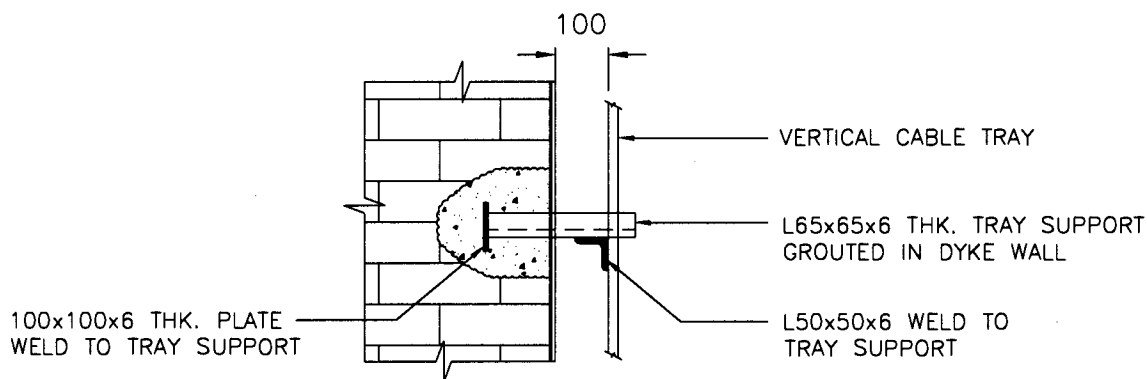
5	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
4	04.04.16	REVISED & ISSUED AS STANDARD	BP	FA/SA	BRB	RN
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



DETAIL-1



DETAIL-2

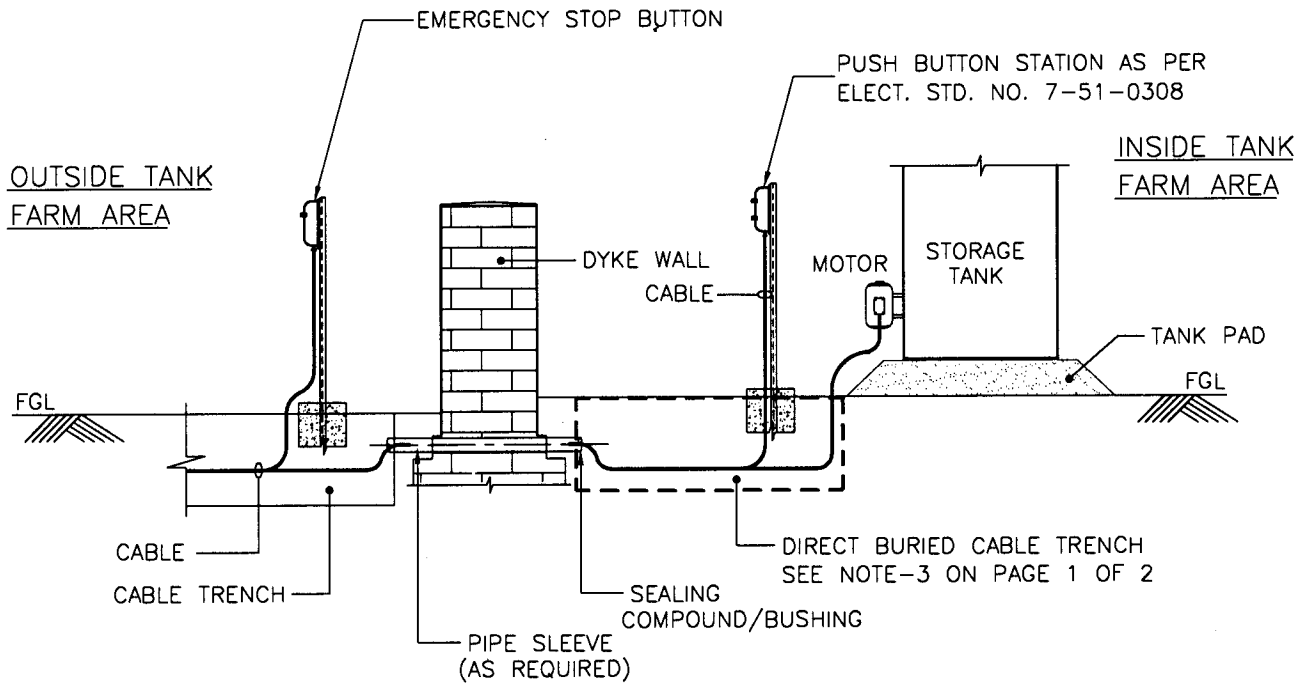


DETAIL-A

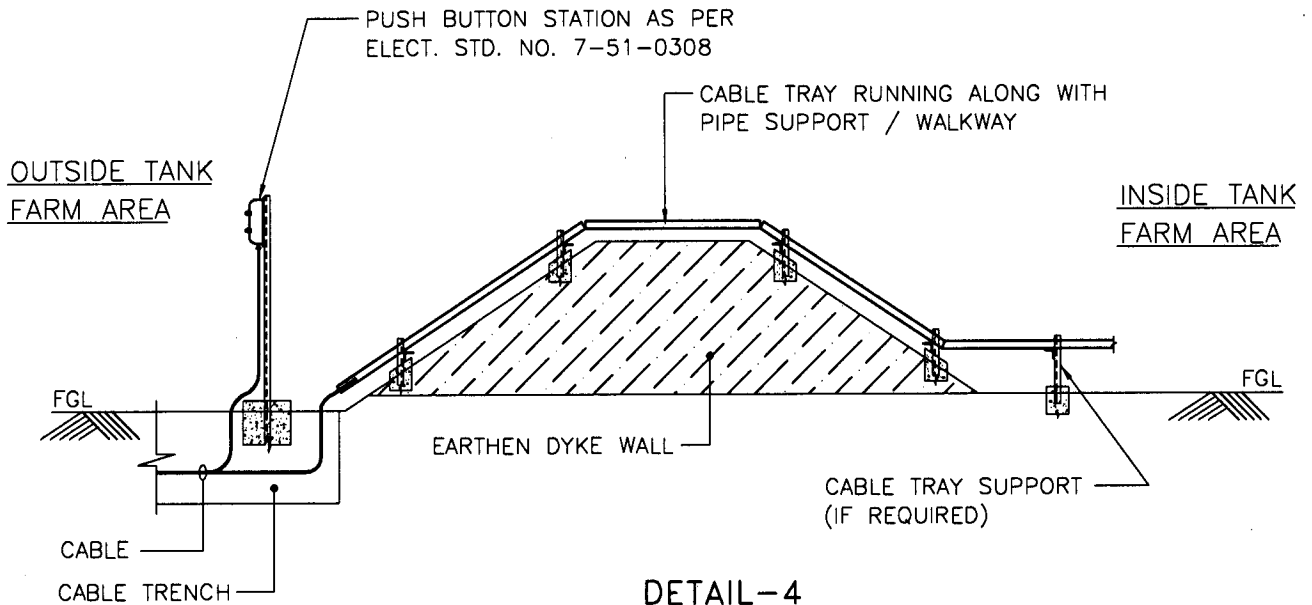
NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. CABLE TRAY SHALL BE PROVIDED WITH REMOVABLE TRAY COVER.
3. IN CASE OF UNPAVED AREA INSIDE TANK FARM, BURIED CABLE TRENCH CAN BE PROVIDED AS PER PROJECT PHILOSOPHY.

1	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
0	28.10.15	ISSUED AS STANDARD	BP	FA/SA	BRB	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



DETAIL-3



DETAIL-4

1	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
0	28.10.15	ISSUED AS STANDARD	BP	FA/SA	BRB	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						Copyright EIL - All rights reserved

Project	Overall Project Management and EPCM Services for Capacity Expansion of Panipat Refinery			Client	IOCL REFINERY DIVISION - HEAD OFFICE
Unit	COMMON	Location		Job No.	B269
				Unit No.	999
PURCHASER'S DATA					
A. Site Conditions					
1.	Maximum Ambient Temperature	°C	50		
2.	Minimum Ambient Temperature	°C	5		
3.	Design Ambient Temperature	°C	45		
4.	Relative Humidity	%	90		
5.	Altitude Above MSL	mm	1000		
6.	Environment	Hot, Humid & Corrosive			
B. Operating Conditions					
1.	Voltage	kV	6.6 +/- 10 %		
2.	Frequency	Hz	50 +/- 3 %		
3.	No of phases	Three			
4.	System fault level	kA	40		
5.	System earthing	Resistance Earthing			
6.	Auxiliary supply				
	AC	V	240 +/- 5 %		
	DC	V	110 +15% /- 10 %		
C. Electrical Data					
1.	Busbar current rating (inside panel at design temp.)	As per Job Specification			
2.	1 sec. Short Circuit withstand capacity	kA	40		
3.	System Breaking capacity	kA	40		
	% D.C. Component	As per IEC			
4.	System making capacity	kA(peak)	100		
5.	Type of Circuit Breaker	VCB			
	Shunt Trip Coil-1 :	V	110 DC		
	Shunt Trip Coil-2 :	V	230V AC (Refer Note-2)		
6.	Duty Cycle of C.B.	O-3min-CO-3min-CO			
7.	Suitability for Cap. Switching	Required			
8.	Surge supressor for all Feeders	Yes			
9.	Provision of earthing				
	Earthing truck	Required			
	Earthing switch	Not Required			
D. Miscellaneous					
1.	Interface with ECS	Required			
2.	Incoming Power Entry	Cable/Bus Duct			
3.	Cable Entry	Bottom			
4.	Separate bolted removable gland palte for cable entry	Reqd.(Gland Plate Drilled at side)			
5.	Cable glands and lugs for cable termination	Refer Job Specification			
6.	Paint shade	RAL-7032			
7.	Windows at the rear side of panels for thermography	Not Required			
MANUFACTURER'S DATA					
A. Switchboards					
1.	Make				
B	13-SEP-2021	ISSUED WITH MR/TENDER	V V S N MURTY	ANIL KUMAR GARHWAL	HARISH KUMAR
A	27-APR-2020	ISSUED WITH MR/TENDER	JAYENDRA L CHAUHAN	HARISH KUMAR	HARISH KUMAR
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

Project	Overall Project Management and EPCM Services for Capacity Expansion of Panipat Refinery			Client	IOCL REFINERY DIVISION - HEAD OFFICE	
Unit	COMMON	Location	Job No.	B269	Unit No.	999
2.	Type designation					
3.	Degree of protection					
4.	Max. overall weight of C.B. panel	Kg				
5.	Overall dimensions of C.B. panel					
	Width	mm				
	Depth	mm				
	Height	mm				
6.	Overall dimensions of dummy /gland palte for cable entry					
	Width	mm				
	Depth	mm				
	Height	mm				
7.	Overall weight and dimensions of largest shipping section					
	Weight	Kg				
	Width	mm				
	Depth	mm				
	Height	mm				
8.	Overall dimensions of each swbd. including all dummy/adaptor/rear extension panels					
	Width	mm				
	Depth	mm				
	Height	mm				
9.	Recommended clearances					
	Front	mm				
	Rear	mm				
	Above	mm				
10.	Shock loading on foundation					
11.	Max. size/no. of cables that can be terminated inside the panel					
	without rear extension panel					
	with rear extension panel					
	size of rear extension panel					
12.	Clearance in air					
	Phase to Phase (min.)	mm				
	Phase to Earth (min.)	mm				
13.	Busbar current rating at design ambient temperature		A			
14.	Busbar (separately for each swbd)					
	(a).Horizontal main busbar size (No. of flats x size of each flat)					
	(b).Horizontal main busbar size as tested at CPRI for full short ckt					
	withstand as per specification requirement (No. of flats x size of each flat)					
	(c).Vertical dropper size (No. of flats x size of each flat)					
15.	Horizontal main busbar/Vertical busbar material					
16.	Insulating material (Busbar supports)					
17.	Earth busbar size					
18.	Earth busbar material					
19.	1 min. power frequency withstand voltage (rms	kV				
	Over voltage factor for PTs					
20.	Impuse withsatnd voltage (peak)	kV				
B	13-SEP-2021	ISSUED WITH MR/TENDER	V V S N MURTY	ANIL KUMAR GARHWAL	HARISH KUMAR	
A	27-APR-2020	ISSUED WITH MR/TENDER	JAYENDRA L CHAUHAN	HARISH KUMAR	HARISH KUMAR	
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By	

Project	Overall Project Management and EPCM Services for Capacity Expansion of Panipat Refinery			Client	IOCL REFINERY DIVISION - HEAD OFFICE	
Unit	COMMON	Location		Job No.	B269	Unit No. 999
	Wave shape of impulse voltage					
21.	1 sec. short ckt. Withstand capacity		kA			
22.	Peak dynamic withstand capacity		kA			
23.	Safety Features					
	(a).Heat shrinkable sleeves, rated to withstand the system line to line voltage for one min., provided on busbar					
	(b).Removable FRP shrouds for all busbar joints and tap-off connections provided					
	(c).Arc propagation barrier in busbar compartment provided					
	(d).Breaker service, test and drawn-out position provided					
	(e).Distinct overall lockable door for breaker compartment provided					
	(f).Automatic safety shutter provided					
	(g).Independent pressure release flaps provided for all HV compartments					
	(h).Wire mesh for all louvered openings provided					
	(i).Suitable interlocks to prevent faulty operation as per Cl. 4.4.10 of spec. 6-51-0001 provided					
	B. Circuit Breaker					
1.	Type					
	2nd shunt trip coil for VFD feeders					
2.	Make					
3.	Type Designation					
4.	Circuit Breaker mounting in panel					
5.	No. of poles/phase					
6.	Current rating (in free air)		A			
7.	Current rating inside the panel at specified design temperature		A			
8.	Short time rating (1sec.)		kA			
9.	Symmetrical breaking capacity		kA			
9.1	% D.C. Component					
10.	Peak making current		kA			
11.	1 min. dry withstand voltage (power frequency)		kV			
12.	Duty Cycle					
13.	Total opening time		m sec.			
14.	Total closing time		m sec.			
15.	Power required for opening		W/VA			
16.	Power required for closing		W/VA			
17.	Power required for spring charging motor		W/VA			
18.	Breaker is trip free					
19.	Closing mechanism					
20.	Provision of manual spring charging provided					
21.	Mechanical Trip PB provided					
B	13-SEP-2021	ISSUED WITH MR/TENDER	V V S N MURTY	ANIL KUMAR GARHWAL	HARISH KUMAR	
A	27-APR-2020	ISSUED WITH MR/TENDER	JAYENDRA L CHAUHAN	HARISH KUMAR	HARISH KUMAR	
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By	

Project	Overall Project Management and EPCM Services for Capacity Expansion of Panipat Refinery			Client	IOCL REFINERY DIVISION - HEAD OFFICE
Unit	COMMON	Location		Job No.	B269
				Unit No.	999
22.	Mech. On/Off indicator provided				
23.	Operation counter provided				
24.	Time taken for spring charging	sec.			
25.	No. of aux. contacts and their current ratings				
26.	Interrupter				
	(a).Make				
	(b).Pressure switch for monitoring of SF6 gas pressure provided				
	(c).Re-filling arrangement of SF6				
27.	LOTO (Lock-Out Tag-Out) Provision for mechanical locking arrangement				
28.	Suppressor				
	Type designation				
	Make				
27.	Derating reqd. for Cap. Switching				
29.	Earthing System				
30.	Copies of following test certificates enclosed				
	For each type of offered circuit breaker panel with breake				
	(a).Short Circuit tests (Peak and 1 sec.withstand)				
	(b).Heat run test				
	(c).Internal arc test				
	(d).Impulse and power freq. withstand				
	For each type of offered circuit breaker (in panel)				
	(a).Short Circuit test duties				

Eil Notes

- Vendor shall furnish the dimensions of various types/ratings of swbds., CB panels and dummy/adaptor panels separately.
- For all HV Circuit Breakers feeding HV VFDs, two nos. trip coil shall be provided. 1no. trip coil shall operate on 110V DC supply and other trip coil shall operate on 230V AC UPS supply.
- All offered switchboards shall have IAC rating of AFLR 40 kA for 0.2 Sec.
- Variation/ Clarification against the standard specification for HV switchboards 6-51-0001, shall be as per the MoU agreed with EIL by respective HV switchboard manufacturer. No further deviations to tender requirements shall be entertained.

B	13-SEP-2021	ISSUED WITH MR/TENDER	V V S N MURTY	ANIL KUMAR GARHWAL	HARISH KUMAR
A	27-APR-2020	ISSUED WITH MR/TENDER	JAYENDRA L CHAUHAN	HARISH KUMAR	HARISH KUMAR
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

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PROJECT: PANIPAT REFINERY EXPANSION(P-25)

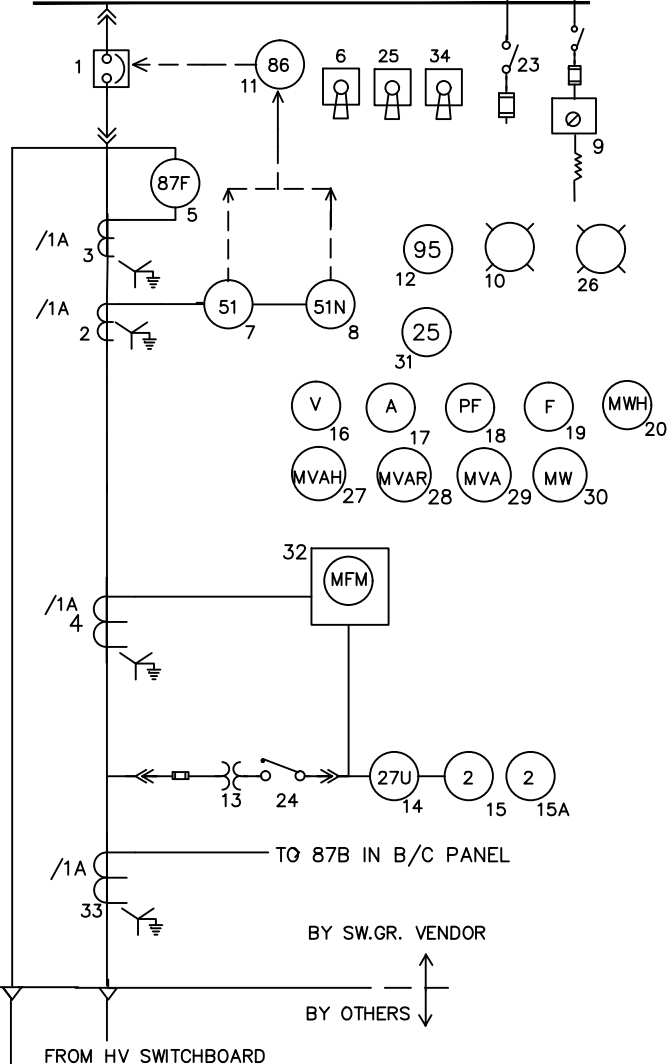
CLIENT: M/S IOCL

REV.	DATE	PURPOSE	BY	CHKD	APPD.
A	05.05.2020	ISSUED WITH MR/TENDER	JLC	HK	HK
B	08.09.2021	ISSUED WITH MR/TENDER	SNM	AKG/RSR	HK

D.C. CONTROL BUS

240V A.C. SPACE HEATER & AUX. CKT. BUS

HV BUS



FEEDER DIFFERENTIAL RELAY
(SENDING END UNIT OF 87F IN
UPSTREAM SWITCHBOARD)
(REFER NOTE-6)

R1 ☐ PART OF NUMERICAL RELAY-1
R2 ☐ PART OF NUMERICAL RELAY-2

NOTE:

1. ANTIPUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN SPECIFICATION 6-51-0001 SHALL BE IN VENDOR'S SCOPE.
3. ALL PROTECTION RELAYS SHALL BE NUMERICAL TYPE.
4. VA BURDEN OF CT & PT SHALL BE DECIDED BY VENDOR WHERE NOT INDICATED.
5. DIGITAL MULTIFUNCTION METERS SHALL BE PROVIDED WITH 1 NO. VOLTMETER (3PHASE), 1 NO. AMMETER (3PHASE), 1 NO. PF METER (0.5 LAG-1.0-0.5 LEAD), 1NO. FREQUENCY METER (45 TO 55 HZ), 1 NO. MWH METER
6. FOR FEEDER DIFFERENTIAL PROTECTION VENDOR/CONTRACTOR SHALL SUPPLY IDENTICAL RATED CTs AS THAT OF UPSTREAM SWITCHBOARD. NUMERICAL RELAY FOR SAME SHALL BE FREE ISSUED BY OTHERS, FOR INSTALLATION IN THE SUPPLIED SWITCHBOARDS. DETAILS OF RELAY AND CTs SHALL BE PROVIDED DURING DETAILED ENGG.
7. THERE SHALL BE ONE COMMON CONTROL SWITCH FOR ALL CONTROL SUPPLY TO THE FEEDER. SEPARATE FUSES FOR FOLLOWING BRANCH CIRCUIT SHALL BE PROVIDED:
 - SPRING CHARGING CIRCUIT
 - CLOSING CIRCUIT
 - TRIPPING, CONTACT MULTIPLIER & DIGITAL INPUT CIRCUIT
 - INDICATION CIRCUIT
 - NUMERICAL RELAY SUPPLY (INCOMING OF NUMERICAL RELAY SUPPLY FUSE SHALL BE TAPPED BEFORE THE CONTROL SUPPLY SWITCH)

EQUIPMENT DATA

ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	52	1	CIRCUIT BREAKER
2	-	3	METERING/PROTECTION C.T. 5P10
3	-	3	FEEDER DIFFERENTIAL C.T. CI.-PS
4	-	3	METERING CT CLASS 1.0
R2 5	87F	1	FEEDER DIFF. RELAY TYPE 'HORM4' WITH STABILISING RESISTOR & METROSIL
6	52 C/S	1	BKR. CONTROL SW. CLOSE-NEUTRAL-TRIP (SPRING RETURN TO NEUTRAL)
R1 7	51	2	IDMTL O/C RELAY (50-200%)
8	51N	1	IDMTL E/F RELAY (10-40%)
9	-	1	PANEL SPACE HEATER WITH SWITCH, FUSE AND THERMOSTAT
10	-	AS REQD	INDICATING LAMP
11	86	1	TRIPPING RELAY (ELECTRO MECHANICAL)
R1 12	95 95B	1	TRIP CKT. SUPERVISION RELAY
13	-	3	Y/Y CONNECTED CI.-1 P.T., WITH 110V SECONDARY WITH PRIMARY FUSE $\sqrt{3}$
14	27U	2	U/V RELAY (40-80%)
15	2	1	TIME DELAY ON PICK UP TIMER 0.5-5.0 SEC.
15A	2	1	TIME DELAY ON DROP OFF TIMER 0.5-5.0SEC
R1 16	-	1	VOLTMETER
17	-	1	AMMETER
18	-	1	PF METER 0.5LAG-1.0-0.5LEAD
19	-	1	FREQUENCY METER 45 TO 55Hz
20	-	1	MWH METER
21	-	AS REQD	AUX. RELAY
22	-	1	CUBICLE LAMP WITH SWITCH & FUSE
23	-	1	D.P. SWITCH WITH FUSE FOR D.C. CONTROL SUPPLY (REFER NOTE-7)
24	-	1	4-POLE MCB 10A
25	-	1	UPSTREAM BREAKER TRIP SWITCH (2 POSITION)
26	-	2	INDICATING LAMP (ON/OFF UP STREAM BREAKER)
R1 27	-	1	MVAH METER
28	-	1	MVAR METER
29	-	1	MVA METER
30	-	1	MWH METER
31	25	1	SYNCH. CHECK RELAY
32	-	1	DIGITAL MUTLIFUNCTION METER
33	-	3	PROTECTION C.T. FOR 87B PROT. CI.-PS
34	-	1	LOCAL/ECS SELECTOR SWITCH



ENGINEERS INDIA LIMITED
NEW DELHI

6.6KV SWITCHBOARD
HARDWARE DATASHEET FOR
INCOMER FROM PLANT FEEDER

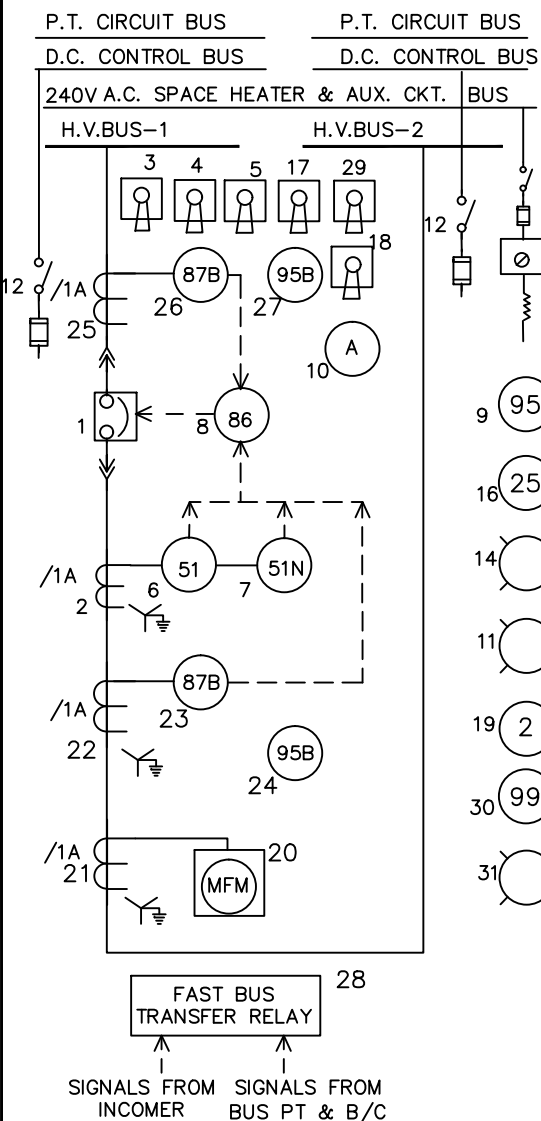
DATA SHEET

REV

B269-999-16-50-DS-0004
SHT 1 OF 1

B

PROJECT: PANIPAT REFINERY EXPANSION(P-25)	REV	DATE	PURPOSE	BY	CHKD	APPD
CLIENT: M/S IOCL	A	05.05.2020	ISSUED WITH MR/TENDER	JLC	HK	HK
	B	13.09.2021	ISSUED WITH MR/TENDER	SNM	AKG/RSR	HK



- R1 ☐ PART OF NUMERICAL RELAY-1
R2 ☐ PART OF NUMERICAL RELAY-2
R3 ☐ PART OF NUMERICAL RELAY-3
R4 ☐ PART OF NUMERICAL RELAY-4

NOTE:

1. ANTIPUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN SPECIFICATION 6-51-0001 SHALL BE IN VENDOR'S SCOPE.
3. A-I-M AND TRIP A-T-B SELECTOR SWITCHES SHALL BE PROVIDED IF AUTO TRANSFER REQUIREMENT IS SPECIFIED IN RESPECTIVE SWITCHBOARD DATASHEET.
4. ALL PROTECTION RELAY SHALL BE NUMERICAL TYPE
5. VA BURDEN OF CT SHALL BE DECIDED BY VENDOR.
6. DIGITAL MULTIFUNCTION METERS SHALL BE PROVIDED WITH 1 NO. AMMETER (3PHASE).
7. MANUAL BYPASS FEATURE SHALL BE PROVIDED FOR BUS DIFFERENTIAL FOR BOTH BUS SECTIONS INDEPENDENTLY.
8. THERE SHALL BE ONE COMMON CONTROL SWITCH FOR ALL CONTROL SUPPLY FEEDER. SEPARATE FUSES FOR FOLLOWING BRANCH CIRCUIT SHALL BE PROVIDED:
 - SPRING CHARGING CIRCUIT
 - CLOSING CIRCUIT
 - TRIPPING, CONTACT MULTIPLIER & DIGITAL INPUT CIRCUIT
 - INDICATION CIRCUIT
 - NUMERICAL RELAY SUPPLY (INCOMING OF NUMERICAL RELAY SUPPLY FUSE SHALL BE TAPPED BEFORE THE CONTROL SUPPLY SWITCH)

EQUIPMENT DATA

ITEM NO	NEMA NO.	QTY.	DESCRIPTION
1	52	1	CIRCUIT BREAKER
2	-	3	METERING / PROTECTION C.T. CI.-1/5P10
3	-	1	BREAKER CONTROL SWITCH CLOSE-NEUTRAL TRIP (SPRING RETURN TO NEUTRAL)
4	-	1	AUTO-IND-MANUAL SELECTOR SWITCH (STAYPUT & LOCKABLE)
5	-	1	3 POSITION SW. FOR TRIP BKR.-A/TRIP TIE/ TRIP BKR.-B (STAYPUT & LOCKABLE)
6	51	2	IDMTL O/C RELAY (50-200%) OR APPD. EQUIV.
7	51N	1	IDMTL E/F RELAY (10-40%)
8	86	1	TRIPPING RELAY (ELECTRO MECHANICAL)
9	95	1	TRIP CKT. SUPERVISION RELAY
10	95B	1	AMMETER (3 PHASE)
11	-	1	CUBICLE LAMP WITH SWITCH AND FUSE
12	-	2	DP SWITCH 10A WITH FUSE FOR D.C. CONTROL SUPPLY (NOTE-8)
13	-	AS REQD.	AUX. RELAY
14	-	AS REQD.	CLUSTER LED TYPE INDICATING LAMP
15	-	1	PANEL SPACE HEATER WITH SWITCH FUSE & THERMOSTAT
16	25	1	SYNCH.CHECK RELAY
17	-	1	32A/63A DC CONTROL SUPPLY CHANGEOVER SWITCH(4 POSITION)
18	-	1	32A AC CONTROL SUPPLY CHANGEOVER SWITCH (4 POSITION)
19	2	AS REQD.	ON/OFF DELAY TIMER
20	-	1	DIGITAL MULTIFUNCTION METER
21	-	3	METERING CT CLASS 1.0
22	-	3	PROTECTION C.T. FOR 87B PROT. CI.-PS
23	87B	1	HIGH IMPEDANCE BUSBAR DIFF. PROTECTION RELAY ALONG WITH CT SUPERVISION RELAY FOR COMPLETE BUS SECTION (NOTE-7)
24	95B	1	BUS WIRE SUPERVISION RELAY FOR COMPLETE BUS SECTION
25	-	3	PROTECTION C.T. FOR 87B PROT. CI.-PS
26	87B	1	HIGH IMPEDANCE BUSBAR DIFF. PROTECTION RELAY ALONG WITH CT SUPERVISION RELAY FOR COMPLETE BUS SECTION (NOTE-7)
27	95B	1	BUS WIRE SUPERVISION RELAY FOR COMPLETE BUS SECTION
28	-	1	FAST BUS TRANSFER RELAY ALONG WITH ALL OTHER ACCESSORIES AS REQUIRED
29	-	1	LOCAL/ECS SELECTOR SWITCH
30	-	1	CLOSING CIRCUIT SUPERVISION
31	-	1	CLOSING CKT. HEALTHY INDICATION LAMP LAMP(LED TYPE)



ENGINEERS INDIA LIMITED
NEW DELHI

**6.6KV SWITCHBOARD
HARDWARE DATASHEET FOR
BUSCOUPLER WITH FAST BUS
TRANSFER**

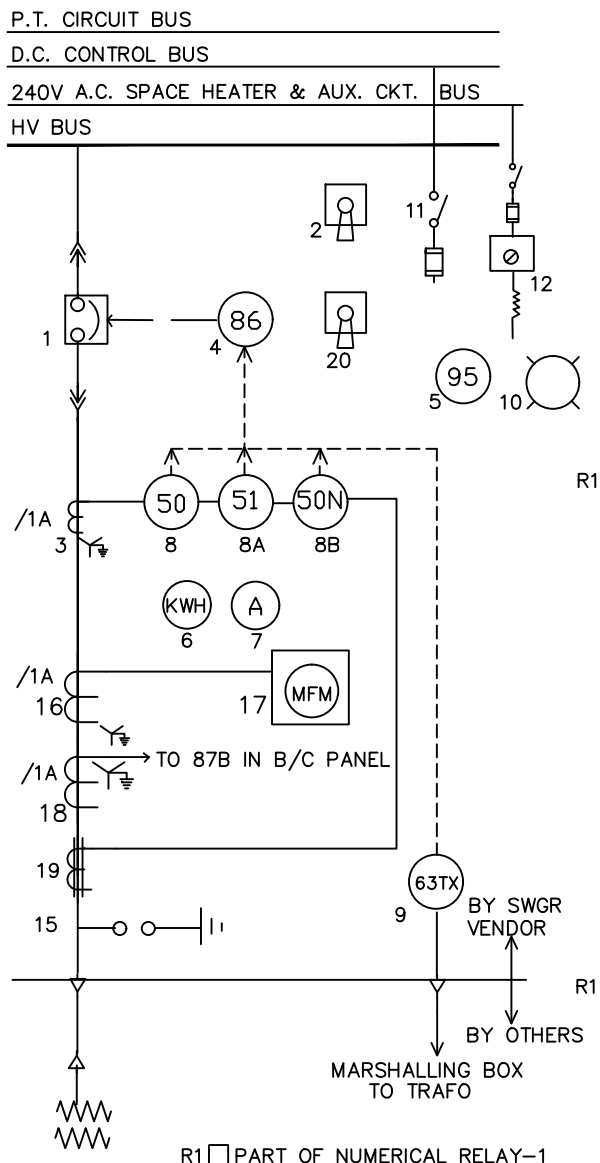
DATA SHEET

REV

B269-999-16-50-DS-0005
SHT 1 OF 1

B

PROJECT: PANIPAT REFINERY EXPANSION(P-25)	REV	DATE	PURPOSE	BY	CHKD	APPD
CLIENT: M/S IOCL	A	05.05.2020	ISSUED WITH MR/TENDER	JLC	HK	HK
	B	13.09.2021	ISSUED WITH MR/TENDER	SNM	AKG/RSR	HK



EQUIPMENT DATA			
ITEM NO	NEMA NO.	QTY.	DESCRIPTION
1	52	1	CIRCUIT BREAKER
2	-	1	BREAKER CONTROL SWITCH CLOSE-NEUTRAL-TRIP (SPRING RETURN TO NEUTRAL)
3	-	3	PROTECTION C.T. CI.-5P10
4	86	1	TRIPPING RELAY (ELECTRO MECHANICAL)
5	95	1	TRIP CKT. SUPERVISION RELAY
6	95B	1	KWH METER
7	-	1	AMMETER(3 PHASE)
8	50	2	INSTANTANEOUS O/C RELAY <500-2000%>
8A	51	2	IDMTL O/C RELAY <50-200%>
8B	50N	1	INSTANTANEOUS E/F RELAY (10-40%) WITH STABILISING RESISTOR
9	63TX	3	AUX. RELAY FOR TRANSF. TROUBLE/TRIP (HAND RESET - 8 SIGNALS)
10	-	AS REQD	CLUSTER LED TYPE INDICATING LAMP
11	-	1	DP SWITCH 10A WITH FUSE FOR DC CONTROL SUPPLY (NOTE-7)
12	-	1	PANEL SPACE HEATER WITH SWITCH, FUSE AND THERMOSTAT.
13	-	1	CUBICLE LAMP (CFL) WITH SWITCH & FUSE
14	-	AS REQD.	AUX.RELAY
15	-	1SET	METAL OXIDE TYPE SURGE SUPPRESSOR
16	-	3	METERING CT CLASS 1.0
17	-	1	DIGITAL MULTIFUNCTION METER
18	-	3	PROTECTION C.T. FOR 87B PROT. CI.-PS
19	-	1	CORE BALANCE CURRENT TRANSFORMER
20	-	1	LOCAL/ECS SELECTOR SWITCH

NOTE:

1. ANTIPUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN SPECIFICATION 6-51-0001 SHALL BE IN VENDOR'S SCOPE.
3. ALL PROTECTION RELAYS SHALL BE NUMERICAL TYPE.
4. VA BURDEN OF CT & PT SHALL BE DECIDED BY VENDOR WHERE NOT INDICATED.
5. DIGITAL MULTIFUNCTION METERS SHALL BE PROVIDED WITH 1 NO. AMMETER (3PHASE), 1 NO. MWH METER, 1 NO. MW METER
6. THERE SHALL BE ONE COMMON CONTROL SWITCH FOR ALL CONTROL SUPPLY FEEDER. SEPARATE FUSES FOR FOLLOWING BRANCH CIRCUIT SHALL BE PROVIDED:
 - SPRING CHARGING CIRCUIT
 - CLOSING CIRCUIT
 - TRIPPING, CONTACT MULTIPLIER & DIGITAL INPUT CIRCUIT
 - INDICATION CIRCUIT
 - NUMERICAL RELAY SUPPLY (INCOMING OF NUMERICAL RELAY SUPPLY FUSE SHALL BE TAPPED BEFORE THE CONTROL SUPPLY SWITCH)



ENGINEERS INDIA LIMITED
NEW DELHI

6.6KV SWITCHBOARD HARDWARE DATASHEET FOR TRANSFORMER FEEDER

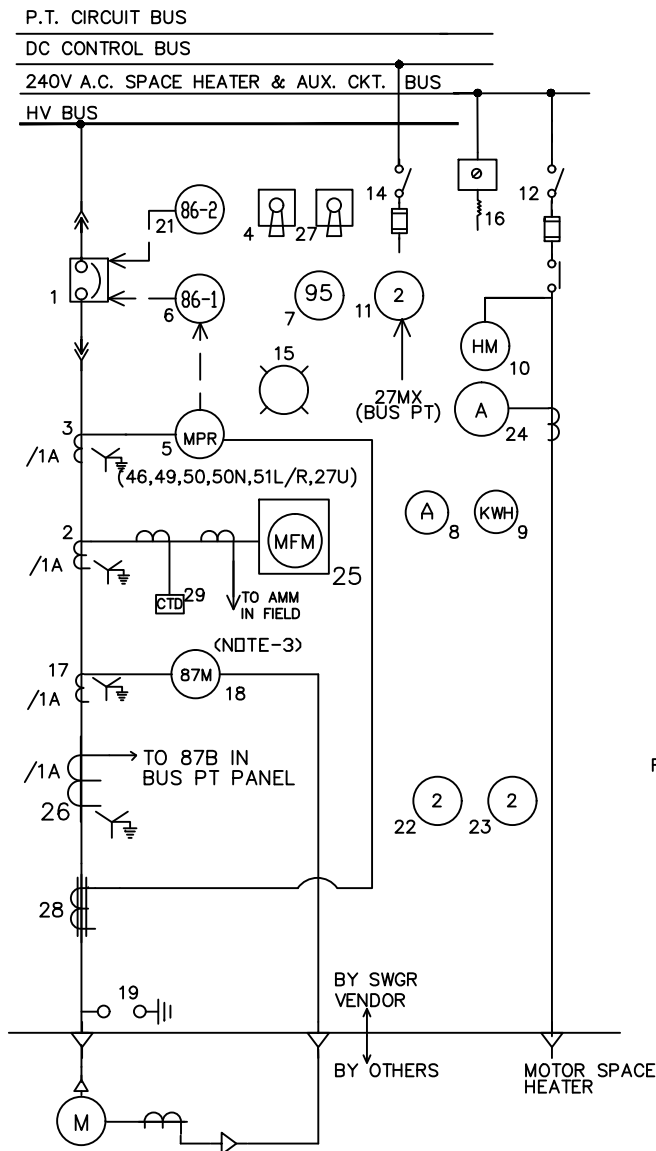
DATA SHEET

REV

B269-999-16-50-DS-0006
SHT 1 OF 1

B

PROJECT: PANIPAT REFINERY EXPANSION(P-25)	REV	DATE	PURPOSE	BY	CHKD	APPD
CLIENT: M/S IOCL	A	05.05.2020	ISSUED WITH MR/TENDER	JLC	HK	HK
	B	13.09.2021	ISSUED WITH MR/TENDER	SNM	AKG/RSR	HK



R1 ☐ PART OF NUMERICAL RELAY-1
R2 ☐ PART OF NUMERICAL RELAY-2

EQUIPMENT DATA			
ITEM NO	NEMA NO.	QTY.	DESCRIPTION
1	52	1	CIRCUIT BREAKER
2	-	3	METERING C.T. (DUAL CORE) CI.-1, 15 VA
3	-	3	PROTECTION C.T. CI.-5P10
4	-	1	BREAKER CONTROL SWITCH CLOSE-NEUTRAL-TRIP (SPRING RETURN TO NEUTRAL)
5	MPR	1	MOTOR PROTECTION RELAY WITH STABILISING RESISTOR
6	86-1	1	TRIPPING RELAY (VAJH TYPE)
7	95 95B	1	TRIP C.T. SUPERVISION RELAY
8	-	1	AMMETER
9	-	1	KWH METER
10	-	1	HOUR RUN COUNTER (5 DIGITS)
11	2	1	TIMER ON DELAY 0.5-5.0 SEC
12	-	1	DP SWITCH WITH FUSE FOR MOTOR SPACE HEATER
13	-	1	CUBICLE LAMP (CFL) WITH SWITCH AND FUSE
14	-	1	DP SWITCH 10A WITH FUSE FOR D.C. CONTROL SUPPLY (NOTE-7)
15	-	AS REQD	CLUSTER LED TYPE INDICATING LAMPS
16	-	1	PANEL SPACE HEATER WITH SWITCH, FUSE AND THERMOSTAT
17	-	3	MOTOR DIFFERENTIAL C.T.s, CI.-PS
18	87M	1	MOTOR DIFFERENTIAL PROTECTION RELAY WITH STABILISING RESISTOR & METROSIL AS REQD.(NOTE-3)
19	-	1 SET	METAL OXIDE TYPE SURGE ABSORBERS
20	-	AS REQD	AUX RELAY
21	86-2	1	TRIPPING RELAY FOR TRIP THROUGH PROCESS SIGNAL (VAJS TYPE)
22	2	1	ON DELAY TIMER FOR MOTORS WITH REACCELERATION
23	2	1	OFF DELAY TIMER FOR MOTORS WITH REACCELERATION
24	-	1	AMMETER FOR MOTOR SPACE HEATER WITH CL-1 CT
25	-	1	DIGITAL MULTIFUNCTION METER
26	-	3	PROTECTION C.T. FOR 87B PROT. CI.-PS
27	-	1	LOCAL/ECS SELECTOR SWITCH
28	-	1	CORE BALANCE CURRENT TRANSFORMER
29	-	1SET	CTD-CURRENT TRANSDUCER(4-20mA) & OTHER ACCESSORIES FOR CURRENT INDICATION IN DCS/ PLC ('R' PHASE)

NOTE:

1. ANTIPUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN SPECIFICATION 6-51-0001 SHALL BE IN VENDOR'S SCOPE.
3. 87M RELAY (ITEM 18) SHALL BE PROVIDED FOR MOTOR RATED 1500KW AND ABOVE ALONG WITH C.T. FOR MOTOR DIFF. PROTECTION
4. BREAKER CONTROL SWITCH SHALL BE WIRED FOR TRIPPING AND TEST CLOSING OF BREAKER.
5. ALL PROTECTION RELAYS SHALL BE NUMERICAL TYPE. METERING SHALL BE PART OF NUMERICAL RELAY
6. AUTO RE-ACCELERATION FEATURE WITH INHIBIT FEATURE TO BE PROVIDED AS STANDARD.
7. PROVISION FOR AUTO START TO BE PROVIDED AS STANDARD.
8. VA BURDEN OF C.T.s SHALL BE DECIDED BY VENDOR WHERE NOT INDICATED.
9. DIGITAL MULTIFUNCTION METERS SHALL BE PROVIDED WITH 1 NO. AMMETER (3PHASE), 1 NO. KWH METER,
10. MOTOR FEEDER SHALL BE PROVIDED WITH 4-20mA CURRENT/VOLTAGE TRANSDUCERS (AS REQUIRED) FOR FEEDBACK TO DCS.
11. THERE SHALL BE ONE COMMON CONTROL SWITCH FOR ALL CONTROL SUPPLY FEEDER. SEPARATE FUSES FOR FOLLOWING BRANCH CIRCUIT SHALL BE PROVIDED:
 - SPRING CHARGING CIRCUIT
 - CLOSING CIRCUIT
 - TRIPPING, CONTACT MULTIPLIER & DIGITAL INPUT CIRCUIT
 - INDICATION CIRCUIT
 - NUMERICAL RELAY SUPPLY (INCOMING OF NUMERICAL RELAY SUPPLY FUSE SHALL BE TAPPED BEFORE THE CONTROL SUPPLY SWITCH)



ENGINEERS INDIA LIMITED
NEW DELHI

6.6KV SWITCHBOARD
HARDWARE DATASHEET FOR
INDUCTION MOTOR FEEDER

DATA SHEET

REV

B269-999-16-50-DS-0007
SHT 1 OF 1

B

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PROJECT: PANIPAT REFINERY EXPANSION(P-25)
CLIENT: M/S IOCL

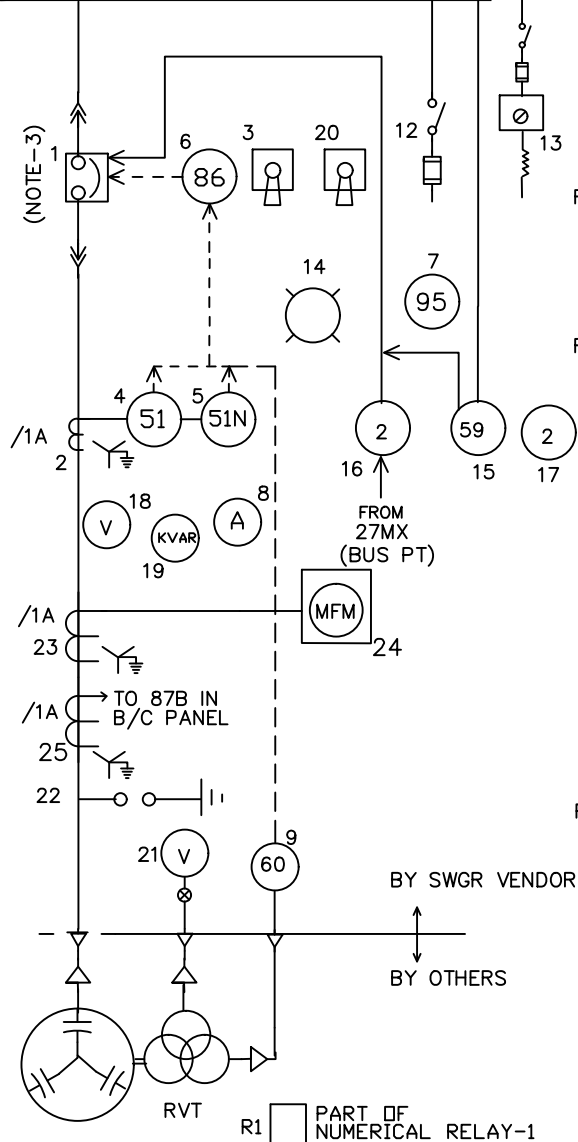
REV	DATE	PURPOSE	BY	CHKD	APPD
A	05.05.2020	ISSUED WITH MR/TENDER	JLC	HK	HK
B	13.09.2021	ISSUED WITH MR/TENDER	SNM	AKG/RSR	HK

PT CIRCUIT BUS

DC CONTROL BUS

240V A.C. SPACE HEATER & AUX. CKT. BUS

HV BUS



EQUIPMENT DATA

ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	52	1	CIRCUIT BREAKER
2	-	3	METERING / PROTECTION CT CL.-1/5P10
3	-	1	BREAKER CONTROL SW. CLOSE-NEUTRAL-TRIP (SPRING RETURN TO NEUTRAL)
4	51	2	IDMTL O/C RELAY (50-200%)
5	51N	1	IDMTL E/F RELAY (10-40%)
6	86	1	TRIPPING RELAY (VAJH TYPE)
7	95	1	TRIP CKT. SUPERVISION RELAY
8	-	1	AMMETER (3 PHASE)
9	60	1	NEUTRAL DISPLACEMENT RELAY
10	-	AS REQD	AUX. RELAY
11	-	1	CUBICLE LAMP (CFL) WITH SWITCH AND FUSE
12	-	1	DP SWITCH 10A WITH FUSE FOR DC CONTROL SUPPLY
13	-	1	PANEL SPACE HEATER WITH SWITCH FUSE AND THERMOSTAT
14	-	AS REQD	CLUSTER LED TYPE INDICATING LAMP
15	59	1	DEFINITE TIME OVER VOLTAGE RELAY (105-170%, 0-5 SEC.)
16	2	1	TIMER ON DELAY TYPE (0.5-5 SEC)
17	2	1	ON DELAY TIMER (0-600SEC) FOR CLOSING INTERLOCK
18	-	1	VOLTMETER (3 PHASE)
19	-	1	KVAR METER
20	-	1	LOCAL/ECS SELECTOR SWITCH
21	-	1	VOLTMETER WITH SELECTOR SWITCH 3-WAY AND OFF.
22	-	1SET	METAL OXIDE TYPE SURGE SUPPRESSOR
23	-	3	METERING CT CLASS 1.0, 15VA
24	-	1	DIGITAL MULTIFUNCTION METER
25	-	3	PROTECTION C.T. FOR 87B PROT. CL.-PS

NOTES:

1. ANTI-PUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN SPECIFICATION 6-51-0001 SHALL BE IN VENDOR'S SCOPE.
3. CIRCUIT BREAKER SHALL BE SUITABLE FOR CAPACITOR SWITCHING DUTY.
4. ALL PROTECTION RELAYS SHALL BE NUMERICAL TYPE.
5. METERING AS SHOWN SHALL BE PART OF NUMERICAL RELAY.
6. VA BURDEN OF CT SHALL BE DECIDED BY VENDOR EXCEPT METERING CT.
7. DIGITAL MULTIFUNCTION METERS SHALL BE PROVIDED WITH 1 NO. AMMETER (3PHASE), 1 NO. MVAR METER, 1 NO. VOLTMETER (3PHASE).
8. THERE SHALL BE ONE COMMON CONTROL SWITCH FOR ALL CONTROL SUPPLY TO THE FEEDER. SEPARATE FUSES FOR FOLLOWING BRANCH CIRCUIT SHALL BE PROVIDED:
 - SPRING CHARGING CIRCUIT
 - CLOSING CIRCUIT
 - TRIPPING, CONTACT MULTIPLIER & DIGITAL INPUT CIRCUIT
 - INDICATION CIRCUIT
 - NUMERICAL RELAY SUPPLY (INCOMING OF NUMERICAL RELAY SUPPLY FUSE SHALL BE TAPPED BEFORE THE CONTROL SUPPLY SWITCH)
- CONTACTS FOR VOLTAGE/CURRENT FOR INTERFACE WITH APFC SHALL BE PROVIDED:
 - INCOMER: LPT VOLTAGE AND CURRENT
 - BUSCOUPLER: BPT VOLTAGE AND CURRENT



ENGINEERS INDIA LIMITED
NEW DELHI

6.6KV SWITCHBOARD HARDWARE DATASHEET FOR CAPACITOR FEEDER

DATA SHEET

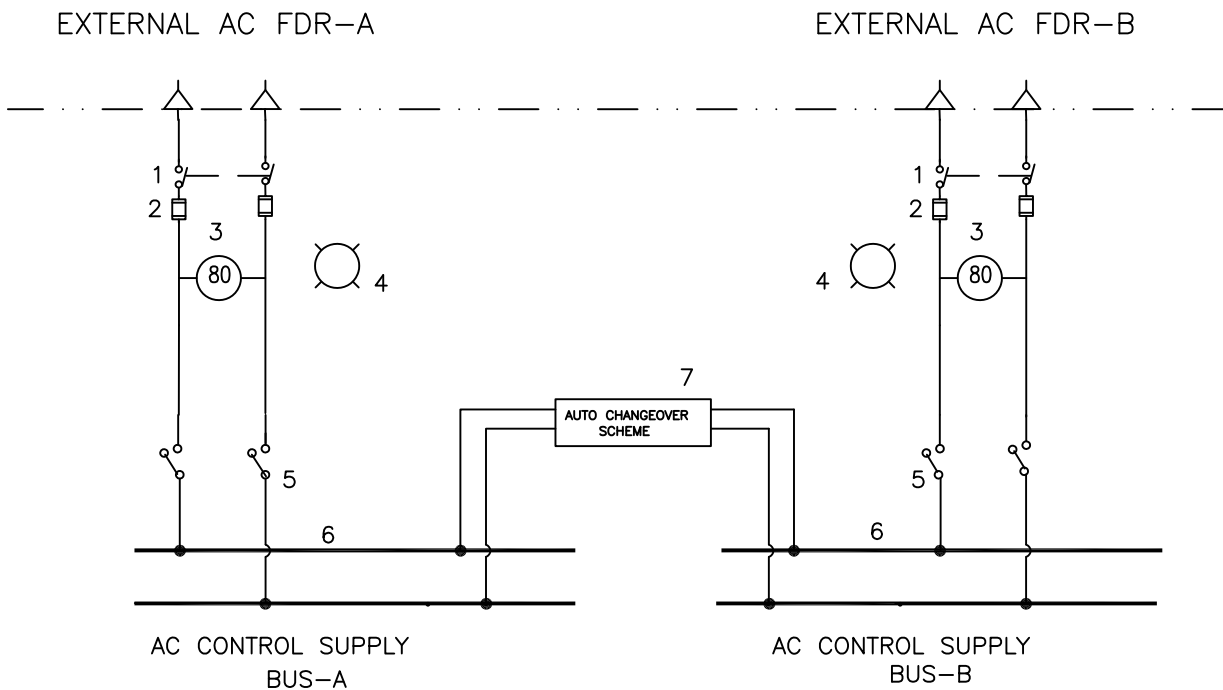
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SHT 1 OF 1

B

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PROJECT: PANIPAT REFINERY EXPANSION(P-25) CLIENT: M/S IOCL	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	05.05.2020	ISSUED WITH MR/TENDER	JLC	HK	HK
	B	08.09.2021	ISSUED WITH MR/TENDER	SNM	AKG	HK



EQUIPMENT DATA (FOR EACH AC BUS SECTION)			
ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	—	1	DP SWITCH 25A (MIN)
2	—	2	HRC FUSE
3	80	1	AC SUPPLY FAILURE RELAY (30–60%) WITH 2NO + 2NC CONTACTS FOR OWNERS USE
4	—	1	INDICATING LAMP – LED TYPE
5	—	1	CONTROL (ON/OFF) SWITCH
6	—	3	AC CONTROL SUPPLY BUS
7	—	AS REQD	ALL COMPONENTS FOR AUTO CHANGEOVER SCHEME

NOTES:

1. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN SPECIFICATION SHALL BE IN VENDOR'S SCOPE.
2. THE COMPONENT RATING ARE INDICATIVE AND SAME SHALL BE SIZED BASED ON AC POWER REQUIREMENT OF THE SWITCHBOARD BY THE VENDOR. ALL RELAYS SHALL BE NUMERICAL TYPE.
3. IN NORMAL CONDITION, EACH AC FEEDER SHALL BE FEEDING RESPECTIVE AC BUS. IN CASE OF TRIPPING OF ONE INCOMER, AUTO-CHANGEOVER SHALL TAKE PLACE SO THAT COMPLETE BUS SECTION CAN BE FED FROM HEALTHY SOURCE. ONCE POWER IS AGAIN AVAILABLE AT BOTH INCOMERS, RESTORATION SHALL BE DONE SO THAT THERE IS NO LOSS OF CONTROL POWER.
4. THE CHANGEOVER SCHEME SHALL BE 'MAKE BEFORE BREAK TYPE'.



ENGINEERS INDIA LIMITED
NEW DELHI

HARDWARE DATASHEET FOR
CHANGEOVER SCHEME FOR AC
CONTROL SUPPLY
FOR HV AND MV SWITCHBOARD

DATA SHEET

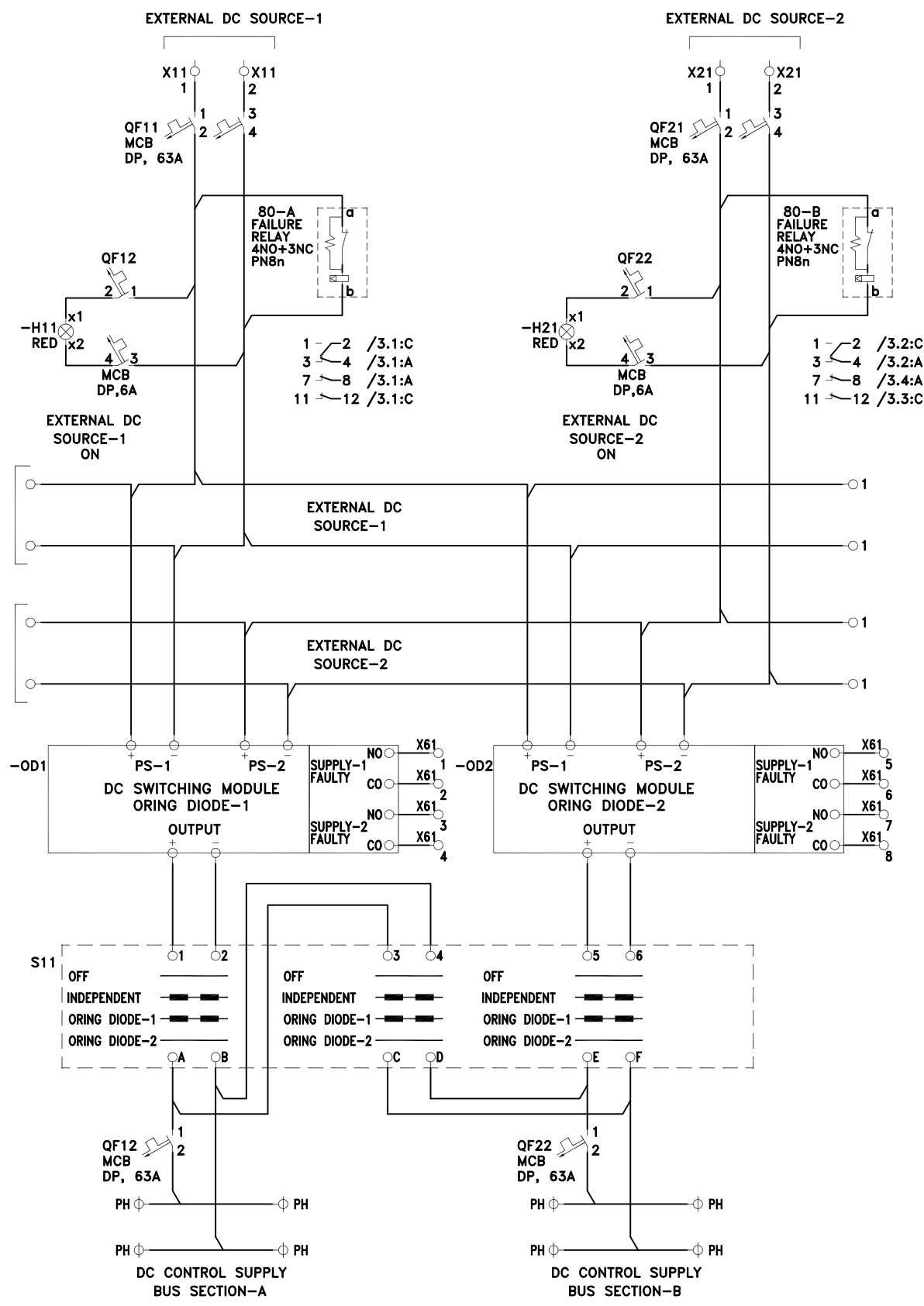
B269-999-16-50-DS-0010
Sheet 1 of 2

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PROJECT: P25 PROJECT CLIENT: M/s IOCL	REV	DATE	PURPOSE	BY	CHKD	APPD
	B	13.09.2021	ISSUED WITH MR	SNM	AKG/RSR	HK



ENGINEERS INDIA LIMITED
NEW DELHI

DC SUPPLY AUTO CHANGEOVER FOR SWBD

DATA SHEET

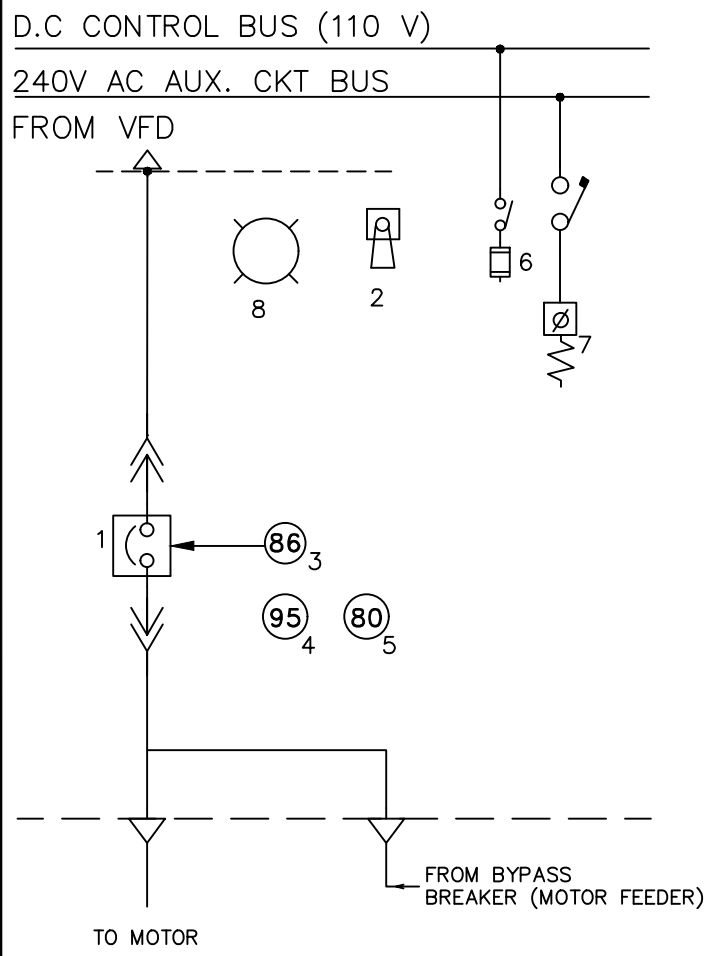
B269-999-16-50-DS-0010
SHT 2 OF 2

REV

B

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PROJECT: PANIPAT REFINERY EXPANSION(P-25) CLIENT: M/S IOCL	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	05.05.2020	ISSUED WITH MR/TENDER	JLC	HK	HK
	A	13.09.2021	ISSUED WITH MR/TENDER	SNM	RSR	HK



EQUIPMENT DATA			
ITEM NO	NEMA NO.	QTY.	DESCRIPTION
1	52	1	VACUUM CIRCUIT BREAKER
2	-	1	BREAKER CONTROL SWITCH CLOSE-NEUTRAL-TRIP (SPRING RETURN TO NEUTRAL)
3	86	1	TRIPPING RELAY (ELECTROMECHANICAL TYPE)
4	95	1	TRIP CKT SUPERVISION RELAY
5	80	1	CONTROL SUPPLY SUPERVISION RELAY
6	-	1	DP. SWITCH WITH FUSE FOR D.C. CONTROL SUPPLY
7	-	1	PANEL SPACE HEATER WITH SWITCH AND THERMOSTAT
8	-	AS REQD	CLUSTER LED TYPE INDICATING LAMPS
9	-	1	CUBICLE LAMP (CFL) WITH SWITCH AND FUSE

- NOTES:
1. ANTIPUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
 2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN JOB SPECIFICATION SHALL BE IN VENDOR'S SCOPE..
 3. FOR THE OTHER REQUIREMENTS OF RELAYS AND METERS, REFER JOB SPECIFICATION.
 4. FOR THE REQUIREMENTS OF ECS INTERFACE, REFER I/O LIST ENCLOSED SEPARATELY IN M.R/TENDER
 5. VA BURDEN OF PT SHALL BE DECIDED BY THE VENDOR/CONTRACTOR.
 6. THERE SHALL BE ONE COMMON CONTROL SWITCH FOR ALL CONTROL SUPPLY FEEDER. SEPARATE FUSES FOR FOLLOWING BRANCH CIRCUIT SHALL BE PROVIDED:
 - SPRING CHARGING CIRCUIT
 - CLOSING CIRCUIT
 - TRIPPING, CONTACT MULTIPLIER & DIGITAL INPUT CIRCUIT
 - INDICATION CIRCUIT



ENGINEERS INDIA LIMITED
NEW DELHI

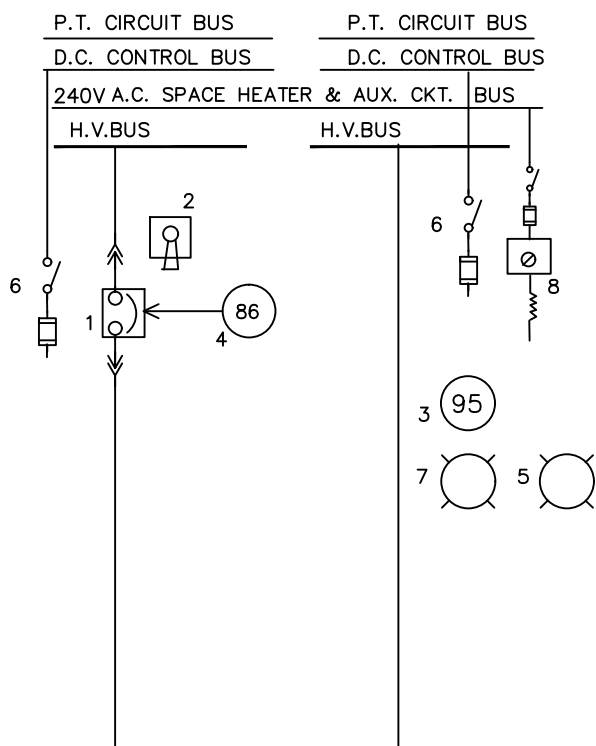
6.6KV SWITCHBOARD
HARDWARE DATASHEET TIE
FEEDER FOR VFD DRIVEN
MOTORS WITH BYPASS

DATA SHEET
B269-999-16-50-DS-0014
Sht.1 OF 1

REV
A

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PROJECT: PANIPAT REFINERY EXPANSION(P-25) CLIENT: M/S IOCL	REV	DATE	PURPOSE	BY	CHKD	APPD
	A	05.05.2020	ISSUED WITH MR/TENDER	JLC	HK	HK
	B	08.09.2021	ISSUED WITH MR/TENDER	SNM	AKG	HK



EQUIPMENT DATA			
ITEM NO	NEMA NO.	QTY.	DESCRIPTION
1	52	1	CIRCUIT BREAKER
2	—	1	BREAKER CONTROL SWITCH CLOSE-NEUTRAL TRIP (SPRING RETURN TO NEUTRAL)
3	95	1	TRIP CKT. SUPERVISION RELAY (CONVENTIONAL)
4	86	1	TRIPPING RELAY (CONVENTIONAL)
5	—	1	CUBICLE LAMP WITH SWITCH AND FUSE
6	—	2	DP SWITCH 10A WITH FUSE FOR D.C. CONTROL SUPPLY
7	—	AS REQD.	CLUSTER LED TYPE INDICATING LAMP
8	—	1	PANEL SPACE HEATER WITH SWITCH FUSE & THERMOSTAT

NOTE:

1. ANTIPUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE . ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN SPECIFICATION 6-51-0001 SHALL BE IN VENDOR'S SCOPE.
3. THERE SHALL BE ONE COMMON CONTROL SWITCH FOR ALL CONTROL SUPPLY FEEDER. SEPARATE FUSES FOR FOLLOWING BRANCH CIRCUIT SHALL BE PROVIDED:
 - SPRING CHARGING CIRCUIT
 - CLOSING CIRCUIT
 - TRIPPING AND CONTACT MULTIPLIER CIRCUIT
 - INDICATION CIRCUIT



ENGINEERS INDIA LIMITED
NEW DELHI

6.6KV SWITCHBOARD
HARDWARE DATASHEET FOR
BUSCOUPLER WITH MANUAL
TRANSFER

DATA SHEET

REV

B269-999-16-50-DS-0016
SHT 1 OF 1

B

Project	Overall Project Management and EPCM Services for Capacity Expansion of Panipat Refinery	Client	IOCL REFINERY DIVISION - HEAD OFFICE
Unit	COMMON	Location	Panipat
		Job No.	B269
		Unit No.	999

PURCHASER'S DATA

A. Site Conditions		
1.	Maximum Ambient Temperature	°C 50
2.	Minimum Ambient Temperature	°C 5
3.	Design Ambient Temperature	°C 45
4.	Relative Humidity	% 90
5.	Altitude Above MSL	m 1000
6.	Environment	Hot, Humid & Corrosive
B. RELAY SELECTION		
1. RELAY FUNCTION		
a	Only Protection	<input type="checkbox"/>
b	Protection and metering	<input type="checkbox"/>
c	Protection and metering and control	<input checked="" type="checkbox"/>
d	Ethernet communication	<input checked="" type="checkbox"/>
e	Password protection	
	a. For write	<input type="checkbox"/>
	b. For both read and write	<input checked="" type="checkbox"/>
2. CONSTRUCTION FEATURE		
a	Enclosure type	IP5X
b	Terminal size-sqmm for external wires	2.5 for Control, 4 for CT/PT
c	Mounting	Flush
d	Drawout feature	As per 6-51-0055
e	Display type	Alphanumeric/Graphical display as per 6-51-0055
3. SPECIAL REQUIREMENT IF ANY		
a	Applicable standards	IEC
b	Distance for cable capacitance for application where field contacts are directly wired to relay e.g. Motor start/ stop, intertrip	m upto 4000
4. INPUT POWER SUPPLY		
a	Site selectable feature	<input checked="" type="checkbox"/>
b	Input supply	V As per Job Specification
5. CT/ PT INPUT TO RELAY		
a	Current operated relays	<input type="checkbox"/>
	a1 Main CT input	
	a2 CT for sensitive EF or back up EF	
b	Voltage operated relays	<input type="checkbox"/>
	b1 PT input	
c	Comprehensive relay	<input checked="" type="checkbox"/>
	c1 Main CT input	3CTs, 4 Wire
	c2 PT input	3 Phase, 4 Wire
	c3 CT for sensitive EF or back up EF	1 CT, 2 Wire for Incomer/Trafo feeder
d	CT Secondary current	1
C. RELAY PROTECTION/ METERING FUNCTIONS		
1. CURRENT OPERATED RELAYS		
a	3 phase O/C element (50, 51)	* I> <input checked="" type="checkbox"/> * I>> <input checked="" type="checkbox"/> * I>>> <input checked="" type="checkbox"/>
	Characteristics as per IEC	
	* Inverse (normal, very, extremely, long) and definite time for I > and I >>	

B	16-SEP-2021	ISSUED WITH MR	V V S N Murty	RAHUL GANGULY	HARISH KUMAR
A	28-APR-2020	ISSUED WITH MR/TENDER	JAYENDRA L CHAUHAN	HARISH KUMAR	HARISH KUMAR
Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

Project	Overall Project Management and EPCM Services for Capacity Expansion of Panipat Refinery			Client	IOCL REFINERY DIVISION - HEAD OFFICE	
Unit	COMMON	Location	Panipat	Job No.	B269	Unit No. 999
	* Definite time for I >>>					
b	E/F relay (50N, 51N, 51G)			* I> <input checked="" type="checkbox"/>	* I>> <input checked="" type="checkbox"/>	* I>>> <input checked="" type="checkbox"/>
	Characteristics as per IEC					
	* Inverse (normal, very, extremely, long) and definite time for IO >, IO >>					
	* Definite time for IO>>>					
c	Metering/ event recording					
	3 phase/ line currents			<input checked="" type="checkbox"/>		
	Disturbance record			<input checked="" type="checkbox"/>		
	Breaker trip/ close status			<input checked="" type="checkbox"/>		
	Relay faults			<input checked="" type="checkbox"/>		
	Trip Values			<input checked="" type="checkbox"/>		
2	VOLTAGE OPERATED RELAYS					
a	3 phase O/V element with time delay (59+2)			* OV> <input checked="" type="checkbox"/>	* OV>> <input checked="" type="checkbox"/>	
b	3 phase U/V element with time delay (27+2)			* UV> <input checked="" type="checkbox"/>	* UV>> <input checked="" type="checkbox"/>	
	Characteristics as per IEC					
	* Inverse (normal, very, extremely, long) and definite time for UV>, UV>>					
c	Under/ Over Frequency element with time delay (81U/ 81O)					
	Settable under voltage restraint			<input checked="" type="checkbox"/>		
	df/dt element			<input checked="" type="checkbox"/>		
	Number of stages with u/f				During Detail Engg.	
	Number of stages with df/dt				During Detail Engg.	
d	Synchrocheck function			<input checked="" type="checkbox"/>		
e	Metering/ event recording					
	3 phase/ line Voltages			<input checked="" type="checkbox"/>		
	Disturbance record			<input checked="" type="checkbox"/>		
	Breaker trip/ close status			<input checked="" type="checkbox"/>		
	Relay faults			<input checked="" type="checkbox"/>		
	Trip Values			<input checked="" type="checkbox"/>		
3	MOTOR PROTECTION RELAY					
a	Protection elements					
	Thermal overload (49)			<input checked="" type="checkbox"/>		
	OC protection with doubling feature (50)			<input checked="" type="checkbox"/>		
	EF protection (50N)			<input checked="" type="checkbox"/>		
	Locked Rotor protection			<input checked="" type="checkbox"/>		
	Maximum start time			<input checked="" type="checkbox"/>		
	Maximum number of starts			<input checked="" type="checkbox"/>		
	Negative phase sequence			<input checked="" type="checkbox"/>		
	Under voltage delayed trip			<input checked="" type="checkbox"/>		
	EF Through CBCT			<input checked="" type="checkbox"/>		
	Single phasing			<input checked="" type="checkbox"/>		
b	Metering/ events					
	3 phase/ line current			<input checked="" type="checkbox"/>		
	Hour run			<input checked="" type="checkbox"/>		
	KW, KWH, pf			<input checked="" type="checkbox"/>		
	Disturbance record			<input checked="" type="checkbox"/>		
	Plot start characteristic			<input checked="" type="checkbox"/>		
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				Unit No.	999

	Trip values	<input checked="" type="checkbox"/>
	Start time	<input checked="" type="checkbox"/>
	Start current	<input checked="" type="checkbox"/>
c	Control	
	Breaker close in test mode	<input checked="" type="checkbox"/>
	Reacceleration logic	<input checked="" type="checkbox"/>
	Breaker trip	<input checked="" type="checkbox"/>
	RTD/BTD input	<input type="checkbox"/>
4	COMPREHENSIVE NUMERICAL RELAY	
a	Current op elements (51, 50, 51N, 50N, 51G)	Required as per Hardware Datasheet
b	Voltage op elements (59, 27, 2, 81U, 81O)	Required as per Hardware Datasheet
c	Control function	
	Breaker close/ trip from relay	Required
	Breaker close/ trip on serial	Required
	PLC logic function for control scheme	Required
	Digital I/P & Digital O/P:	As per approved logic diagram with 20% spare
	Motor Feeder control function	Required
5	SPECIAL PROTECTION RELAYS (Refer Job Spec)	
	Part of main relay	<input type="checkbox"/>
	Separate relay	<input checked="" type="checkbox"/>
a	Differential relays	<input checked="" type="checkbox"/>
	BUS	Refer Job Specification / Hardware datasheet
	Feeder	Refer Job Specification / Hardware datasheet
	Trafo	Refer Job Specification / Hardware datasheet
	Machine	Refer Job Specification / Hardware datasheet
b	Directional relays (67, 67N)	<input checked="" type="checkbox"/>
c	Restricted EF (64R)	<input checked="" type="checkbox"/>
d	Generator protection	<input checked="" type="checkbox"/>
e	Distance protection	<input type="checkbox"/>
f	Reverse power relay	<input checked="" type="checkbox"/>
6	OTHER RELAY FEATURES	
a	Analog inputs 4-20mA	
	RTD/ BTD-GPR	Not Required
	WTI/ OTI-Trafo relay	Not Required
	WTI= Winding temperature indicator	
	OTI= Oil temperature indicator	
b	Out put relays	
	Number of relays	As required
	Contact rating	2A, 110V DC/220V DC
	Reset	Hand reset
	FUNCTIONS part of numerical relay	
c	Lock out function (86)	<input type="checkbox"/>
d	Trip circuit supervision(95)	<input checked="" type="checkbox"/>
e	Watch dog	<input checked="" type="checkbox"/>
f.	Time stamp	<input checked="" type="checkbox"/>
g	Modular construction for easy and quick replacement of faulty PCB/circuit	<input checked="" type="checkbox"/>
D	ETHERNET COMMUNICATION AND RELAY INTEGRATION	

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1	RELAY INTEGRATION						
a	Communication ports at Relay						
	Relay front		RS 232/RJ45/USB as per 6-51-0055				
	Relay back		Suitable for IEC61850 Interface				
b	Protocol of relay LAN		IEC 61850				
c	Requirment of Integration						
	Integrator with DC		<input type="checkbox"/>				
	Directly to MMI		<input checked="" type="checkbox"/>				
d	Topology		As per Job Specification				
e	Data concentrators		Not Required				
2	REDUNDANCY						
a	Relay LAN / serial		<input checked="" type="checkbox"/>				
	Redundant (serial)		<input checked="" type="checkbox"/>				
	Non redundant (star)		<input checked="" type="checkbox"/>				
b.	From DC to MMI		<input type="checkbox"/>				
	Redundant		<input type="checkbox"/>				
	Non redundant		<input type="checkbox"/>				
c	From DC to ECS-RTU		<input type="checkbox"/>				
	Redundant		<input checked="" type="checkbox"/>				
	Non redundant		<input type="checkbox"/>				
3	REDUNDANCY REQUIREMENT FOR DC/ETHERNET SWITCH/MMI						
a	Ports at STAR coupler						
	For each relay		Non Redundant				
	For DC/Ethernet Switch		Redundant				
b	Data concentrator / Ethernet Switch						
	Power supply card		Redundant				
	Communication port for each relay LAN		Redundant				
	Communication Processor		Not Applicable				
4	SERIAL COMMUNICATION FROM DC/ETHERNET SWITCH ONWARDS						
a	DC/Ethernet Switch to MMI						
	Topology		As per Specification				
	Protocol		IEC 61850				
b	DC to DCS		Not Applicable				
c	DC/Ethernet Switch to ECS-RTU		IEC 61850				
d	Scan time		As per Specification				
5	OTHER REQUIREMENT						
a	Time synchronization		<input checked="" type="checkbox"/>				
b	Remote relay parameterization		<input checked="" type="checkbox"/>				
c	Annunciation at MMI		<input checked="" type="checkbox"/>				
MANUFACTURER'S DATA							
1. NUMERICAL RELAY TYPES							
	Relay Make/Model	Serial Ports	Analogue Inputs	No of DI/DO	Protocal	Any Other Data	Remarks
A	Incomer						
B	Buscoupler						
B	16-SEP-2021	ISSUED WITH MR	V V S N Murty	RAHUL GANGULY	HARISH KUMAR		
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Unit	COMMON	Location	Panipat	Job No.	B269	Unit No.	999
C	Generator						
D	Transformer						
2 DATA CONCENTRATOR / ETHERNET SWITCH AND RELAY INTEGRATION							
a	Model no.						
	Make						
b	Input power supply						
	Voltage						
	Power reqt						
c	Redundancy						
	Power supply						
	Communication processor						
	Communication port						
	Relay LAN/ Serial communication						
	ECS-RTU interface						
	MMI interface						
d	Serial interface/ Relay LAN						
	Topology						
	Protocol						
	Nos of relay in each						
	Topology						
	Type of port						
	Cable type						
e	Serial interface- MMI						
	Topology						
	Protocol						
	Type of Port						
	Cable type						
f	Serial Interface -ECS-RTU						
	Topology						
	Protocol						
	Type of Port						
	Cable type						
g	Number of Digital Input/ Aanalogue Input (4-20mA)						
	DI for substation eqpt						
	Spare DI						
	AI as per project data sht						
	Spare AI						
h	Maximum Scan Time						
	Status						
B	16-SEP-2021	ISSUED WITH MR	V V S N Murty	RAHUL GANGULY	HARISH KUMAR		
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Project Overall Project Management and EPCM Services for Capacity Expansion of Panipat Refinery **Client** IOCL REFINERY DIVISION - HEAD OFFICE

Unit COMMON **Location** Panipat **Job No.** B269 **Unit No.** 999

	events	
	Data acquisition (analog)	
	Disturbance record download time	
i	Other features	
	Spare capacity for additional devices for relay LAN	
	Time synchronization options	
	Power walk in time	
	Restoration time of communication of DC with NR & MMI	

3	STANDARD FEATURES OF RELAY / SYSTEM ARCHITECTURE

Notes
1

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LIGHTING FIXTURE SCHEDULE

PROJECT : P-25, PANIPAT

OWNER : INDIAN OIL CORPORATION LIMITED

PMC : ENGINEERS INDIA LIMITED

EIL JOB No. : B269

B	10.08.21	ISSUED WITH TENDER	MKM	RAHUL	HK
A	13.11.19	ISSUED WITH TENDER	CA	RAHUL	SV
Rev	Date	Purpose	Prepared By	Checked By	Approved By

S. No.	Light Fixture - Description	Makes & Catalogue Nos.
1.	LED IND-1: Surface mounted / Pendant Type LED Tube Lights for Office or Commercial Buildings – completely integral with in-built linear SMD LEDs/ electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 20 Watts.	<ul style="list-style-type: none"> Bajaj : BLRB 18W LED XE Crompton : LSDL –20- CDL ; Philips : TMC501 With TLED 1X18W/4FT Master LED Tube Pyrotech: PC-14-D-L-WXOA/18W <p>Or Equivalent Models.</p>
2.	LED IND-2: Surface mounted / Pendant Type Integral LED Tube Lights for Industrial Warehouses /Workshops / Sub-Stations – completely integral with in-built linear SMD LEDs / electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 36 Watts. An alternative solution for conventional 2x28 W/2x36 W fluorescent Battens.	<ul style="list-style-type: none"> Philips : TMC 501 With TLED 2X18W/4FT Master LED Tube Crompton : LDL -36 – CDL; Bajaj : BLRB 218W LED XE Pyrotech: PC-14-D-L-WXOA/36W <p>Or Equivalent Models</p>
3.	LED IND-3: Surface mounted / Pendant Type Integral LED Tube Lights for industrial outdoor /weatherproof applications & IP-65 Ingress Protection – completely integral with in-built linear SMD LEDs / electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 36 Watts.	<ul style="list-style-type: none"> Bajaj : Linea Excel {BIPC 40W LED XE}; Crompton : Shield {IPFC1LT8/16 & 2X LGT8-20-865-2}; Philips : Endura LED Waterproof – 42 Watts; WT550 C LED 40S CW PSU S1 PC; <p>Or Equivalent Models.</p>
4.	LED IND-4: Surface mounted / Pendant Type Integral LED Tube Lights for Industrial Warehouses /Workshops / Sub-Stations – completely integral with in-built linear SMD LEDs / electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 36 Watts. An alternative solution for conventional 2x28 W/2x36 W fluorescent Battens.(Suitable for Mounting on Metsec Channel with white enameled reflector)	<ul style="list-style-type: none"> Crompton: Master LED tube 1200mm-18W 869 T8 Bajaj: BLRB 218W LED XE <p>Or Equivalent Models.</p>
5.	LED-1: Recess mounted, compact / slim panel / tile light in square shape – suitable for mounting in 2 Feet X 2 Feet Grid type False Ceiling with minimum 35 Watts rating & White Color – with built-in driver & all mounting accessories.	<ul style="list-style-type: none"> Bajaj : ““Armstorme” {BZRSQ 36W WH GZi}; Crompton : LCTLRNI-36-FO-CDL Philips : RC 420B LED 35S PSU W60L60 Pyrotech: PB-12-D-L-WXOA/36W <p>Or Equivalent Models.</p>
6.	LED-2: Recess mounted, compact / slim panel / tile light in square shape – suitable for mounting in 2 Feet X 2 Feet Grid type False Ceiling White Color – with built-in driver & all mounting accessories.	<ul style="list-style-type: none"> Crompton: LCTLRN-50-FO-CDL Bajaj: BZRSQ 43W LED GZi WH <p>Or Equivalent Models.</p>

7.	LED -3: Recess mounted, compact / flat, round or square shaped LED down-lighter in white finish – suitable for mounting in gypsum / Armstrong type false ceiling – with minimum 18 Watts rating & White Color – with built-in driver and all mounting accessories.	<ul style="list-style-type: none"> Bajaj : SLEEK Round / Square {BGSLO Sleek 18W WH RD / SQ}; Crompton : QUARTZ Round / Square {LCDE or LSDE-18W-CDL/NW}; Philips : Green LEDi {DN 195B LED 20S – 6500PSU WHS1}; Pyrotech: PB-12-D-L-WXOA/18W <p>Or Equivalent Models.</p>
8.	LED -4: Recess Mounted Adjustable / Swivel LED spot-light / COB Light with tilting (Gimbal) feature and a minimum rating of 20 Watts & golden yellow / white color light – with white round / square frame, built-in driver, suitable for mounting on gypsum false-ceiling & all mounting accessories.	<ul style="list-style-type: none"> Philips : ECO Accent Recessed Adjustable {RS271B LED 20/850 PSU-E WB WH}; Bajaj : KLASS Series COB {BRDCSL 16 W WW}; QUADRA SERIES COB{BLDRS24W} Crompton : AQUA COB LED {LR-RAD-20- CDL/NDL-24/50D}; <p>Or Equivalent Models.</p>
9.	LED -5: Surface Mounted – Ceiling Tile LED Fixture of dimensions 2 Feet X 2 Feet – suitable for direct ceiling mounting - with minimum 35 Watts rating & White Color – with built-in driver & all mounting accessories.	<ul style="list-style-type: none"> Crompton : ORION-I – LCTLSN-36-CDL Bajaj : SKYLITE-BCTBLS-36 WZTWH Philips : CIRRUS – SM365C LED33-6500 PSU-OD WH Pyrotech: PB-12-D-L-WXOA/36W <p>Or Equivalent Models.</p>
10.	LED -6 : Surface mounted round or square shaped LED down-lighter in white finish – suitable for direct ceiling mounting – with minimum 18 Watts rating & White Color – with built-in driver and all mounting accessories.	<ul style="list-style-type: none"> Crompton : Pearl II – Round / Square {LCDSPLN- R-18-CDL / LCDSPLN-S-18-CDL}; Bajaj : Sleek – Round / Square– BGSLO Sleek Surface 18 W WH RD / BGSLO Sleek Surface 18W WH SQ}; Philips : Cirrus Mini {SM5 18C LED 16S 6500PSU OD WH} Pyrotech: PB-13-D-L-WXOA/18W <p>Or Equivalent Models.</p>
11.	LED -7: Surface mounted round or square shaped LED Dome -lights – suitable for direct wall mounting – with minimum 18 Watts rating & White Color – with built-in driver and all mounting accessories.	<ul style="list-style-type: none"> Philips : CoreLine Wall-Mounted {WL120V LED12S / 840 PSR WH}; Bajaj : TARA Round Shaped Surface Mounted {BGCML 18095WH} Crompton : Orbit {LCDSPLN-R-18-CDL}; <p>Or Equivalent Models.</p>
12.	LED -8: Rechargeable Lantern type LED Fixtures of minimum 4 Watts rating - with inbuilt sealed rechargeable Battery / Cell suitable for operation at 240 Volts AC and with a minimum battery back-up time of 2 hours.	<ul style="list-style-type: none"> Philips – Ujjwal Plus LED Lantern; Bajaj LED Glow 648 LR Rechargeable Lantern; Crompton - CG-LL30 LED Rechargeable Lantern;

		Or Equivalent Models.
13.	LED-RSD-10: LED Fixture suitable for 110V/220V DC complete with 18W LED Lamp, driver, including other materials as applicable for installation (Recess mounted)	<ul style="list-style-type: none"> Pyrotech (PB-13-P-L-WXOA/18W) Or Equivalent Models.
14.	LED-SFD-12: LED Fixture suitable for 110V/220V DC complete with 18W LED Lamp, driver, including other materials as applicable for installation (Surface mounted)	<ul style="list-style-type: none"> Pyrotech (PB-13-P-L-WXOB/18W) Or Equivalent Models.
15.	LED -LB-1: Indoor Industrial Low Bay LED Luminaries - with high pressure die-cast aluminum housing, mirror / lens optics (heat- resistant) for symmetric light distribution and high system efficacy for a rating of 80 Watts up to 100 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories.	<ul style="list-style-type: none"> Bajaj : Duranto Highbay Luminaire 100 Watts{BGHB 100W LED GV}; Crompton : SURROUND -II LHB11-70-CDL/60 - 70Watts; Philips : GreenPerform Highbay G2 – 80 Watts{BY689P LED 90/NW PSU S-NB}; Pyrotech: PD-17-D-L-WXOA/90W Or Equivalent Models.
16.	LED -HB1: Indoor Industrial Medium Bay LED Luminaries - with high pressure die-cast aluminum housing, mirror / lens optics (heat- resistant) for symmetric light distribution and high system efficacy for a rating of 120 Watts up to 150 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories.	<ul style="list-style-type: none"> Bajaj : Duranto Highbay Luminaire 150 Watts{BGHB 150W LED}; Crompton : SURROUND-II {LHB11-110-CDL/60 -110 Watts}; Philips : GreenPerform Highbay G2 – 130 Watts{BY688P LED 140/NW PSR S-NB}; Pyrotech: PD-17-D-L-WXOA/150W Or Equivalent Models.
17.	LED -HB2: Indoor Industrial High Bay LED Luminaries - with high pressure die-cast aluminum housing, mirror / lens optics (heat- resistant) for symmetric light distribution and high system efficacy for a rating above 180 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories.	<ul style="list-style-type: none"> Bajaj : Duranto Highbay Luminaire 200 Watts{BGHB 200W LED}; Crompton : Crompton : LHB11-180-CDL/60- 180Watts; Philips : Green Perform Highbay G2 – 200 Watts{BY687P LED200/NW PSR S-WB L3000}; Pyrotech: PD-17-D-L-WXOA/180W Or Equivalent Models.

18.	<p>LED RCD-03</p> <p>Recess mounted circular LED downlighter White powder coated recess mounting pressure die-cast aluminium housing. Specially designed COB LED die-cast aluminium carriage assembly. Die-cast aluminium carriage assembly provided with heat sink for efficient dissipation of heat – important for LED luminaires. 2 nos., spring loaded MS mounting brackets to suit false ceiling – easy to install & maintain. Constant current output driver. fixture should have minimum system lumen of 5000lm & minimum efficacy at System level >100lumens/watt with max 50W, Life of fixture : 50K Hrs. @ L70B50 Lumen maintenance, CCT up to 5700 CRI >80, THD <10%@ 240v ac. An operating Voltage Range of 140 - 270 V. Minimum Internal Surge Protection 3kv, IP 40. BIS certification is required for LED Driver & Luminaire, Luminaire manufacture shall provide LM79 report from in house NABL accredited lab & LM80 report issued by LED manufacturer.</p>	<ul style="list-style-type: none"> • BAJAJ:- BRDCSL 50W LED WH - 50W <p>Or Equivalent</p>
19.	<p>LED RSD-10A</p> <p>LED Fixture suitable for 110V/220V DC complete with 40W LED Lamp, driver, including other materials as applicable for installation (Recess mounted)</p>	

OUTDOOR LED LIGHT FIXTURES

20.	LED BK -1: Outdoor Surface Mounted Bulkhead LED Lights – with die-cast aluminum housing / toughened glass lens and minimum IP -65 ingress protection of minimum 10 watts rating – complete with integral type electronic drivers & all mounting accessories.	<ul style="list-style-type: none"> Bajaj : Wee Plus {BIBWP 10 W LED} Crompton : Sunrise LED Bulkhead {LBH-10- CDL}; Philips : Vista Glow WT140W LED7S CW PSU S1 PC; Pyrotech: PP-11-D-L-WXOA/10W <p>Or Equivalent Models.</p>
21.	LED BK -2: Outdoor Surface Mounted Bulkhead LED Lights – with die-cast aluminum housing / toughened glass lens and minimum IP -65 ingress protection of minimum 30 watts rating – complete with integral type electronic drivers & all mounting accessories.	<ul style="list-style-type: none"> Pyrotech: PP-11-D-L-WXOA/30W <p>Or Equivalent Models.</p>
22.	LED ST-4 : LED Street Light Fixtures with Leaf / Sleek Type design & SMD or COB Type LEDs for high system efficacy & rating of 80 Watts to 100 Watts – having powder coated Pressure Die-Cast Aluminum Body & toughened glass visor fitted in a frame & completely integral – with all mounting accessories. The fixture enclosure shall have minimum IP 65 ingress protection.	<ul style="list-style-type: none"> Bajaj : EDGE Streetlight – 100 Watts {BRLEP 90W LED}; Crompton : NEXUS STAR - 90 Watts {LSTP-90-CDL}; Philips : Green Line V2 BRP410 LED 092 CW HE NR FG S2 PSU GR; Pyrotech: PP-11-D-L-WXOA/10W <p>Or Equivalent Models.</p>
23.	LED ST-10 : LED Street Light Fixtures with Leaf / Sleek Type design & SMD or COB Type LEDs for high system efficacy & rating of 120 Watts having powder coated Pressure Die-Cast Aluminum Body & toughened glass visor fitted in a frame & completely integral – with all mounting accessories. The fixture enclosure shall have minimum IP 65 ingress protection.	<ul style="list-style-type: none"> Crompton: LSTP120 CDL Bajaj:- BRTFG 120W LED <p>Or Equivalent Models.</p>
24.	LED ST-11 : LED Street Light Fixtures with Leaf / Sleek Type design & SMD or COB Type LEDs for high system efficacy & rating of 120 Watts to 150 Watts – having powder coated Pressure Die-Cast Aluminum Body & toughened glass visor fitted in a frame & completely integral – with all mounting accessories. The fixture enclosure shall have minimum IP 65 ingress protection.	<ul style="list-style-type: none"> Bajaj : Edge Streetlight – 150 Watts {BRTFG 135W LED}; Crompton : 135 Watts {LSTP-135-CDL};; Philips : Greenline Extra BRP322 LED 122 CW HE MR PC S3 XT; Pyrotech: PE-11-D-L-WXOA/150W <p>Or Equivalent Models.</p>
25.	LED FD-1: LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 80 Watts up to 110 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated	<ul style="list-style-type: none"> Philips : Uniflood 2 Series Flood Light - 110Watts {BVP122 LED110 CW FLNB FG XTFC}; Crompton : OMEGA LED Flood Light – 110 Watts{LFLN11-110-CDL/60}; Bajaj : Force Flood Light – 100 Watts {BJFL 100W LED I}; Pyrotech: PD-17-D-L-WXOA/110W

	pressure die-cast & Aluminum Body & toughened glass front cover.	Or Equivalent Models.
26.	LED FD-2: LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 150 Watts up to 200 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	<ul style="list-style-type: none"> Philips : Tempo Series LED Flood Lights – 172Watts { BVP410 LED 172 CW HE NB FG S3 XT}; Crompton : 200 Watts LED Flood Lights {LFLN11-200-CDL/60};; Bajaj : Turbo Flood Light – 200 Watts {BJFL 200W LED I}; Pyrotech: PD-17-D-L-WXOA/200W <p>Or Equivalent Models.</p>
27.	LED FD-3: LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 250 Watts & above – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	<ul style="list-style-type: none"> Philips : Tempo Series LED Flood Lights – 252Watts {BVP410 LED 252 CW HE AK55 FG S3XTFC}; Crompton : MAGPIE – 250 Watts LED Flood Lights{LFLPI-250-CDL/60}; Bajaj : Turbo Flood Light – 350 Watts {BJFL 350W LED I}; Pyrotech: PD-17-D-L-WXOA/250W <p>Or Equivalent Models.</p>
28.	LED FD-9: LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 400 Watt & above – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	<ul style="list-style-type: none"> Crompton: MAGPIE+ LFLPI-400-CDL/60 Bajaj: BJFL 400W LED IP66 Philips: Tango G3 BVP383 LED450/CW 400W 220-240V SWB IN; Pyrotech: PD-17-D-L-WXOA/500W <p>Or Equivalent Models</p>
29.	LED BL-1: Integral decorative LED Bollard Luminaries with opal acrylic diffusers of minimum 8 Watts rating & suitable for landscape lighting with IP-65 Ingress Protection and anti-corrosive powder-coated die-cast aluminum housing – complete with all mounting accessories (anchor bolts / base-plates)	<ul style="list-style-type: none"> Bajaj : Tetris LED Bollard {BGBOS 600 9W LED}; Crompton : Maya-III COB LED Bollard {LBLA3-10- CDL}; Philips : City Cube Series LED Bollard - 8.5 Watts{BCP400 LED04 U CW PSU GR S1}; Pyrotech: PD-15-D-L-WXOA <p>Or Equivalent Models.</p>
30.	LED PT-1 LED Post Top Lantern type fixture. Lumen Output shall be equivalent to that of 80W HPMV	<ul style="list-style-type: none"> Bajaj BLTSP 25W NW LED (Globe) <p>Or Equivalent Models.</p>

OUTDOOR TYPE FIXTURES			
LIGHTING FIXTURE (Ex-d/Ex-de/Ex-n/Ex-nR) SUITABLE FOR ZONE-1 & ZONE-2 AREA			
Fixture type	Description	Wattage	Manufacturer Type Designation
Ex-LED-1A	Weatherproof, non sparking restricted breathing type Ex nR well glass LED lighting fixture complete with LED lamp, driver accessories including other materials as applicable for installation suitable for Zone-2 classified areas, total lumen output in the range of 4000-4500 lumens, with minimum efficacy greater than 100 lumens/watt.		
Ex-LED-2A	Same as Ex-LED-1A but with total lumen output in the range of 6500-7000 lumens.		
Ex-LED-3A	Same as Ex-LED-1A but with total lumen output in the range of 10000-10500 lumens.		
Ex-LED-4	Weatherproof, non sparking restricted breathing type Ex nR floodlight LED lighting fixture complete with LED lamps, driver accessories, including other materials as applicable for installation, total lumen output in the range of 6500-7000 lumens with minimum efficacy greater than 100 lumens/watt.		
Ex-LED-5	Same as Ex-LED-4 but with lumen output in the range of 10000-10500 lumens.		
FLP-LED-1A	Flameproof and weatherproof Ex d/ Ex de type well glass LED lighting fixtures complete with LED, driver, accessories, including other materials as applicable for installation, suitable for gas group IIB temperature class T3, total lumen output in the range of 4000-4500 lumen with minimum efficiency greater than 100 lumen /watt.		
FLP-LED-2A	Same as FLP-LED-1A but with total lumen output in the range of 6500-7000 lumens.		
FLP-LED-3A	Same as FLP-LED-1A but with total lumen output in the range of 10000-10500.		

FLP-LED-4A	Flameproof and weatherproof Ex d/ Ex de flood light LED fixture complete with LED lamp, driver, accessories, including other materials as applicable for installation, suitable for gas group IIB, temperature class T3, total lumen output in the range of 6500-7000 with minimum efficiency greater than 100 lumen/watt.		
FLP-LED-5A	Same as FLP-LED-4A but with lumen output in the range of 10000-10500 lumens.		
FLP-LED-6A	Flameproof and weather proof Ex-d/ Ex de well glass LED lamp, driver, accessories including other materials as applicable for installations, suitable for gas group IIB, temperature class T3, total lumen output in the range of 4000-4500 lumens with minimum efficiency greater than 100 lumens/watt and suitable for 220V/110V DC.		
FLP-LED-1A- IIC	Same as FLP-LED-1A but suitable for gas group IIC, temp. Class T3.		
FLP-LED-2A IIC	Same as FLP-LED-2A but suitable for gas group IIC, temp. Class T3.		
FLP-LED-3A- IIC	Same as FLP-LED-3A but suitable for gas group IIC temperature class T3.		
FLP-LED-4A- IIC	Same as FLP-LED-4A but suitable for gas group IIC temperature class T3.		
FLP-LED-5A- IIC	Same as FLP-LED-5A but suitable for gas group IIC temperature class T3.		
FLP-LED-6A- IIC	Same as FLP-LED-6A but suitable for gas group IIC temperature class T3.		
FLP-LED12	Ex proof Ex d/ Ex de type LED Fixtures complete with LED Lamp, driver, including other materials as applicable for installation.	52 W	Philips BCW216 Stahl EXLUX 6002 Eaton eLLK 92 LED 800 or equivalent
FLP-LED-12- IIC	Same as FLP-LED-12 but suitable for gas group IIC temperature class T3.		
CHEMICAL RESISTANT FIXTURES			
LED13	LED Chemical resistance Fixtures complete with LED Lamp, driver, including other materials as applicable for installation.	Up to 50W	Philips WT461C or equivalent
CM2	Chemical resistance fixture suitable for 2x36 W fluorescent lamp.	2x36 W	Philips TMX-95/236 Crompton IFV-1124HSB Bajaj BJI-236 VP

CM3	Similar to CM2 but suitable for 2x18W fluorescent lamps with reeded light stabilized clear acrylic cover (for use in indoor areas with high humidity and corrosive vapor).	2x18 W	Philips TDC-10/218 Bajaj BJI-218FG
CM4	Similar to CM3 but with 2x36W fluorescent lamps.	2x36 W	Philips TDC-10/236 Crompton IPFC-24HSB
CM5	Ceiling/pendent mounting drip proof and dust tight fixture suitable for 2x36 W fluorescent lamps with aluminum housing, stove enameled grey outside and white inside with gasketed clear acrylic cover.	2x36 W	Philips TPW-11/236 Crompton IDJ-1124HSB Bajaj BJI-236
CM6	Dust & Vapor proof fixture suitable for 1x40W fluorescent lamp with glass sheet cover.	1x40W	Crompton IPFC 14HSB Bajaj BJI-136FG

Notes:

- All fixtures shall be latest energy efficient type.
- All fixtures shall be complete with lamps.
- All LED fixtures shall be supplied complete with LED lamp & drivers.
- All LED fixtures shall have high power factor (Min. 0.95).
- Manufacturer shall ensure that LED panels are sourced from reputed LED manufacturers.
- The LED light fixtures should be tested for luminous lux level as per IES-LM-79. Type test certificates shall be furnished in compliance to same. Type test certificates for LM-79 for all fixtures shall be from a NABL (National Accreditation Board for Testing and Calibration Laboratories) accredited Lab or UL Laboratory.
- The LED's used in the lighting fixtures should be tested for the service life as per IES-LM-80. Type test certificates shall be furnished in compliance to same.
- The LED Driver shall comply with the requirement of IEC 61347-2-13.
- Fixture life time (L70) shall be > 50000 hrs at ambient of 45 degree C.
- Make of fixtures shall be embossed on the body of the lighting fixtures.
- LED lamps shall be provided with highly translucent diffusers with advance optical system with high internal reflectivity material of excellent and smooth output for glare free light and no visibility of LED to eyes.
- All lighting fixtures shall be supplied complete with associated LED lamp and driver.
- All above Luminaries with controllers & drivers must be suitable for a working voltage range of 150 to 270 Volts – 50 Hz - AC.
- In case any of the above referred models / makes are discontinued, prior approval from the engineer-in-charge has to be taken for supplying any alternate makes / models.
- Retrofit type of flameproof LED fixtures will not be acceptable (implies LED bulbs fixed inside flameproof enclosures). All flameproof fixtures shall have integral panelled LED clusters (COB - Chip on Board or SMD - Surface mount Device).

TECHNICAL AMENDMENT NO: 01

ITEM DESCRIPTION : (RWTP, RODM, ZLDP, CPU) PLANT FOR P-25

BIDDING DOCUMENT NO. : B269-475-17-44-PA-T-8701

DISCIPLINE : SMED (ROTATING PART)

0	05-03-2022	ISSUED AS TECHNICAL AMENDMENT	MKY	MG	TK
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

The terms, conditions and specifications of Bidding Document stand modified to the extent indicated under column “MODIFICATIONS/ADDITION/DELETION”. All other terms & conditions, stipulations and specifications of bidding document shall remain unaltered.

S No	Part No / Vol No	Page No.	Section / Document no.	Clause No / Item No	Subject	Modifications / Additions/Deletion
1.			B269-487-80-42-SP-8701		JOB SPECIFICATION FOR WATER BLOCK PACKAGE (RWTP, RODM, ZLDP, CPU)	<p><u>Modification:</u></p> <p>Document # B269-475-8-43-SP-8701, Rev-B is modified to Document No. # B269-475-80-42-SP-8701, Rev-C & enclosed here. Bidder to consider the revised document.</p>

S No	Part No / Vol No	Page No.	Section / Document no.	Clause No / Item No	Subject	Modifications / Additions/Deletion
2.			List of Standard Specification: a) 6-41-0006 b) 6-41-0301		a) Standard specification for centrifugal pumps (Special Purpose Process Service). b) Standard specification for dosing packages (skid mounted)	<p><u>Modification:</u></p> a) Document # 6-41-0006, Rev-3 is modified to Document No. # 6-41-0007, Rev-0 & enclosed here. Bidder to consider the revised document. b) Document # 6-41-0301, Rev-0 is modified to Document No. # 6-41-0301, Rev-1 & enclosed here. Bidder to consider the revised document.
3.			Vendor list: B269-475-80-42-VL-8701, Rev-A		Vendor list of Rotating equipment	<p><u>Addition:</u></p> Following Documents has been added. Bidder to consider the same.

Encl :

- Doc. No. # B269-475-8-43-SP-8701, Rev-C(21 pages)
- Document # 6-41-0006, Rev-3(27 pages)
- Document # 6-41-0301, Rev-1(28 pages)
- Document # B269-475-80-42-VL-8701, Rev-A(21 pages)

JOB SPECIFICATION FOR WATER BLOCK PACKAGE (RWTP, RODM, ZLDP, CPU) (TENDER NO. B269-475-17-44-PA-T-8701) (SME-ROTATING EQUIPMENT)

PROJECT : CAPACITY EXPANSION OF PANIPAT REFINERY (P25 PROJECT)
LOCATION : IOCL PANIPAT REFINERY
CONSULTANT : ENGINEERS INDIA LIMITED
EIL JOB NO. : B269

C	05.03.2022	Revised & Issued for Tender	MKY	MG	TK
B	05.05.2020	Issued for Tender	MKY	AM	AM
Rev.	Date	Purpose	Prepared by	Checked by	Approved by

SECTION I: ROTATING EQUIPMENT

1. GENERAL

1.1. Scope

This Specification covers the design criteria for the purpose of carrying out Engineering for Procurement of various rotating equipment required and their requirements with regard to spare parts & special tools. This Job Specification shall be applied for "WATER BLOCK PACKAGE (RWTP, RODM, ZLDP and CPU) for PROJECT with Tender no. B269-475-17-44-PA-T-8701 for P25 Project, IOCL, Panipat.

The Contractor shall use data sheets / Proforma as enclosed in this section of the bid package, for carrying out engineering for procurement at his end.

For the equipments, for which no such data sheets/proformas are furnished by PMC/Owner, the Contractor may use his standard data sheets / proformas or of Equipment Manufacturer's standard data sheets/ proformas.

1.2. Selection of Rotating Equipment

Selection of Rotating Equipment shall be based upon the following considerations:

- Suitability for the specified duty conditions.
- Standard Models under vendor's regular range of manufacture.
- Proven Track record in similar service as specified under acceptance criterion.
- Optimum operating and maintenance costs.
- Maximum Interchangeability of parts.
- Ease of operation and maintenance.

1.3. Order of Precedence

The design, manufacturing, testing etc. for the above equipment shall be as per the following documents applicable to these equipment and shall be in the same order of precedence:

- i. Process Data sheet/Design Data
- ii. P & IDs
- iii. Scope of Supply/ Works
- iv. This specification
- v. Engineering Design Basis- Rotating Equipment (B269-999-80-42-EDB-1003 Rev. 0)
- vi. Equipment Data Sheets
- vii. Applicable Standard specifications of individual equipment
- viii. Other International/National codes and standards referred to

However, in case of any conflict, contractor shall bring out the same to the notice of Owner/PMC. Owner/PMC's decision shall be final.

1.4. In case deviations are considered essential by the contractor (after exhausting all possible efforts), these shall be clearly brought out and consolidated under technical exception chapter at bidding stage. However vendor specific deviation (if any) to applicable codes/specifications shall be subject to Owner/PMC's approval during Detailed Engineering.

1.5. Electrical items, Instrumentation & Controls, Piping, Pressure Vessels, Mechanical equipment, Heat exchangers etc. associated with rotating equipment shall comply with the design requirements as given in the respective Engineering documents enclosed in the bid package.

1.6. Equipment design and engineering shall incorporate adequate safety features (as per applicable

specifications of respective equipment as well as Health, Safety and Environment Codes & Standards applicable for the subject project) to provide protection to operating personnel, equipment and environment.

- 1.7. All electrical components & installations, instruments shall be suitable for the electrical area classification and grouping in which the equipment is installed.
- 1.8. All drains shall be terminated with a flanged valve at the equipment battery limit. Further piping required for safe disposal shall be done by contractor.
- 1.9. All vents shall be taken to safe location, depending upon the properties of fluid to be vented.
- 1.10. Equipment noise level (For Driver + Driven Equipment + Auxiliary) shall not exceed 85 dBA when measured at 1 m distance from the equipment skid in any direction.
- 1.11. Maximum allowable working pressure and temperature of the equipment shall not be less than the design pressure and temperature specified in the data sheet nor less than those specified in specifications, codes and standards.
- 1.12. Unless otherwise specified, Equipment shall be either driven directly or through gearbox. However, V-Belt drive arrangement may be used for Roots Blower. V-belt, if provided, shall be Antistatic, oil resistant, non conducting type certified suitable for the intended area classification and equipped with a positive belt tensioning drive. Gear Box, if offered, shall be as per API 677 and with minimum service factor of 1.5.
- 1.13. Driven equipment & drivers (including gear units and couplings if any) shall be designed to perform satisfactorily under specified start up conditions, part load operation, and maximum differential pressure operation and relief valve set pressure and up to full speed.
- 1.14. Couplings between driver and driven equipment shall be of all metallic, non-lubricated flexible element type (i.e. either diaphragm coupling or flexible membrane or flexible metallic disc pack) with spacer for all equipment except Diesel engine, for which manufacturer's standard may be followed.
- 1.15. Only Stainless Steel shims shall be used for equipment alignment.
- 1.16. All rotating equipment base plates shall have jacking provision for leveling and screws for alignment. The jacking bolts shall be of stainless steel.
- 1.17. All rotating equipment shall be unitized along with their drivers at respective rotating equipment manufacturer's works.
- 1.18. Thermal relief valves shall be provided for components that may be blocked in by isolation valves including any cooling water return circuit piping of a cooler or a jacket.
- 1.19. For all equipment located on grade level, the height of foundation shall be minimized for easy accessibility, when it is not possible to do so suitable working platform shall be provided around the equipment for ease of operability and maintenance.
- 1.20. ***Vendor is advised to select the best available efficient pumps for high energy consuming services like the feed pumps for the UF and RO systems, in order to optimize power requirement.***

2. SITE & UTILITY DATA

- 2.1. Refer Site & Utility Data attached elsewhere in bid package.

3. SCOPE OF SUPPLY AND WORK

Scope of supply and work shall be as indicated in Document No. B269-475-80-43-SOW-8701-01, forming part of this Tender.

4. APPLICABLE CODES AND STANDARDS

International Standards/Codes along with applicable EIL Standard Specifications as per the table given below shall be the basis of design, selection, manufacture, inspection/testing of the equipment.

S no.	Description	Standards / Codes	EIL standard specification Number
1	PUMPS:		
1.1	Centrifugal Pumps (Special Purpose Process Service)	API 610 11 th Edition	6-41-0007 Rev.0
1.1	Centrifugal Pumps (General Purpose Process Service)	-----	6-41-0002 Rev. 5
1.2	Centrifugal Pumps (General Water Service)	-----	6-41-0003 Rev. 5
1.3	Positive Displacement Pumps (Controlled Volume)	API 675 3 rd Edition	6-41-0021 Rev. 5
1.4	Positive Displacement Pumps (Rotary)	API 676 3 rd Edition	6-41-0022 Rev. 5
2.0	Dosing Packages	-----	6-41-0301 Rev. 1
2	COMPRESSORS / FANS & BLOWERS		
2.1	Rotary Compressor Lobe Type (Roots Blowers)	Mfr's. Standard	----
2.2	Turbo Blower (Centrifugal Fan)		6-42-0002 Rev. 5

For design aspects not specifically covered by datasheets, specification, codes & standards or regulations, the design shall be based on good engineering practices.

5. EQUIPMENT QUALIFICATION CRITERIA

Qualification Criteria as specified in individual applicable standard specification should be applied for acceptance of all the offered Rotating Equipment.

An Indian Subsidiary (enlisted with EIL) of Foreign Principal can also be qualified based on prevalent 'Make in India' Policy of EIL (Annexure-B).

6. SPECIAL REQUIREMENTS

6.1. Special Requirements for Centrifugal Pumps (Special Purpose Process)

- 6.1.1. Centrifugal Pump (Special Purpose Process) shall meet requirements as specified in the Process Data Sheet, P&IDs, this Job specification, Engineering Design Basis – Rot. Eqpt., API 610 11th edition, Consultant Std. Spec. 6-41-0007 and other Specification referred therein.

- 6.1.2. As a minimum, Pump Vendor's scope of supply shall include but not limited to the following:
- Centrifugal Pump, driver along with fixing bolts, anchor bolts and shims etc.
 - Flexible metallic coupling
 - Mechanical Seal & Sealing System including API seal plans.
 - Common base plate for pump & motor along with all foundation anchor bolts and nuts (as required)
 - All auxiliary & associated piping within & between pump skid, Lube oil skid etc.
 - Lube Oil system mounted on separate skid (as required)
 - All specified inspection and testing
 - All Electrical & Instrumentation items are as per respective specification
 - Automatic recirculation valve (as required as per Process Package)
 - Painting, preparation of shipment & packaging
 - Additional items not specified in the bid package, but recommended by vendor for safe, smooth and efficient operation of the complete package shall be provided by vendor.
- 6.1.3. Unless specified otherwise, pumps shall be directly driven by electric motor & pumps driven through gearbox are not acceptable.
- 6.1.4. For each pump, minimum continuous flow of the offered pump model shall be less than the 'Normal Flow' as indicated in the respective process data sheet. Continuous flow by-pass is not envisaged, unless specified in respective Process Datasheet. Pumps offered with continuous flow bypass shall be REJECTED.
- 6.1.5. Pumps shall be selected to have their rated operating point preferably falling in the range of 70% to 110% of best efficiency point (BEP) flow. Maximum flow case with max. Differential Head as defined in pump process datasheet shall be considered as rated case.
- 6.1.6. Pump performance curves shall be continuously rising from rated/end of curve (as applicable) to shut off irrespective of no pump operation below pump MCF. Achieving Head rise from Rated to shut off by using orifice plate or any other means is not acceptable.
- 6.1.7. Pumps shall meet all the specified cases indicated in the Process Data Sheet and shall be designed for the worst case specified in the Process Data Sheet. The driver and other accessories shall be designed to meet all the cases specified. In case of pump in multiple case of operation extra head that is generated for other cases shall be killed by the downstream control valve. However, guaranteed case shall be considered for rated flow with actual differential head generated by the pump.
- 6.1.8. Maximum number of stages shall not exceed TEN for Centrifugal Horizontal Pumps.
- 6.1.9. Unless otherwise specified, Pumps where difference between NPSHA and NPSHR from quoted minimum flow to rated flow is less than 0.6 meter are not acceptable. The said NPSHR value shall correspond to the maximum value of NPSHR from rated flow down to the recommended minimum continuous stable flow specified by the vendor. Additionally, in case of parallel operation and/or auto start against open discharge valve condition, NPSHR at end of curve shall not exceed specified NPSHA. Vendor to offer their suitable model considering the same, as the same is a rejection criteria. Problems, if any, shall be highlighted during pre-bid stage. Pumps fitted with inducers for reducing NPSHR are not acceptable.

Note: Elevation considered for NPSHA calculation is indicated in each pump PDS. Actual difference in PDS specified pump centerline elevation & Actual pump centerline elevation shall be considered for calculating NPSH margin requirements. Pump foundation height to be considered as approx. 300 mm above grade level.

6.1.10. Maximum Discharge Pressure of Pump considering maximum shut off pressure (with 0% +ve tolerance) with maximum suction pressure and maximum specific gravity at pumping temperature shall not exceed downstream design pressure.

6.1.11. For congealing service (where pour point is more than min. ambient temperature), the stuffing box shall be jacketed with steam to ensure fluid inside seal does not congeal.

6.1.12. Multistage Pumps

6.1.12.1. Balance piston or Balance Drum shall necessarily be provided for designs where all axial thrust is cumulative (i.e. all impellers facing the same direction) to reduce the axial thrust. Balancing Disc shall not be employed to balance thrust. The balance line shall be connected to pump suction within the pump confines or to suction vessel (as recommended by Pump OEM).

Note: Pump Vendor P&ID (and associated contractor P&ID) shall clearly indicate Balance Leak off Line and its tie in point connections so as to avoid issues during installation.

Vendor to ensure that Balance Leak Off (BLO) flow is added to the rated capacity of the pump and pump sizing shall be done accordingly. Correlation showing the extent of wear to balance line flow shall also be provided. The balance line shall be provided with pressure gauge and pressure relief valve. In case balance line is located inside the barrel, it is not possible to mount instrument, the same shall not be provided.

Balance line shall utilize flange joints. Screwed connections are not allowed. BLO line shall be designed for casing MAWP.

6.1.12.2. Vendor shall indicate the Dry Critical Speed, 1st and 2nd Wet Critical Speeds for the Rotors of Pumps and shall comply with separation margin w.r.t. operating speeds as per API-610 and shall also furnish the following details for Rotor during detail engineering stage:

- (a) Critical speed map showing operation speeds Vs First critical and Second critical speeds (wet and dry) in the X-axis and Y-axis respectively for
 - (i) design clearance (100% clearances) and
 - (ii) for retirement clearance (200% clearance)
- (b) A sketch showing the following details for each rotor:
 - (i) Weight of Rotor assembly excluding bearings.
 - (ii) Shaft diameter (at impeller, seal and bearing area) and weight.
 - (iii) Span between bearings
 - (iv) Design speed for which the Pump rotor is designed.
 - (v) Natural deflection of the Rotor; and
 - (vi) Diameters & Clearances between Stator and Rotor at all wearing and other close clearance points - quantify.

Also a Rotor setting Diagram with clearances, deflection etc. shall be furnished both at Running and Retirement clearances.

6.1.12.3. Impeller of multistage pumps shall be positively locked against axial movement in the direction opposite to normal hydraulic thrust.

6.1.12.4. Each Centrifugal Horizontal Multistage Pump driven by Elec. Motor with force feed lubrication system shall undergo with Complete Unit Test (i.e. No Load String Test) at pump vendor shop. Complete unit test shall be carried out along with job gear box (if applicable), job motor drivers, job seal and job probes and shall be performed for at least 4 hours at pump manufacturer's shop.

- 6.1.12.5. Type of bearings for pumps shall, as a minimum, meet the requirements specified in Cl. 6.10.1 of API 610 11th edition and shall be as per vendor's standard proven design. Vendor must furnish adequate past supply references, in his offer, of having supplied similar bearing designs with similar lube oil system for similar services (speeds and power ratings) to justify meeting the qualification requirement specified.
- Vendor shall provide details in the ERP (attached elsewhere) for selected radial and thrust bearings such as type (Antifriction/sleeve/tilting pad, as applicable) to justify the provenness of the offered design.

Vendor shall also provide calculations as per API 610 (Cl. 6.10 & Table 10) to justify that the offered type of bearings meets the minimum requirements specified therein.

6.1.13. Mechanical Shaft Seals

- (a) Seal Type & seal plan are specified in Process Package. However, Pump Vendor shall obtain seal vendor's recommendation and furnish the same during detailed engineering. In case, the seal vendor's recommendation are not in agreement with seal plan indicated in Process Package, the vendor shall furnish the proposed seal plan along with seal vendor recommendation for Owner/ PMC review/ approval during detailed engineering and provide the finally approved seal plan without any cost & time implication.
- (b) Seal and Sealing System shall be suitable for Design Temperature as defined in respective equipment PDS. Also refer API 682 Annexure A specifically for Engineered Seals selection.
- (c) Mechanical seals to be suitable for maximum shut-off pressure/ casing design pressure under static conditions for pusher type seals. For Bellows seal, mechanical seal shall be suitable up to bellows design pressure, as a minimum.

Note: Pumps with shut off more than 40 bar G shall be provided with Engineered Seals.

In case of Sealing Plan 52/53B (wherever applicable) (also refer special Requirements for seal flushing plans), the complete sealing system along with instruments and all accessories shall be mounted/ installed on the pump base plate.

- (d) The seal system temperature for seal plan 52 shall not exceed 70°C during normal operation.
- (e) Mechanical seals shall be from one of the makes specified in Vendor list attached with bid package.
- (f) Seal and Seal systems (i.e. Mechanical Seals & Seal Flushing Plans, as the case may be, shall be supplied by Seal OEM).
- (g) Stuffing Box Dimensions shall be as per API Standard 610 (ISO:13709).
- (h) The complete sealing system along with instruments and all accessories shall be mounted/ installed on the pump base plate. In case of between bearing pumps there shall be two such independent units, one each for each stuffing box and both the system shall be mounted on the same side to allow for maintenance of the pump. Aux. Seals/ Flushing Systems & Plans/ Cooling Systems & Plans shall be as per API 682 requirements.
- Vendor shall furnish recommended Buffer/ Barrier Fluids for each pump item. When specified, the buffer fluid shall be a synthetic fluid suitable for the seal operating environment and approved by the

mechanical seal supplier. Consideration shall be given to minimize the number of fluids the end user/ refiner has to stock.

- (i) Orientation of seal pot and auxiliary connections: The interface points for auxiliary connections (i.e. cooling water supply/return, other connections etc.) as well as the seal reservoir & cooler (i.e. for seal plan 52,53B) shall be located on the Left Hand Side, when viewed from non-drive end of pump, of the pump skid. All the seal plans shall be towards suction of the pump keeping both sides coupling portion open for maintenance activities. Also refer "Standard for orientation of seal pot and connections of centrifugal pumps (Doc# 7-44-0321)" enclosed with bid package.
- (j) Mirror image of seal pot arrangement to have a clear passage in between the pumps, when two pumps are placed in one bay.
- (k) For congealing service, the stuffing box shall be jacketed with steam to ensure fluid inside seal does not congeal.
- (l) Instrumentation associated with Mechanical seal plan shall be as per the instrumentation specifications, data sheets etc.
- (m) Refer "Annexure A-Seal Plans" for "Special Requirements for Seal Flushing Plan 32/52/53B/54".

6.1.14. Auxiliary Piping

- (a) All auxiliary piping interface connection shall be terminated with flanged valve at single point inlet/outlet at the edge of base plate.
- (b) Piping material shall be Stainless Steel (SS) metallurgy for Seal Flushing Plans/ LO system and Cooling Water Plans. Offered MOC shall be suitable for intended service operating and design conditions and the same shall be substantiated with past supply references. Minimum size of piping shall be ¾ inch dia.

6.1.15. For technical requirement for Couplings, Machine Health Monitoring System, Lube Oil Coolers etc., refer elsewhere in this Job Specification, Engineering Design Basis- Rotating Equipment, EIL Standard Specification, Mechanical Datasheet etc.

6.1.16. Minimum MOC of centrifugal pumps (special purpose process) shall be carbon steel (API 610 material class S5). Wherever, cast iron is specified as pump MOC in process datasheet for centrifugal pump (special purpose process), Contractor to provide API 610 Material Class S5 or higher metallurgy. It is contractor responsibility to ensure the suitability of the proposed MOC to the specified service operating and design conditions.

6.2. Special Requirements for Centrifugal Pumps (General Purpose Process/General Water service)

- 6.2.1. Centrifugal Pump shall meet requirements as specified in Process Data Sheet, P&IDs and this Job specification, EIL Specification 6-41-0002, 6-41-0003 and other Specification referred therein.
- 6.2.2. Mechanical seals shall be of Cartridge design and shall conform to API Standard 682. Balanced mechanical seals shall be provided for centrifugal pumps (general purpose process service).
- 6.2.3. Seal flushing plans, piping material shall be of Stainless Steel. For cooling water plans, piping material shall be carbon steel.

- 6.2.4. In case of gland packing pump, pump seal flushing line should be of SS.
- 6.2.5. The total head capacity curve of the pump should be continuously rising towards the shut-off.
- 6.2.6. Equipment along with the drivers shall be procured from the respective driven equipment manufacturers as skid mounted units with all accessories, auxiliaries along with auxiliary piping.
- 6.2.7. A gate valve & a magnetic drain plug shall be provided for all centrifugal pumps bearing housings.
- 6.2.8. Centrifugal Pumps in H₂SO₄ / HCl / NaCl Service:
- Material of construction for H₂SO₄ / HCl / NaCl unloading/transfer pumps shall be as specified in process package.
 - Single mechanical pusher type seal with single coil spring of Alloy-20 material, GFT/Ceramic Seal faces, Teflon secondary seals & Seal plan 11, 61 shall be used.
- 6.3. **Special Requirements for Positive Displacement Pump (Controlled Volume)**
- 6.3.1. Pump shall meet the requirements as specified in Process Data Sheet, P&IDs, this Job specification, API 675 and EIL standard specification 6-41-0021.
- 6.3.2. Operating speed shall not be more than 100 strokes per minute.
- 6.3.3. Controlled Volume pumps shall be of double/sandwich diaphragm type with rupture detection system achieved through a pressure transmitter & a pressure gauge.
- 6.3.4. Pump unit complete with speed reducer, driver, suction pulsation dampener (if required or specified) & discharge pulsation dampener, suction and discharge manifold piping duly pre-fabricated for multi-head pumps, external relief valves, instrumentation & controls for diaphragm rupture detection system & automatic capacity control (as specified) etc. shall be mounted on a common baseplate and shall be supplied as a skid mounted package.
- 6.3.5. If automatic capacity control is required for any pump item, contractor shall provide 4-20 mA electronic signal for each of these pumps separately. All the necessary instruments required for automatic stroke adjustment shall be in vendor's scope of supply. In addition to the above, vendor shall provide necessary arrangement for manual stroke adjustment.
- 6.3.6. Only one number & common gas charging kit for discharge pulsation dampener (bladder / diaphragm, gas charged type) shall be supplied for a particular pump item tag.
- 6.4. **Special Requirements for chemical dosing skids**
- 6.4.1. Chemical dosing skid supplier shall do the complete engineering for the chemical dosing package. Chemical dosing skid supplier shall meet the requirements of Clause 3.1 of EIL standard Specification (6-41-0301)
- 6.4.2. Bidder's scope of supply for each package shall include but not limited to the following:
- Chemical storage vessels / tanks of required capacity as per process data sheets.
 - Double/Sandwich Diaphragm type Positive displacement pump (controlled volume) of required capacity as per process data sheets, each complete with its diaphragm rupture detection system (i.e. pressure indicator & pressure switch) for generating alarm in case of diaphragm rupture, external safety relief valve conforming to API standard, suction pulsation dampener, discharge pulsation dampener, flexible metallic coupling and electric motor driver, mounted on a common base plate.

- Calibration cylinder (wherever specified) as per the system requirement.
- Y-Type/T- Type Suction strainers as required or indicated in the P& IDs.
- Necessary interconnecting piping, valves, fittings as required or indicated in the P&IDs.
- Necessary instrumentation & controls as per P&IDs, Line List and Instrumentation Job Specification.
- Plant air operated diaphragm type drum unloading pumps (wherever specified), each complete with air dryer requiring no electric power, air filter regulator with pressure gauge, bleed type master air valve, air discharge muffler, air side external relief valve (manufacturer's standard), liquid discharge side check valve, drain valve and adapter for mounting the pump on the chemical drum.
- Skid mounted junction boxes & interconnecting cabling for instruments as indicated in the Instrumentation Job Specification enclosed elsewhere in the tender.
- Skid mounted Local control station (LCS) for the electric motor drivers of metering pumps, as described in electrical specification enclosed elsewhere in the tender.
- Interconnecting cabling and other electrical items as detailed in electrical job specification enclosed elsewhere in the tender.
- Common base plate (suitable for four point lift) for each chemical dosing package with lifting lugs & leveling jackscrews.
- All foundation/anchor bolts, SS Shims, nuts and washers required for each skid.
- Access ladders and platforms, as required for safe and easy access to tank/ vessel, valves, man-ways and instrument connections.
- Drum racks i.e. space/platform (as specified) for keeping chemical drums/barrels.
- Mandatory spares for metering pumps & their drivers.
- Quotation for recommended spare parts for two years normal operation for metering pumps & their drivers.
- Commissioning spares, as recommended by the bidder for chemical dosing package.
- Special tools & tackles, as recommended by the bidder for chemical dosing package.
- Documents, drawings and other deliverables as per "Vendor Data Requirement" sheet enclosed with the tender.
- Any other item(s) not covered in this specification, Process Data Sheets and P&IDs but required for safe & smooth operation of the chemical dosing package.

6.4.3. Equipment shall meet the duty requirements and performance parameters as specified in process data sheets for dosing systems.

6.4.4. Equipment shall be designed for outdoor, without-roof and hazardous area location.

6.4.5. Strainers / Filters shall be provided before inlet of each pump as per respective P&IDs.

6.5. Special Requirements For Rotary Air Blowers (Lobe type)

6.5.1. Scope of Supply

Contractor shall ensure that components and auxiliary equipments to make a complete blower unit requiring only location in place and hooking up of piping and wiring and piping for operation and maintenance aspects are included in manufacturer's scope. These shall include but not limited to the following for each unit

- Blower with Electric Motor driver.
- Common base plate for entire train with grounding lugs.
- Inlet and Exhaust Silencer.
- Inlet and outlet Bellows (SS).
- Skid mounted gauge board with Pressure gauge and Temp gauge for Suction, Intermediate and Discharge conditions.
- Acoustic Housing for complete Blower/Motor Package.(if Required)
- Pressure Relief valve.
- Differential Temperature Transmitter for high discharge temperature Indication/Alarm at control room/LCP
- Differential Temperature Transmitter for actuating high discharge temperature trip.
- Differential Pressure Transmitter for Indication/Alarm at control room/LCP.
- Differential Pressure switch for actuating High Differential pressure trip.
- Vibration Isolators for the complete Package.
- Ventilation systems

6.5.2. Blowers and drivers (including gear units and couplings, if any) shall be designed to perform satisfactorily under specified start up conditions, part load/full load operation, maximum differential pressure operation and relief valve setting pressure and up to the trip speed.

6.5.3. Suitable air intake filter shall be provided. The filter construction shall have suitable provision for preventing water ingress into the filter due to rains and shall have a bird screen.

6.5.4. All metal parts of filters such as housing, case of filter elements, inlet silencer, supporting and fixing system of filter elements inside the housing including supports, stays, nuts, bolts etc. shall be of type 304 or 316 stainless steel. Complete piping from filter element to blower inlet including any expansion joints shall be of type 304 or 316 stainless steel

6.5.5. Bearing oil lubrication shall be ring oil / splash as per manufacturer's standard for the offered bearings. In case use of force-feed pressurized lube oil system is recommended, the same along with all instrumentation and interconnecting piping shall be provided.

6.5.6. Balancing of rotating element shall be carried out along with the coupling half. Balancing shall be as per Grade 2.5 of ISO-1940.

6.5.7. Relief valve set pressure shall be equal to 110% of the differential pressure added to discharge pressure.

6.5.8. Acoustic Enclosure & Ventilation System

- a) In order to meet the specified noise level of 85 dBA @ 1m, if required, an acoustic enclosure

over the package shall be provided.

- b) The acoustic enclosure shall be provided over the blower & shall be self-supporting, de-mountable structure, usually of the closed-fitting hood type, mounted on the base plate, to limit the noise within specified limits. The steel panels shall be galvanized & steel framework sections shall be prime painted. Locally mounted instruments shall be placed outside the enclosure & mounted on the LGB/LCP. The enclosure shall be constructed with fire resistant materials. All enclosures shall be free of any depression or crevices where water or dust might collect.
- c) Any instrument & electrical items which are located inside the enclosure shall be suitable for applicable area classification specified elsewhere.

6.5.9. Driver Sizing:

Electrical motor drivers as per (IEC/IS) shall be rated for continuous duty (Duty type S1) whereas motor as per American Standards shall be designed to operate at a service factor of 1.0. Rating shall not be less than the following:

Motor Name plate Rating	Motor MCR (% of BLOWER Rated BKW Guaranteed with +0% tolerance)
All Ratings	110% of Rated BKW for any of the specified operating conditions or 105 % of BKW at RV Set Pressure, whichever is higher.

6.6. Special Requirements for Turbo Blowers (Centrifugal Type)

- 6.6.1. Turbo Blower (Centrifugal Fans) shall meet requirements as specified in the Process Data Sheet, P&IDs, this Job specification, Engineering Design Basis, EIL Std. Spec. 6-42-0002 and other Specification referred therein.

6.6.2. Driver Sizing:

Electrical motor drivers as per (IEC/IS) shall be rated for continuous duty (Duty type S1) whereas motor as per American Standards shall be designed to operate at a service factor of 1.0. Rating shall not be less than the following:

Motor Name plate Rating	Motor MCR (% of Blower Rated BKW Guaranteed with +0% tolerance)
All Ratings	110% of Rated BKW including transmission losses for any of the specified operating conditions or BKW at Un-throttled Minimum Ambient Temperature Conditions including transmission losses, whichever is higher.

6 EQUIPMENT STORAGE

- 6.1 All rotating equipment shall be packed for an outdoor storage period of 12 months.
- 6.2 All the openings shall be plugged & sealed condition during dispatch.
- 6.3 Instruments like gauges, speed indicators, probes, oiler etc shall be removed from the main equipment and dispatched separately to avoid the damage of these components during transportation handling and erection. The packing however, can be kept separately in same box as that of main equipment.

- 6.4 In addition to the normal packing the pump and motor skids shall be separately covered with weather and rain protection VCI (vaporize corrosion inhibitor) cover with opening for piping.

7 INSPECTION & TESTING

- 7.1 Inspection and Tests specified in Equipment Data Sheets, Applicable Specifications, Codes and Standards shall be carried out by the Equipment vendor at his works. Equipment Vendor shall furnish material test certificates showing the chemical & mechanical properties of the materials used in the equipment.
- 7.2 Contractor shall prepare Inspection and Test Plan for each equipment. These plans will form a part of the Enquiry Document as well as the Purchase Order on equipment vendor.
- 7.3 Contractor shall review material test certificates of all equipment. Contractor shall submit these certificates along with review records to OWNER.
- 7.4 Contractor shall conduct inspection and witness test of all equipment at vendor's works and issue inspection & test reports and records to OWNER.
- 7.5 OWNER and/or his consultant may participate with Contractor's inspectors in any inspection, test or non-destructive test. Contractor shall notify owner of all inspection and tests at least four weeks before the scheduled date of inspection and test and reconfirm the same at-least one week before the date of inspection and testing.

8 VENDOR DATA REQUIREMENT

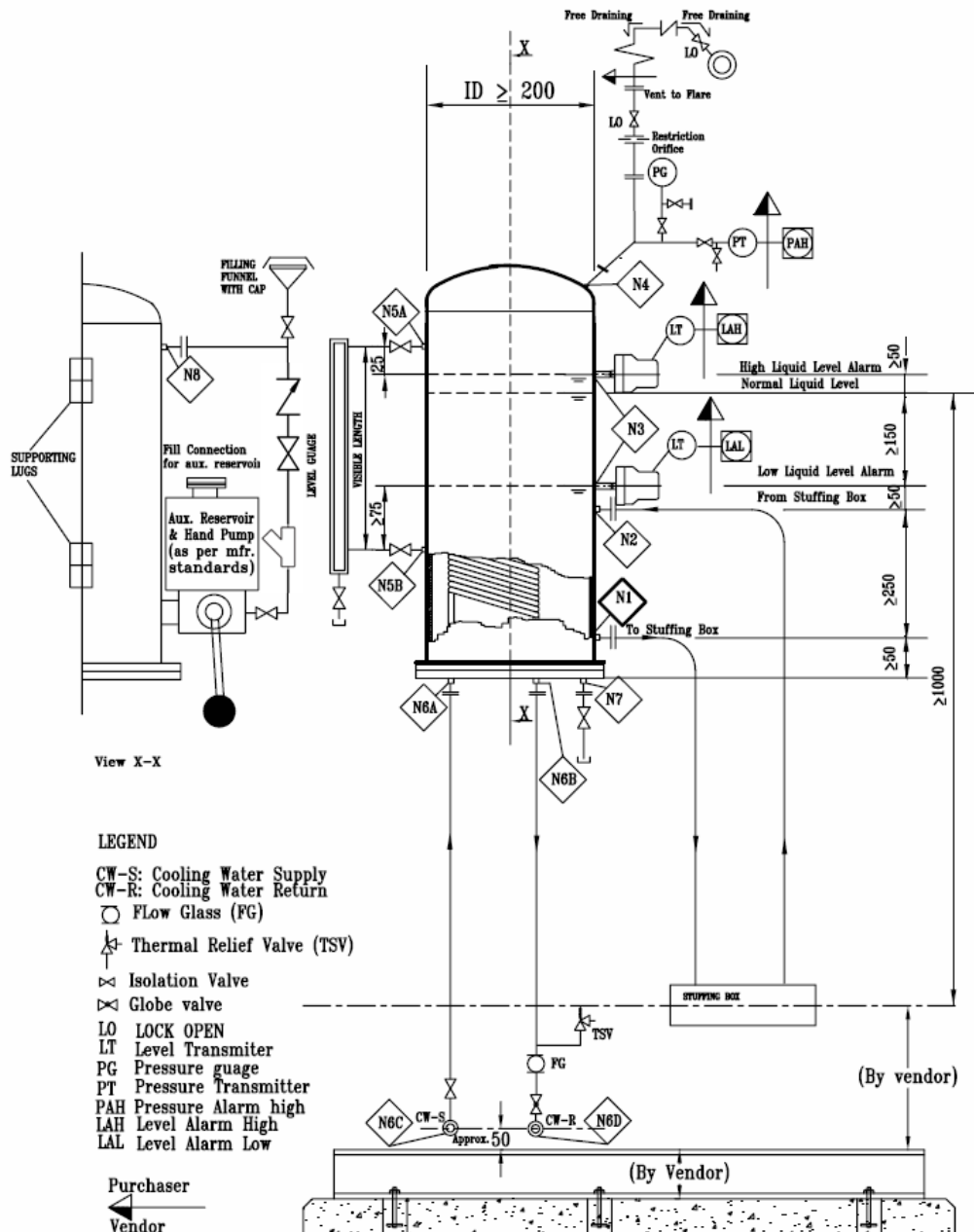
Vendor Data Requirement as indicated in Doc. # B269-475-80-43-VR-8701-01 Rev-A enclosed elsewhere in the tender package, shall be followed. Only critical vendor data/documents such as Equipment Data Sheets, P&ID's, Foundation Drawing, Equipment Layout, Inspection & Test Procedures etc. shall be taken for Owners/Consultant's review. All other drawings/documents shall be retained for Owners/Consultant's records.

Annexure – A

Special Requirements for Seal Flushing Plan 52/53B/54

Following Sketches shall be referred for schematic details:

TYPICAL SKETCH FOR SEAL PLAN 52



Note 1 : Pipe projection for filling connection shall be minimum and shall be rigidly supported.

Note 2 : Cap for filling connection of funnel/aux. reservoir shall be hinged and bolted.

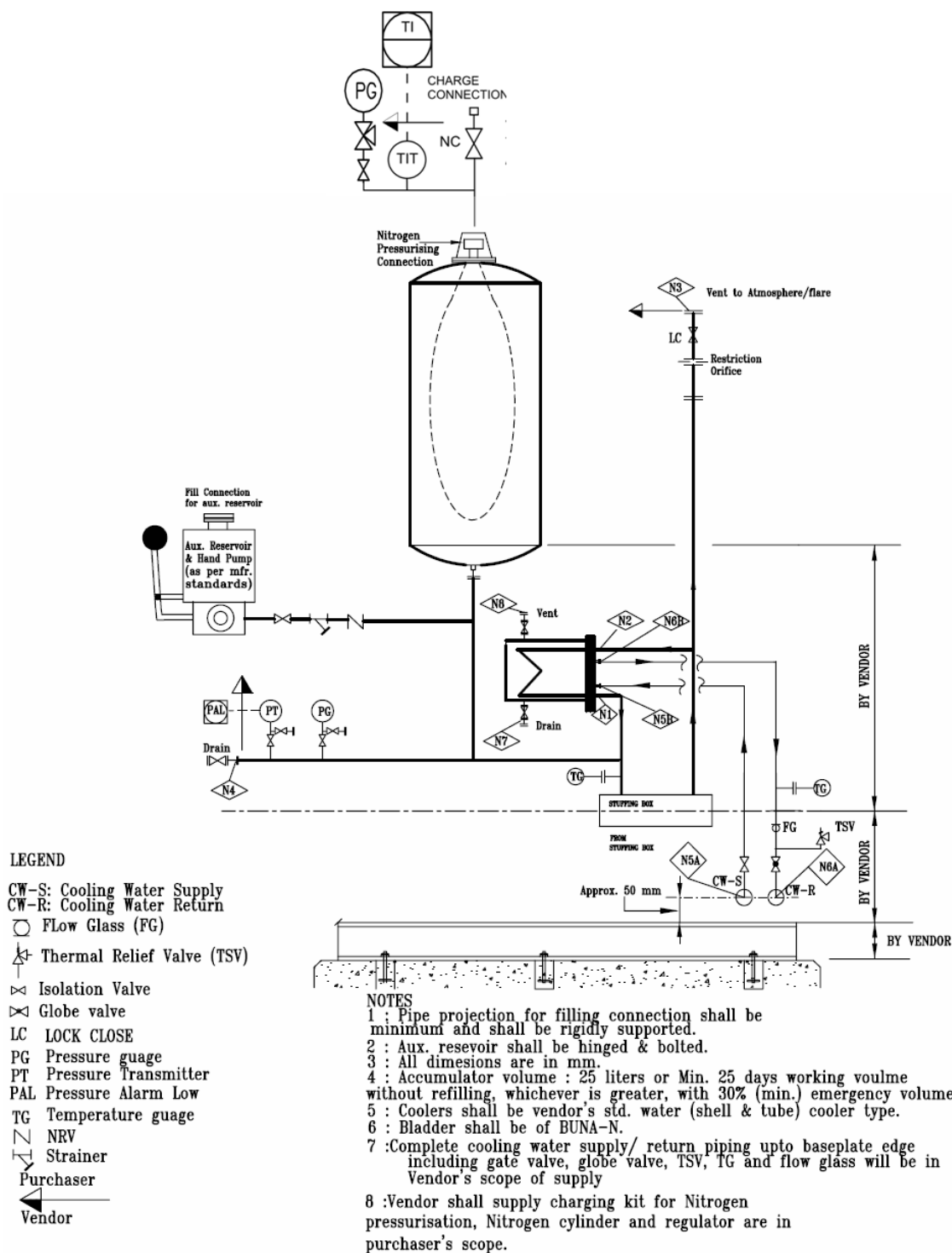
Note 3 : All dimensions are in mm.

DESIGN PARAMETERS (for 52)				
Optg. Pressure (kg/cm²g) / Optg. Temp (°C)		:	As per respective pump data sheets	
Design Pressure (kg/cm²g) / Design Temp (°C)		:	40.0 (min.) / Ambient (min.) §	
Hydro test pressure (kg/cm²g):		:	1.5 times Design Pressure	
Shell		:	SS 316L (Sch 40 S)	
Head		:	SS 316L	
Gasket		:	SS 304/316: Spiral Wound Gasket	
§ The design of sealing system shall be as per the design parameters indicated above or pressure-temperature rating equal to the maximum discharge pressure & temperature of the pump casing, whichever is higher.				
API SEAL PLAN 52				
NOZZLE SCHEDULE				
Nozzle	Service	Size, mm (")	Min. ANSI Rating §	Flange type
N1	To: Stuffing Box	20 (3/4")	300#	SWRF
N2	Return: Stuffing Box	20 (3/4")	300#	SWRF
N6	For Level transmitter	Refer Instr. Spec	300#	SWRF
N4	Reservoir vent to Flare	20 (3/4")	300#	SWRF
N5A/B	For Level Indicator	20 (3/4")	300#	SWRF
N8A/B	Cooling Water Supply/Return (at reservoir)	15 (1/2")	150#	SWRF
N10	Reservoir Drain	20 (3/4")	300#	SWRF
N7	Filling Nozzle	15 (1/2")	150#	SWRF
N9	Reservoir Bottom Flange	200(8")	300#	SWRF
INSTRUMENTS				
Description	Function	Required	Remarks	
Pressure Gauge (PG)	Press. Indication	Yes		
Pressure Trans. (PT)	Press. Low Alarm	Yes		
Temp. Safety Valve (TSV)	--	Yes		
Restr. Orifice (RO)	--	Yes		
Flow Glass (FG)	--	Yes		
Temp. Gauge(TG)	Temp. Indicator	Yes		
Level Transmitter (LT)	Level low alarm	Yes		
Level Gauge(LG)	Level indicator	Yes		

Remarks:

- The fluid reservoir shall be arranged in accordance with the schematic shown in the drawing.
- The reservoir and piping shall be designed, fabricated & tested in accordance with
 - ISO 15649/ASME B 31.3 using Piping component
 - ASME Sec VIII Div 1
- The complete seal system for each stuffing box including the reservoir shall be arranged as one skid and supported/bolted to the base plate in a manner that the projection of any equipment/instruments falls within the confines of base plate. The reservoir and the accessories to be mounted on a structural support furnished by the manufacturer and should not be affected by the pump vibration. In case of between bearing pumps there shall be two such units, one each for each stuffing box mounted on opposite ends of the pump.
- The mechanical design of auxiliary piping shall achieve the following:
 - Proper support and protection to prevent damage from vibration or from shipment, operation & maintenance.
 - Proper flexibility and normal accessibility for operation, maintenance and thorough cleaning.
 - Installation in a neat and orderly arrangement adapted to the contour of the machine without obstructing access openings.
 - Elimination of air pockets by the use of valved vents or non-accumulating piping arrangements.
 - Complete drainage through low points without dis-assembly of piping, seal or gland components.
 - Reduce the number of potential emission sources and pressure drops by minimising the use of threaded connections, flanges, fittings and valves.
- Refer Instrumentation specification for detailed specification of instruments.
- Flange type specified in the table above is for sealing system design of 300# rating. Wherever the sealing system design exceeds 300# rating the flange type for complete sealing system (including coolers etc.) shall be as per standard ASME B 16.5.

TYPICAL SKETCH FOR SEAL PLAN 53B

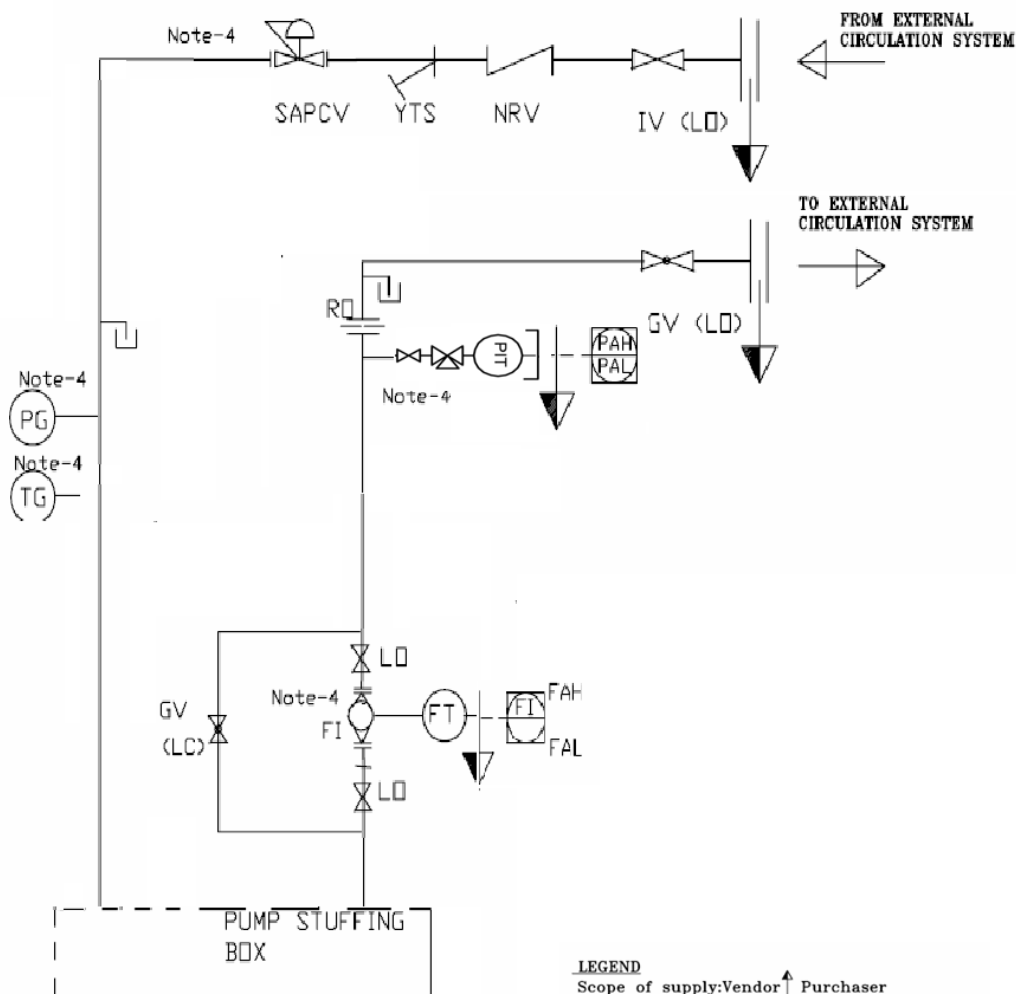


DESIGN PARAMETERS (for Plan 53B)								
Optg. Pressure (kg/cm²g) / Optg. Temp (°C)					:	As per respective pump data sheets		
Design Pressure (kg/cm²g) / Design Temp (°C)					:	40.0 (min.) / Ambient (min.) §		
Hydro test pressure (kg/cm²g):					:	1.5 times Design Pressure		
MOC of Reservoir					:	SS 316L		
MOC of Bladder					:	BUNA-N		
§ Sealing system shall be designed for shutoff pressure/casing design pressure at design temperature.								
NOZZLE SCHEDULE					INSTRUMENTS			
Nozzle	Service	Size, mm (")	Min. ANSI Rating §	Flange type (Rem 6)	Description	Function	Required	Remarks
N1	To:seal	20 (3/4")	300#	SWRF				
N2	From Seal	20 (3/4")	300#	SWRF	Temperature Gauge (TG)(Barrier Fluid)	Temperature Indication Local	YES	
N3	Vent	15 (1/2")	3000#	SWRF				
N4	Drain	20 (3/4")	300#	SWRF	Pressure Gauge (PG) (Barrier Fluid)	Press. Indication Local	YES	
N5A	Cooling water Supply @ grade	20 (3/4")	150#	SWRF	Pressure Transmitter (PT)	Press. Alarm Low (PAL)	YES	
N5 B	Cooling Water Inlet	15 (1/2")	300#	SWRF	Temp. Safety Valve (TSV)	--	YES	
N6 A	Cooling Water Return @ grade	20 (3/4")	150#	SWRF	Restr. Orifice (RO)	--	YES	
N6 B	Cooling Water Outlet	15 (1/2")	300#	SWRF	Flow Glass (FG)	--	YES	
N7	HE Drain	15 (1/2")	300#	NPT (F)	Temperature Gauge (TG) (CW-R)	Temperature Indication Local	YES	
N8	HE Vent	15 (1/2")	300#	NPT (F)				

REMARKS

- The Barrier fluid reservoir shall be arranged in accordance with the schematic shown in the drawing.
- The reservoir and piping shall be designed, fabricated & tested in accordance with
 - ☐ ISO 15649/ASME B 31.3 using Piping component
 - ☐ ASME Sec VIII Div 1
- The complete seal system for each stuffing box including the reservoir shall be arranged as one skid and supported/bolted to the base plate in a manner that the projection of any equipment/instruments falls within the confines of base plate. The reservoir and the accessories to be mounted on a structural support furnished by the manufacturer and should not be affected by the pump vibration. In case of between bearing pumps there shall be two such units, one each for each stuffing box mounted on opposite ends of the pump.
- The mechanical design of auxiliary piping shall achieve the following:
 - Proper support and protection to prevent damage from vibration or from shipment, operation & maintenance.
 - Proper flexibility and normal accessibility for operation, maintenance and thorough cleaning.
 - Installation in a neat and orderly arrangement adapted to the contour of the machine without obstructing access openings.
 - Elimination of air pockets by the use of valved vents or non-accumulating piping arrangements.
 - Complete drainage through low points without dis-assembly of piping, seal or gland components.
 - Reduce the number of potential emission sources and pressure drops by minimising the use of threaded connections, flanges, fittings and valves.
- Refer Instrumentation specification for details of instruments.
- Flange type specified in the table above is for sealing system design of 300# rating. Wherever the sealing system design exceeds 300# rating the flange type for complete sealing system (including coolers etc.) shall be as per standard ASME B 16.5

TYPICAL SKETCH FOR SEAL PLAN 54



LEGEND

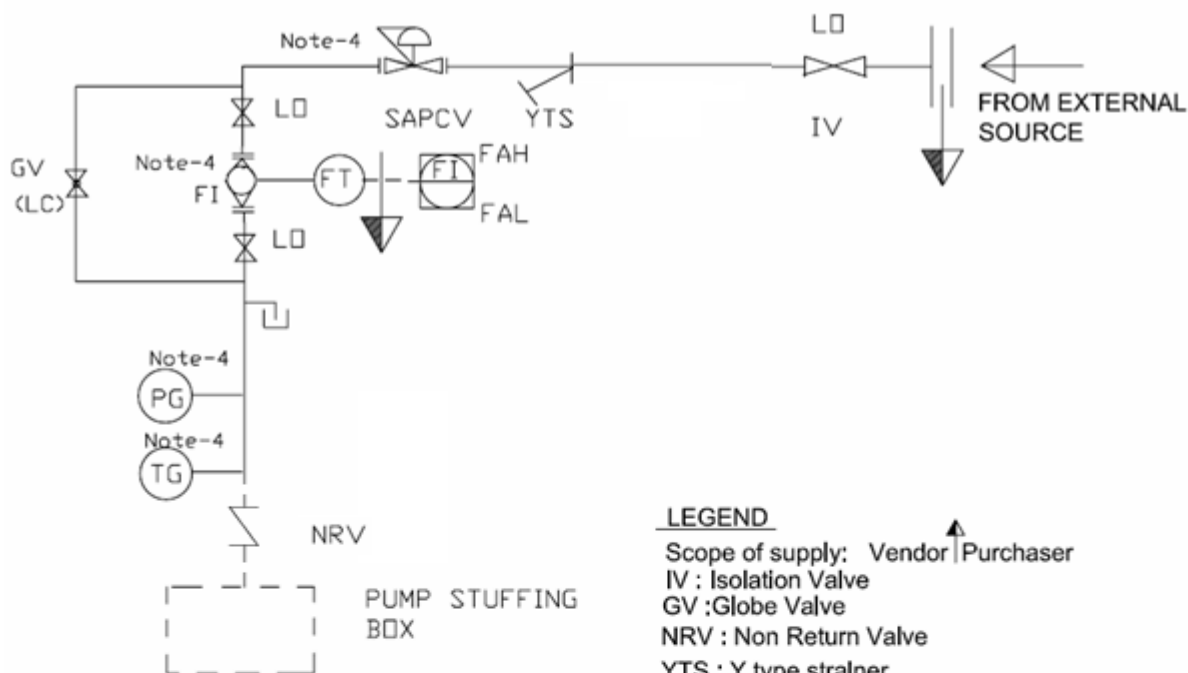
Scope of supply: Vendor ↑ Purchaser

IV : Isolation Valve
GV : Globe Valve
LO : Lock Open
LC : Lock Closed
NRV : Non Return Valve
YTS : Y type strainer
FT : Flow Transmitter
FAL : Low flow alarm in purchaser's DCS
FAH : High flow alarm in purchaser's DCS
FI : Flow Indicator (Rotameter with built in Flow Transmitter)
SAPCV : Self Actuated Pressure Control Valve
CP : Capped Drain Point
PS : Pressure Switch
PAH : High Press. alarm in purchaser's DCS
PAL : Low Press. alarm in purchaser's DCS
RO : Restriction Orifice

NOTES :

1. System shown is for one stuffing box. For between bearing pumps, two such independent systems shall be provided.
2. All piping and valves shall be SS 316.
3. The flow indicator (FI) shall be a metal tube Rotameter with local flow indication & adjustment and also with built in Flow Transmitter.
4. Isolation & drain valves etc. shall be provided for all instruments.
5. All instruments shall comply with instrumentation specifications attached with the Enquiry Document.
6. All auxiliary piping supports & routing shall be done in such a way that it should not obstruct pump maintenance.
7. All auxiliary piping connections shall be either flanged or screwed except for connection shown as flanged in the above drawing.
8. All auxiliary piping shall be confined within the baseplate.

PIPING AND INSTRUMENTATION SCHEMATIC FOR API SEAL FLUSHING PLAN 32



LEGEND

Scope of supply: Vendor | Purchaser
 IV : Isolation Valve
 GV :Globe Valve
 NRV : Non Return Valve
 YTS : Y type strainer
 FT : Flow Transmitter
 FAL : Low flow alarm in purchaser's DCS
 FI : Flow Indicator (Rotameter with built in Flow Transmitter)
 SAPCV : Self Actuated Pressure Control Valve
 ▮ : Capped Drain Point
 LO: Lock Open
 LC: Lock Closed

NOTES :

1. System shown is for one stuffing box. For between bearing pumps, two such independent systems shall be provided.
2. All piping and valves shall be SS 316.
3. The flow indicator (FI) shall be a metal tube Rotometer with local flow indication & adjustment and also with built in Flow Transmitter.
4. Isolation & drain valves etc. for instruments shall be provided.
5. All Instruments shall comply with Instrumentation specifications attached with the Enquiry Document.
6. All auxiliary piping supports & routing shall be done in such a way that it should not obstruct pump maintenance.
7. All auxiliary piping connections shall be either flanged or screwed except for connection shown as flanged in the above drawing.
8. All auxiliary piping shall be confined within the baseplate.
9. Sealing system shall be designed for casing design pressure at design temperature.

Remark 1: Refer Instrumentation specification for details of instruments

ANNEXURE-B: POLICY ON MAKE IN INDIA

The bidder (Indian as well as Foreign) in order to qualify has to offer equipment with proven track record (PTR) (i.e. proto-type models are not acceptable) and meeting the technical specifications laid out in the Material Requisition.

In order to encourage indigenous vendors to enhance their portfolio and manufacturing capabilities in engagement with their principals and in line with Government of India's policy on "Make in India", EIL offers the following qualification criteria for such subsidiaries which do not have the PTR for the offered equipment, but can get qualified based on either their Foreign Principal or another subsidiary of the Foreign Principal or the holding company of the Foreign Principal, meeting the PTR requirement.

In case, the bidder is an Indian manufacturer who is a subsidiary (Principal holding at least 51% shares) of a Foreign Principal and the qualification criteria is met by the Foreign Principal or another subsidiary of the Foreign Principal or of the Foreign Principal's holding company:

(a) Qualification Criteria for Foreign Principal or another subsidiary of Foreign Principal (Principal holding at least 51% shares) hereinafter called "Group Company" of the Foreign Principal or for the Foreign Principal's Holding Company:

1. The Principal or the Group Company shall be in the business of manufacturing of the offered product line (for at least last five years) for which the Indian Manufacturer is seeking to bid.
2. The Principal or the Group Company, whose PTR is being considered, shall already be enlisted either with EIL OR is in Licensor's vendor list, for the same product line¹.
3. The Principal or the Group Company shall have executed at least TWO orders for the same product line¹, within the last five years, reckoned from the bid due date.

Note: All the above criteria shall be met by the same company (either the Principal or the Group Company).

(b) Qualification Criteria for Indian Manufacturer (hereinafter called the bidder):

1. The Bidder must be a subsidiary of the Foreign Principal (Principal holding at least 51% shares) for at least last one year, reckoned from the bid due date.
2. Scope/activity matrix between the Bidder and Principal or the Bidder and the Group Company, shall be submitted to EIL along with the bid. However, the bidder must also note that EIL shall reserve the right to mandate certain activity (ies) or sourcing to be from identified sources only, (#) depending upon the product line under consideration and its criticality. The bidder shall not claim any extra payment on account of any change in sourcing inline with EIL's requirement.

¹Same Product Line for Principal or Group Company: Same type of Equipment being sought in the inquiry [e.g. Centrifugal pump (Horizontal) (Special purpose process) having equal or higher driver power vis a vis offered driver power].

²Same Product Line for Indian manufacturer: Same type of Equipment being sought in the inquiry [e.g. Centrifugal pump (Horizontal) (Special purpose process) having at-least 50% of the offered driver power].

3. The bidder shall source critical components **OR** the bare tested machine from the Principal or the Group Company or directly from the manufacturers supplying the same to the Principal or the Group Company (a certificate to this effect shall be provided by the Principal or the Group Company) and source non critical components / auxiliary components supplies himself (**subject to # above**).
4. The bidder shall have the necessary engineering, manufacturing capability and adequate infrastructure comprising of space, manpower, equipment corresponding to matrix cited above, duly approved by the Principal or the Group Company, as the case may be, for the product line under consideration.

5. As a minimum, the Principal or the Group Company as the case may be, shall carry out the following activities:
 - Design / Application engineering
 - Approval of sourcing of components
 - Approval of Quality Assurance Plans (QAP) identifying Hold, Check & Witness stages (by Principal)
 - Responsibility Matrix
6. The bidder shall have Manufacturing, Assembly and Testing facility for the proposed scope. However, in the remote case of the Manufacturer not having testing facility at all or not having appropriate testing facility, the Manufacturer shall outsource testing to another independent testing facility subject to acceptance by EIL.
7. The Bidder shall have an established service facility in India (either his own or an approved service provider) which must be approved by Principal or the Group Company, as the case may be.
8. The Bidder shall have executed and supplied minimum two orders in the same product line².
9. The Bidder shall be enlisted with EIL for the same product line².
10. In order to ensure commitment from the Bidder and adequate & continued support and Back up by the Principal or the Group Company from designing to commissioning of the product, the bidder shall provide a Contract cum Equipment Performance Bank Guarantee for 15% (i.e. additional 5%) of the order value within one month of receipt of the order, from an Indian scheduled bank or the Indian branch of a foreign bank.

In addition, the Principal or the Group Company shall furnish a "Corporate Guarantee" along with a Board resolution from an authorized signatory committing their continued support to the bidder, till defect liability period, to ensure that Buyer's interests are protected.
11. The Bidder shall provide extended warranty of 12 months over & above guarantee/ warrantee period specified in the GPC.

Manufacture: "Manufacture" includes any process:

- i. ***Incidental or ancillary to the completion of a manufactured product.***
- ii. ***Which is specified in relation to any goods in Central Excise Tariff Act (CETA) as amounting to the manufacture.***

Documentation required (along with the bid and in single lot)

1. General reference list of Principal or the Group Company for the same product line, for the last five years as well as General reference list of the bidder for the same product line.
2. Scope / Activity Matrix
3. Certificate of Incorporation of the Bidder.
4. Documents for establishing the bidder as a subsidiary of the Foreign Principal (Principal holding at least 51% shares)
5. Documents for establishing the relationship of the group company, if applicable.
6. Corporate Guarantee of the Principal or the Group Company (in the format provided by EIL)

[Note: The bidder may carry these documents during pre-tender / pre-bid meeting, in case they desire to seek some clarification from EIL. However, formal submission of documents shall only be with bid submission.]

उपकेन्द्रीय पम्पों के लिए मानक विनिर्देश विशिष्ट प्रयोजन प्रक्रिया पम्प

STANDARD SPECIFICATION FOR CENTRIFUGAL PUMPS (SPECIAL PURPOSE PROCESS SERVICE)

0	27.01.2021	Issued as Standard Specification	MKA/JSD	TK	NK	SM
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

API	:	American Petroleum Institute
ARV	:	Automatic Recirculation Valve
ASME	:	The American Society of Mechanical Engineers
BEP	:	Best Efficiency Point
BLO	:	Balance Leak off
DCI	:	Document Control Index
EC	:	Experience Criteria
eDMS	:	Electronic Document Management System
FFT	:	Fast Fourier Transform
HPRT	:	Hydraulic Power Recovery Turbine
ISA	:	Instrumentation Society of America
ISBL	:	Inside Battery Limits
MAWP	:	Maximum Allowable Working Pressure
MCF	:	Minimum Continuous Flow
MCR	:	Maximum Continuous Rating
MCS	:	Maximum Continuous Speed
MKS	:	Meter, Kilogram, Seconds
MMS	:	Machine Monitoring System
MOP	:	Main Oil Pump
MRT	:	Mechanical Run Test
NPSH	:	Net Positive Suction Head
NPSHA	:	Net Positive Suction Head Available
NPSHR	:	Net Positive Suction Head Required
NPSH3	:	Net Positive Suction Head 3%
OSBL	:	Outside Battery Limits
P&ID	:	Piping and Instrumentation Diagram
PTC	:	Power Test Codes
PTR	:	Proven Track Record
VDM	:	Vendor Document Management System
VDR	:	Vendor Data Requirements
VMS	:	Vibration Monitoring System

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1 Scope

- i. This specification together with the attendant Data Sheets and other specifications/attachments to inquiry / order defines the minimum requirements for vertical and horizontal centrifugal pumps including pumps running in reverse direction as hydraulic power recovery turbines and their accessories / auxiliaries for use in the petroleum, petrochemical and natural gas industries.
- ii. Vendor shall comply with the requirement of this specification and other specifications/attachments to inquiry/order. No deviation or exception shall be permitted without the written approval of the purchaser.
- iii. Compliance with this Specification shall not relieve the vendor of the responsibility of furnishing equipment and accessories /auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.

In case the vendor considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, they shall recommend the same along with reasons in a separate section along with his proposal and include the same in their scope of supply.

1A Amendments / Supplements to API Standard 610

- 1A.1 Except as modified herein, the centrifugal pumps shall be designed, manufactured, tested and supplied strictly in accordance with the **API Standard 610 - Centrifugal Pumps for Petroleum, Petrochemical and Natural gas industries, Eleventh Edition, September 2010**.
- 1A.2 Except for new paragraphs, the number and title of the paragraphs in this specification correspond to the respective sections and paragraphs of the above standard. Paragraphs not addressed in this specification shall be strictly in accordance to **API Standard 610, Eleventh Edition, September 2010** requirements.

The word in parenthesis following the number or title of a paragraph indicates the following:

- | | | |
|----------------|---|---|
| (Addition) | : | An addition to a part, section or paragraph referred to. |
| (Modification) | : | An amplification or rewording has been made to a part of the corresponding section or paragraph but not a substitution replacing the entire section or paragraph. |
| (Substitution) | : | A substitution has been made for the corresponding section or paragraph of the standard in its totality. |
| (New) | : | A new section or paragraph having no corresponding section or paragraph in the Standard. |
| (Delete) | : | The paragraph is deleted. |

1B Experience Criteria

- 1B.1 The pump model offered shall be from the existing pump model series and shall be from the regular manufacturing range of the vendor (Prototypes are not acceptable).

The mechanical design as well as the hydraulic performance (including NPSHR) for the complete range of operation of the offered model shall have been established in the shop test. (Details to be furnished, if required).

The offered pump model with identical hydraulics and design shall be field proven (at least ONE unit) with minimum operating experience of one year for similar operating/design conditions & driver rating, rotor dynamics, mechanical design, pumping liquid and material of construction, supplied in the last Ten (10) years, from the proposed manufacturing plant, as on bid due date.

(Note: Similar operating/design conditions & driver rating would mean approx. 80% or higher)

- 1B.2 The vendor shall complete the Experience Record Proforma enclosed with the inquiry document to amply prove that the offered pump model meets the above criteria by furnishing details of similar operating/design conditions {flow, head, operating/design pressures & temperatures, viscosity, speeds, efficiencies, driver rating, no. of stages, bearing span/column length etc.}, Rotor Dynamics {Impeller Arrangement, No. of Impellers, Bearing Span, Speeds etc.}, Mechanical Design {Bearing Type & Lubrication, MAWP etc.}, pumping liquid & material of construction etc. as applicable in the format.

Past Test Curves shall also be submitted (when requested) to justify the quoted efficiencies.

Multiple references may be furnished to justify the above.

In addition, manufacturer's catalogue and general reference list for "Centrifugal Pumps-Special Purpose Process Service" shall also be furnished along with the proposal.

1 Scope

Paragraph 1 of **API Standard 610 - Centrifugal Pumps for Petroleum, Petrochemical and Natural gas industries, Eleventh Edition, September 2010** stands modified as per para 1, para 1A and para 1B above.

3 Terms and Definitions

3.21 Maximum Allowable Working Pressure (Addition)

MAWP shall not be less maximum discharge pressure calculated as per 3.22 below and must satisfy the pressure and temperature parameters consistent with the discharge flange rating.

3.22 Maximum Discharge Pressure (Modification)

- Replace 'normal relative density' by 'maximum specified relative density at any specified operating condition' (including start-up/commissioning with water, if specified).

- "Maximum Differential Pressure" by "Maximum Differential Pressure with including all test tolerances".

3.60 Supplier / Vendor (Substitution)

Unless otherwise specified, **Supplier / Vendor** shall be the manufacturer of centrifugal pumps (special purpose), as per API 610, having adequate design, engineering, manufacturing, packaging and testing facilities and shall have supplied similar centrifugal pumps (special purpose) package as a single point responsibility vendor. The vendor shall also be the manufacturer of the proposed centrifugal pumps (special purpose).

4 General

4.1 Unit Responsibility (Substitution)

Vendor shall have UNIT RESPONSIBILITY of complete centrifugal pump package & shall be responsible for complete design, engineering, manufacturing, packaging, testing, supply & supervision of erection & commissioning of total package as per specification requirements. Vendor's scope shall include but not limited to the responsibility for execution, coordination of all technical aspects of equipment and its auxiliary systems,

their selection & integration into a complete package constituting total order. All drawings/documents, including sub vendor's drawings, pertaining to the order shall be duly reviewed & approved by the vendor before onward submission.

5 Requirements

5.1 Units (Modification)

Unless otherwise specified, MKS system of units shall be used.

5.3 Requirements (Substitution)

In case of conflict between this specification and the attendant data sheets, job specifications (if any) and other attached specification the following order of precedence shall govern:

1. Process Data Sheet / P&IDs / Process Package
2. Mechanical Data Sheets.
3. Job Specifications/scope of work (if any)
4. This specification
5. Other standards & specifications
6. Other referred codes and standards

The editions of referenced publication that are in effect at the time of inquiry or at a date specified in the inquiry documents shall be applicable.

In case of any ambiguity in the above documents, the vendor/supplier shall seek clarification from the owner/purchaser and the decision of the owner/purchaser shall be final and binding.

6 Basic Design

6.1 General

6.1.3 (Addition)

Unless otherwise specified, pump minimum continuous flow (MCF) shall be less than process normal flow. Pumps having MCF greater than Process Normal Flow are not acceptable.

6.1.4 (Modification)

The words "different hydraulic design, variable speed capability" stands deleted.

6.1.8 (Addition)

Unless otherwise specified, pumps where difference between NPSHA and NPSHR/NPSH3 from quoted minimum flow to rated flow is less than 0.6 meter are not acceptable. The said NPSHR/NPSH3 value shall correspond to the maximum value of NPSHR/NPSH3 from rated flow down to the recommended minimum continuous stable flow specified by the vendor. Further, in case of parallel operation and/or auto start against open discharge valve condition, NPSHR/NPSH3 upto 120% of best efficiency point shall not exceed specified NPSHA in addition to above margin requirement.

Pumps (except for OH6 type pumps) fitted with inducers for reducing NPSHR/NPSH3 is not acceptable.

Note: Actual datum for NPSHA (i.e. grade level, top of foundation level or any other level as defined in enquiry) shall be referred from the data sheets forming part of enquiry document.

- 6.1.11 (Substitution)
Pumps shall have stable head/flow-rate curves (continuous head rise to shutoff) for all applications. If parallel operation is specified, the head rise from rated point to shutoff shall be at least 10%. Unless otherwise specified, discharge orifice shall not be used to achieve required head rise to shut off, even in case of parallel operation.
- 6.1.12 (Substitution)
Pumps shall have preferred operating region of 70% to 120% of best efficiency flow-rate of the pump as furnished. Rated flow shall be within 70% to 110% of best efficiency flow-rate of the rated impeller except for intermittent duty applications, low flow pumps (≤ 20 m³/hr) and pump rated BkW upto 15 kW. Vendor shall indicate "Preferred Operating Range" and "Allowable Operating Range" on the characteristic curve.
- 6.1.14 (Modification)
The last sentence of this paragraph reading "the equipment...for guidance" stands substituted with the following:

Unless otherwise specified, the maximum permissible sound pressure level of the complete equipment (pump + driver) train including all ancillaries & auxiliaries shall not exceed 85 dBA measured at 1 meter from equipment surface in any direction for the recommended range of operation at site.
- 6.1.17 (Modification)
Unless otherwise specified, vendor shall offer their standard cooling plan (as per API Annex B) guaranteeing safe and satisfactory operation of the pump package.

The need for cooling shall be determined by the vendor, and the method shall be agreed upon by the purchaser. However water cooling shall be provided to bearing housing for all pumps with fluid temperature greater than 250°C operating in ISBL areas.
- 6.1.20 (Modification)
Unless otherwise specified, water cooling systems (jackets, heat exchangers and so forth) shall be designed for the following conditions on the water side:
- | | | |
|--|---|---------------------------------|
| Velocity over heat exchanger surface | : | 1.5 - 2.5 m/sec. |
| Maximum Allowable Working Pressure (MAWP) | : | ≥ 8.0 kg/cm ² g |
| Test Pressure | : | $= 1.5 \times \text{MAWP}$ |
| Maximum Pressure Drop | : | 0.7 kg/cm ² |
| Maximum Inlet Temperature | : | 33°C |
| Maximum Outlet Temperature | : | 45°C |
| Maximum Temperature Rise | : | 12°C |
| Minimum Temperature Rise | : | 6°C |
| Fouling Factor on Water Side | : | 0.0004 m ² hr°C/kcal |
| Shell Side Corrosion allowance (not for tubes) | : | 3.2 mm |
- Note: TSV set pressure (in CW isolatable circuits) shall not exceed the design pressure of purchaser's CW header.
- 6.1.28 (Addition)
Unless otherwise specified, equipment shall be designed to be suitable for outdoor installation without a roof.
- 6.1.35 (New)
For balancing axial thrust in multi-stage pumps, only the following arrangements shall be used:
- Opposed arrangements of impellers.
 - A balancing piston

6.1.36 (New)
Unless otherwise specified, for rated flows exceeding 1000 m³/hr or with differential head above 200 m, only “Between Bearing Type” pump shall be supplied.

6.1.37 (New)
Unless otherwise specified, electric motor driven pumps shall be directly driven.

6.1.38 (New)
Unless otherwise specified, for vertical pumps, material of guide bushing shall be suitable for dry running during start-up / transient conditions as well as running on lubrication by pumping fluid/external source.
Vendor shall select a suitable material (Metallic/Non Metallic) based on their experience and guarantee satisfactory operation. Past supply references to be provided on request.

6.1.39 (New)
Single and two-stage pumps operating at temperatures less than 150°C and multi-stage pumps operating at temperatures less than 120°C shall be suitable for instantaneous start-up from ambient to full operating temperature without any warm-up.

For operating temperatures higher than the above, unless otherwise specified, the pump vendor shall provide casing warm-up arrangement with suitable hardware (i.e. flanged piping, valves, orifice & fittings) within pump skid battery limits. Warm up flow shall be added to the rated flow for pump/driver sizing and selection and the same shall be reflected on data sheet and performance curves. Flanged warm-up connection shall be provided at the skid edge for the further interfacing by purchaser. Casing warm up schematic shall be provided by pump vendor in their proposal.

As part of the operating manual, an appropriate start-up procedure shall be provided by pump vendor.

Required monitoring equipment (i.e. skin thermo- couples, temperature transmitters etc.) to ensure that the pump, including seal(s), does not incur damage due to rapid heat up, shall be supplied by pump vendor.

6.2 Pump Types (Modification)

Unless otherwise specified, pump types as listed in Table 3 shall not be offered.

6.3 Pressure Casings

6.3.1 (Substitution)
The maximum discharge pressure shall be the maximum suction pressure plus the maximum differential pressure including all test tolerances, the pump is able to develop, when operating with the furnished impeller at the rated speed and specified maximum relative density at any specified operating condition’ (including start-up/commissioning with water at normal suction pressure, if specified).

6.3.3 (Modification)
The ‘NOTE’ stands modified as under:
Vendor to note that the criteria specified in a) above shall also be used for design of purchaser’s associated piping system.

6.3.5 (Modification)
Unless otherwise specified, OH2, OH6, BB1 and BB2 pumps shall be equipped with ANSI 300# flanges / PN50 flanges.

6.3.6 (Modification)
Unless otherwise specified, regions of vertically suspended, double-casing and horizontal multistage pumps (pumps with three or more stages) that are subjected only to suction pressure shall be designed for the same MAWP as that of discharge section.

6.3.10 (Modification)
The second line "Gaskets other than spiral-wound may be proposed and furnished, if proven suitable for service and approved by the purchaser" stands deleted.

6.3.11 (Modification)
The words "except as allowed in 9.2.1.2" stand deleted.

6.4 Nozzles and pressure casing connections

6.4.3 Auxiliary connections

6.4.3.1 (Addition)
All drain and vent connections shall be terminated at the skid edge along with instructions that the same are to be further connected to either an open drain or a closed drain.

6.4.3.16 (New)
In case, Balance-leak-off (BLO) line is connected to suction source of the pump, the balance line shall be provided with pressure gauge, orifice & pressure relief valve upto vendors battery limit. Vendor shall ensure that BLO flow has already been considered in pump & driver sizing and the rated capacity is discharged from pump discharge. Screwed connections are not allowed. Balance leak off line shall be designed for the pump casing MAWP.

6.5 External Nozzle Forces and Moments

6.5.1 (Modification):
The pump's pressure casing and their base-plates shall be suitable to withstand twice the forces and moments in Table 5 applied simultaneously to the pump through each nozzle, plus internal pressure, without distortion that would impair operation of the pump or seal.

Note:

1. Vendor to note that the above criteria shall be used for design of purchaser's associated piping system.
2. Annex F of API 610 may be utilised for pumps with Automatic Recirculation Valve (ARV) mounted on the pump discharge nozzle.

6.7 Wear Rings and Running Clearances

6.7.3 (Modification)
Tack welding shall not be employed for fitting of the wear rings.

6.7.4d) (New)
The maximum permissible running clearances shall not be less than twice the new running clearances.
Note: While selecting the running clearances, galling tendency of the offered wear rings shall be taken into consideration.

6.8 Mechanical Shaft Seals

6.8.1 (Addition)

For the applicable flushing plans, the vendor shall also include in his scope of supply, all items shown as optional items in Annex-G of API 682 4th edition (Standard Flush Plan and auxiliary Hardware) along with other additional specified/ required items, if any.

6.9 Dynamics

6.9.2 TORSIONAL ANALYSIS

6.9.2.10 (Modification)

Replace the words 'If specified' by 'If torsional analysis is performed'.

6.9.3 VIBRATION

6.9.3.2 (Modification)

Fast Fourier Transform (FFT) during MRT is to be used for Multi-stage pumps with hydrodynamic bearings, fed with forced lube oil system & equipped with VMS.

6.9.3.3 (Modification)

The words 'if specified' in the last sentence stand deleted.

6.10 Bearings and Bearing Housings

6.10.2 BEARING HOUSINGS

6.10.2.6 (Modification)

Bearing housings shall be equipped with suitable replaceable noncontact type bearing isolators where shaft passes through the housing.

6.10.2.11 (Substitution)

A flat surface at least 25 mm in diameter shall be supplied for the location of magnetic based vibration measuring equipment, whether or not vibration measuring equipment is included in the vendor's scope of supply. Pumps shall also have provision for mounting accelerometers (X & Y) on each bearing housing.

6.10.2.13 (New)

Bearing housing shall be equipped with magnetic drain plug except for multistage pumps where vendor's standard design may not permit this.

6.11 Lubrication

6.11.3 (Substitution)

Provision shall be made for pure/purge oil mist lubrication as specified.

6.12 Materials.

6.12.1.6 (Substitution)

Unless otherwise specified, casing in cast iron construction shall not be offered

6.12.1.8 (Modification)

The words 'if specified' stand deleted.

6.12.1.12 (Modification)

Where even trace quantities of wet H₂S are indicated to be present, reduced hardness materials in accordance with NACE MR0175/MR0103 shall be provided by the vendor.

6.12.2.5 (Modification)

The words 'if specified' stand deleted.
The second sentence also stands deleted.

6.12.3.4 (Modification)

e) Requirements of additional examination shall be as specified vide clause 8.2.1.3 of this specification.

6.12.4.3 (Modification)

ASME Sec VIII, Div 1 shall apply with regard to impact testing requirements.

7 Accessories

7.1 Drivers

7.1.4 (Modification)

Electric motor drivers shall have a maximum continuous rating (MCR) (i.e. service factor equal to 1) not lower than the following unless higher rating is dictated by the Note 1 and / or Note 2:

Pump Rated BKW*		Motor MCR (% of Pump Rated BKW)
Up-to 22 kW	:	To suit maximum BKW indicated on pump data sheet or 125% of rated pump BKW, whichever is higher.
22 kW to 55 kW	:	115%
Higher than 55 kW	:	110%

Note: * including all mechanical & transmission losses & with 0% +ve tolerance.

The electric motor shall be suitable for the electrical area classification specified on the data sheet.

Note:

- The motor nameplate rating for pumps under parallel operation or for pumps with auto-start operation shall not be less than the max. BKW indicated on pump data sheet (maximum power at any point on the pump performance curve from shutoff to end of the curve for the rated impeller) or shall have the specified margin as per this clause whichever is greater. The pump motors shall also be suitable for start-up under open discharge valve condition.
- The motor nameplate rating for applications where the specific gravity of pumped fluid is less than 1.0 shall either be 100% of the BKW of pump at minimum continuous stable flow with clean cold water of sp. gravity 1.0 or shall have the specified margin as per this clause, whichever is greater.

7.1.9 (Modification)

Unless otherwise specified, steam turbine drivers shall be sized to deliver continuously 110% of pump rated power at minimum inlet and maximum exhaust steam conditions.

The steam turbine rating (with minimum inlet and maximum exhaust steam conditions) for pumps under parallel operation or for pumps with auto-start operation shall not be less than the max. BKW indicated on pump data sheet (maximum power at any point on the pump

performance curve from shutoff to end of the curve for the rated impeller). The turbine shall also be suitable for start-up under open discharge valve condition.

In any case, Turbine Rating shall be at least equal to the Motor Rating of the standby pump.

7.2 Couplings and Guards

7.2.3 (Substitution)

Couplings shall be balanced to ISO 1940-1, grade G2.5.

7.2.4 (Substitution)

Unless otherwise specified, all couplings required for multistage pump package(s) (greater than two stages) shall conform to API standard 671 where either the driver rating is greater than 160 kW or the maximum continuous speed is greater than 3000 rpm.

However in case of gear box driven multistage pump units, both low speed and high speed couplings shall conform to API standard 671 if any of the above criteria of speed or power is satisfied.

7.2.7 (Addition)

The coupling service factor shall not be less than 1.5 over the driver rating. However, during selection of coupling, vendor to ensure that the maximum service factor (actual SF) for the coupling shall not exceed the allowable stresses of the drive train. Further, for the pumps equipped with gear box, max service factor for coupling shall not exceed the gear box service factor.

7.2.13 a) (Addition)

Coupling guard shall be open at the bottom to permit manual shaft rotation.

7.2.13d) (Modification)

Coupling guard shall be fabricated from non-sparking material.

7.3 Base Plates

7.3.1 (Addition)

Pumps in corrosive service shall have provision to collect and drain the leakage from mechanical seal or packing, through a drip pan of metallurgy equivalent or superior to pump casing. Leakages from drip pan shall be piped to base-plate with a flanged connection for onward disposal by purchaser. Where the design of bearing prohibits provision of drip pan, the material of bearing bracket shall be suitable for the corrosive service. Base plates shall have jacking provision for aligning the prime movers & shall be provided with 2" 150# flanged connection.

7.3.5 (Modification)

Replace "if specified" by "For all multistage pumps".

7.3.19 (Modification)

The pump manufacturer shall furnish the anchor bolts.

7.3.21 (Modification)

All pumps offered shall have been tested for nozzle load test (either by physical testing or by computer simulation study using finite element analysis) in the past for twice the API loads meeting shaft deflection criteria as per Table-13 for baseplate intended for grouting limits and shall be demonstrated through the past test reports for the offered model. Categorical compliance to the above is mandatory and report may be furnished on demand.

In case pipe load test has not been conducted in the past, the vendor shall demonstrate the pipe load test with the above defined loads & shaft deflection as per Table-13 (either by physical testing at their manufacturing shop or by computer simulation study using finite element analysis) for the proposed pump model(s). Unless otherwise specified, this is not a witness test and only report is required.

7.3.22 (New)

Skid layout of pump trains along-with their auxiliary systems (i.e. seal flushing plans) shall be designed in a manner so as to ensure that there is enough space within the skid for maintenance and operation. Special care shall be taken for pumps provided with seal flushing plans 23, 52, 53, 75, etc so that couplings and seals can be attended for maintenance without disturbing any seal piping/cables/other items located on the skid. As far as possible, area on motor terminal box side shall be left clear of all piping and accessories for ease of maintenance.

7.4 Instrumentation

7.4.2.2 (Modification)

The words 'if specified' stand deleted. The vendor shall supply the detectors.

7.4.2.3 (Modification)

The words 'if specified' stand deleted.

7.4.2.4 (Modification)

The words 'if specified' stand deleted.

7.4.2.5 (New)

Horizontal multistage pumps intended for pumping temperature above 120°C shall be provided with pump casing skin temperature monitoring system consisting of the following:

- Four thermocouples for number of stages ≥ 4 & minimum two thermocouples for number of stages < 4 , along-with yoke mounted temperature transmitters with integral indicator for each thermocouple.
- One Junction Box (JB) to be mounted on the pump base-plate.
- Cables between the thermocouples and transmitters.
- Cables between transmitters and junction box.

For multistage pumps in pipeline applications, where MCF recirculation line is generally not provided, casing skin temperature monitoring as defined above shall be provided irrespective of the pumping temperature.

7.5 Piping and Appurtenances

7.5.1 GENERAL

7.5.1.6 (Modification)

The words 'if specified' stand deleted.

7.5.1.7 (Modification)

Flange fasteners on stainless steel piping systems shall be of stainless steel.

7.5.2 AUXILIARY PROCESS FLUID PIPING

7.5.2.3 (Modification)

Auxiliary process fluid piping material shall be SS-316 as a minimum.

7.5.2.6 (Substitution)

Casing shall be provided with drain connection with nipple, threaded and seal welded and provided with a socket welded gate valve terminated at edge of the base plate. Gate valve shall be of 800# rating with material of construction (MOC) equal or superior to the pump casing. For multistage pumps with more than one drain point, block valves at each drain point shall be provided and the piping shall be terminated at edge of the base plate with a flange. Unless made self venting design, vent connections shall also be provided with a nipple, threaded and seal welded and terminated with a gate valve. Pressure gauge connection shall not be provided unless specifically required in the inquiry. Nipples shall meet the requirements of 6.4.3.4, 6.4.3.5&6.4.3.9.

7.5.2.8 (Modification)

Flanges are required instead of socket welded unions for all auxiliary process fluid piping.

7.5.2.11 (New)

Unless otherwise specified, material for seal flushing liquid cooler shall be as under:

Tube or Coil : Type 316 stainless steel or Monel.

Casing (or Shell) : Carbon Steel.

Cooling water shall be on the casing (Shell) side.

7.5.3 COOLING WATER PIPING

7.5.3.3 (Addition)

Sight flow indicator shall have ball or flag for easy verification of water flowing through pipes.

7.5.3.4 (New)

Thermal relief valve (in each isolatable cooling water circuit) shall be provided upstream of globe valve on the cooling water outlet line. Set pressure of thermal relief valve shall be equal to the design pressure of cooling water piping system.

8 Inspection, Testing and Preparation for Shipment

8.1 General

8.1.7 (New)

Prior to start of test, manufacturer shall furnish the certificate of latest calibration / re-calibration of driver and measuring instruments for review by purchaser's inspection agency.

Unless electrical or mechanical failure occurs, driver used for shop testing need not be recalibrated and original calibration certificate shall remain valid.

Duration of recalibration for all measuring instruments shall be as per the recommendations of HI Standards.

8.2 Inspection

8.2.1 GENERAL

8.2.1.3 (Substitution)

The minimum inspection requirements for pressure containing casing shall be as per the following:

Inspection category	Inspection requirement	Remarks
CATEGORY A	Visual inspection and Magnetic Particle or Liquid Penetrant inspection of following	C1. Liquid penetrant inspection shall be performed only when specified magnetic

Inspection category	Inspection requirement	Remarks
	components as a minimum: - Nozzle weld - Butt welds on pressure containing components - Fillet welds on pressure containing components. - Shaft Radiographic or ultrasonic inspection of the following as a minimum: - Nozzle weld - Butt welds on pressure containing components.	particle inspection is not feasible. C2. Magnetic particle or liquid Penetrant inspection shall be carried out in accordance with Table 14. C3. Ultrasonic inspection shall be carried out when radiography is not feasible. Radiography or ultrasonic inspection shall be carried out in accordance with Table 14.
CATEGORY B	Visual inspection and Magnetic Particle or Liquid Penetrant inspection of following components as a minimum: - Nozzle weld - Butt welds on pressure containing components - Fillet welds on pressure containing components. - Shaft	B1. Liquid penetrant inspection shall be performed only when specified magnetic particle inspection is not feasible. B2. Magnetic particle or liquid penetrant inspection shall be carried out in accordance with Table 14.
CATEGORY C	As per vendor's standard Quality Assurance Plan	
Note: Category A: This category is applicable for services with process design pressure above 70 kg/cm ² g or process design temperature below -29°C or above 300°C. Category B: This category is applicable for services within the design pressure and temperature range other than covered under category A above and category C below. Category C: This category is applicable for carbon steel and cast iron for services with process design pressure up to 40 kg/cm ² g and design temperature from 0 to 150°C.		

8.2.1.5 (New)

Inspection shall also include dimensional check of pump, driver and auxiliaries (if any) duly mounted on the base plate, in accordance with certified general assembly drawing. This will include all main pump dimensions, base plate dimensions, location of foundation bolt holes, size/position/rating of flanges, coupling guard arrangement, verification of the required material certificates and their trace-ability to the respective components. In addition, following checks shall also be carried out:

- A measurement of the actual running clearances throughout the pump.
- A check for the hardness of wear rings.
- A check for good workmanship and finish throughout.

8.2.1.6 Inspection & Testing requirements: (New)

- A. Pump-Centrifugal Horizontal (SPP) / Pump-Centrifugal Vertical (SPP) / Pump-Centrifugal Canned Motor / Pump-Centrifugal Submerged Motor (Cryogenic) / High Speed Integrally Geared Centrifugal Pumps:

S.no.	Inspection & Tests	Scope of Inspection (Note-1)
1	Shop Test / Inspection	R
2	Material Certificates	R
3	Hydrostatic test	R
4	Performance Test / Sound level Test	W
5	NPSH Test as required (as per specification) / Minimum Submergence Test (for Vertical pumps)	W
6	Dismantle Inspection & Re-assembly after test	W (Note-2)
7	Unitization / Check of direction of rotation of pump	O (but not required for PMC jobs; to be governed by contractor's quality plan)
8	Visual, dimension and skid completeness check	W (Conventional jobs) R (PMC jobs)

B. Pump-Centrifugal Horizontal Multistage (SPP) / Pump-Centrifugal (BFW)

S.no.	Inspection & Tests	Scope of Inspection (Note-1)
1	Shop Test / Inspection	R
2	Material Certificates	R
3	Hydrostatic test	W
4	Rotor Dynamic Balancing (Both Main & Spare Rotor)	O
5	Performance Test / Sound level Test	W
6	NPSH Test as required (as per specification)	W
7	Dismantle Inspection & Re-assembly after test	W
8	Unitization / Check of direction of rotation of pump	O (but not required for PMC jobs; to be governed by contractor's quality plan)
9	Visual, dimension and skid completeness check	W (Conventional jobs) R (PMC jobs)
10	Complete Unit Test	W (Note-3)

Legends:

R: Required: Reviewing of manufacturer's shop test reports shall be considered as adequate.

O: Observed: Purchaser shall be notified but work may proceed after scheduled date.

W: Witnessed: A HOLD shall be applied and work shall not proceed without approval.

Notes:

- The inspection & test requirements specified are applicable for each pump unless otherwise specified.
- Dismantle Inspection of pump after performance test shall be applicable only in case of abnormality in mechanical behavior (such as excessive noise & vibration, bearing temperature rise etc.) during performance test.
- All the pumps (except for steam turbine drive pump) with forced feed lubrication system shall undergo complete unit test at rated speed. Job drive, job mechanical seal & job coupling shall be used (with motor getting loaded only upto its full load current value). Shop LO system, Shop machine monitoring instrumentation & controls & shop sealing system can be utilized for this test. All pumps with a discharge pressure above 100 bar and or an absorbed power above 750 kW shall be subjected to complete unit test.

8.2.2 MATERIAL INSPECTIONS

8.2.2.6 (Modification)

The words “if specified” stand deleted.

8.2.2.7 (Modification)

The words “if specified” stand deleted.

8.3 Testing

8.3.1 GENERAL

8.3.1.1 (Modification)

The words ‘if specified’ stand substituted with ‘Unless otherwise specified’

8.3.1.2 (Modification)

Table 16 stands modified as under:

Rated Head : Zero negative tolerance @ rated flow rate & rated speed

Shut-off Head : Following criteria shall apply:

a) Positive tolerance permitted as long as maximum shutoff pressure corresponding to shut-off head (as observed during the shop performance test) and the maximum suction pressure (as specified on pump data sheet), does not exceed the downstream design pressure (as specified on pump data sheet).

b) Negative tolerance (as per Table 16 of API Std. 610, 11th edition) may be permitted only if test curve still shows rising characteristics.

c) Negative tolerance is permitted as long as curve is continuously rising and shutoff head is minimum 110% of rated head.

[Note: Generally shutoff head should be limited within 120% of rated head.]”

NPSHR : Zero positive tolerance.

Rated BKW : Zero positive tolerance. (However, pumps may be accepted up-to 104% of guaranteed BKW subject to Penalties as defined elsewhere.

8.3.1.4 (New)

Unless otherwise specified the following tests shall be witnessed by the Purchaser or by their authorised representative or by both together.

1. Hydrostatic test as per 8.3.2 for Multistage Pumps.
2. Performance test as per 8.3.3.
3. NPSHR test as per 8.3.4.3 when specified in the material requisition or when the difference between NPSHA and NPSHR is less or equal to one (1) meter.
4. Unitization of Pump with Job Driver at shop.
5. Dismantling inspection and reassembly, after the running test
6. Dynamic balancing of Complete Rotor in case of Multistage Pumps
7. Sound level test.

Test Certificates for Hydrostatic Test & Dynamic Balancing of Impeller(s) will suffice for single & two stage pumps. These test certificates shall be furnished to purchaser’s inspector for review prior to performance testing.

8.3.2 HYDROSTATIC TEST

8.3.3 PERFORMANCE TEST

8.3.3.2 j) (New)

Shop driver shall be used for testing and the rating of the driver shall not exceed 150% of power that may be consumed while running at duty point with water; or power at full valve open condition, whichever is higher. The limitation of 150% is applicable only for medium voltage motors.

8.3.3.3 a) (Addition)

At 100% rated flow, shall also be included.

8.3.3.5 c) (Modification)

During the performance test, rise in temperature of bearing oil shall be measured and results recorded on the test log. If specified, pumps provided with oil mist lubrication (Purge/Pure) shall be tested with shop oil mist system & suitable performance at vendor's shop shall be demonstrated.

8.3.3.7 b) (Modification)

The words 'if specified' stand deleted.

8.3.4 OPTIONAL TESTS

8.3.4.2 Mechanical run test

8.3.4.2.1 (Delete)

8.3.4.2.2 (Modification)

The words 'if specified' stand deleted.

8.3.4.3 NPSHR Test

8.3.4.3.1 (Substitution)

If NPSHR test is specified or if it is required to be done as per para 8.3.1.4, NPSHR shall be determined at each test point defined in 8.3.3.3.a) except shut-off and in-case of parallel operation additionally at 120% of BEP.

8.3.4.5 Sound Level Test (Modification)

The words "if specified" stand deleted.

During the performance test, the equipment shall be checked for its sound level at minimum flow, at rated flow, at flow at best efficiency point and at 120% BEP flow.

The maximum allowable value shall not exceed the value specified under clause 6.1.14 or as specified in the datasheet, whichever is lower, when measured at one (1) meter from pump surface.

Where complete unit test is specified, vendor is required to demonstrate the noise levels within the maximum permissible sound level for the complete unit.

Recorded sound levels during shop test shall be taken for reference only & not for final acceptance or rejection. However sound level as specified in the inquiry document shall be guaranteed at site.

8.3.4.6 Auxiliary Equipment Test (Modification)

The words "if specified" stand deleted.

8.4 Preparation for Shipment

8.4.1 (Modification)

Unless otherwise specified, the equipment shall be protected for an outdoor storage of 12 months at site. If any extra precaution is to be taken by the Purchaser for storage beyond 12 months the same shall be explicitly indicated in the operation and maintenance manuals.

8.4.6 (Substitution)

Two copies of the manufacturer's job specific installation manual shall be packed and shipped with the equipment.

9 Specific Pump Types

9.1 Single Stage Overhung Pump

9.1.1 (Addition)

Unless otherwise specified, overhung pumps for rated flow exceeding 1000 m³/hr or differential head above 200 m are not acceptable.

9.1.1.3 (Substitution)

The shaft flexibility index shall be calculated in accordance with K.2 and shall be indicated by the pump vendor in his proposal / technical data sheet. The value of shaft flexibility index for overhung pumps, I_{SF} , for the given pump size factor, K_t shall not exceed 1.2 times the equation K.4 (SI units) or K.5 (US units).

9.1.3 INTEGRAL GEAR DRIVEN (TYPE OH6) PUMPS

9.1.3.6 (Modification)

Diameter of gauges shall be 100mm (4 in.) as a minimum.

9.2 Between Bearing Pumps

9.2.1.2 (Substitution)

Pumps for all services shall be centreline mounted irrespective of pumping temperature.

9.2.2.3 (Modification)

The words 'if specified' stand deleted.

9.2.2.5 (New)

Unless otherwise specified, Maximum number of stages shall not exceed 12 for horizontal pumps subject to meeting PTR with respect to Bearing Span & Speed and similar service. Unless otherwise specified, Maximum number of stages shall not exceed 15 for vertical pumps subject to meeting PTR with respect to Bearing Span & Speed and similar service.

9.2.4 DYNAMICS

9.2.4.1.2 Table 18-Decision logic for rotor lateral analysis (Modification)

The words 'similar or' stand deleted from step-2.

9.2.6 LUBRICATION

9.2.6.2 (Modification)

The words 'ISO 10438-3' shall be replaced with 'ISO 10438/API standard 614, Part 3'

9.2.6.4 (Modification)

The words 'ISO 10438-2' shall be replaced with 'ISO 10438/API standard 614, Part 2'

9.2.6.5 (New)

The pump manufacturer shall supply all the specified/required instrumentation. However, purchaser shall approve the make, type and the specification.

9.2.6.6 (New)

In case a pressure lubrication system is required and is supplied with shaft-driven main oil pumps (MOP), the MOP shall be suitable for safe coast down of the complete equipment train without necessitating the requirement of overhead rundown tank.

In case MOP is not suitable for safe shutdown of the complete equipment train, the vendor in his offer may propose for purchaser's consideration any special arrangement/provision provided for equipment safety and protection when the equipment decelerates. Provision shall be adequate for coast down time and cool-off time as applicable.

Due to space constraints, mechanical seals for lube oil pump can be as per API 610 / API 676.

9.2.6.7 (New)

External pressure-lubrication systems shall comply with the following additional requirements:

- Pumps, filters, strainers, coolers, traps, valves and all other components that retain oil under pressure and are external to the reservoir shall be made of steel.
- Except in case of shaft driven pumps, if a positive displacement type of oil pump is supplied, a separate relief valve (not integral with the pump) shall be provided. The relief valve shall not be used for pressure regulation. Horizontal oil pumps shall not be installed on top of the oil reservoir.
- A removable tube bundle design is required for shell and tube coolers with more than 0.5 m².
- The oil side operating pressure of the oil cooler shall be higher than the water-side operating pressure to prevent contamination of oil in case of cooler failure.
- Filters shall be equipped with a continuous flow transfer valves and an equalising line.
- Oil system shall have drain rim or pan to catch oil spills.
- Unless otherwise specified, heating element shall not be provided. However, if in the opinion of vendor such an arrangement is required (especially in view of the lowest ambient temperature prevailing at job site), the same shall be supplied by the pump manufacturer with specific approval of the purchaser.

9.2.7 TESTING

9.2.7.1 (Modification)

The words 'ISO 10438-3' shall be replaced with 'ISO 10438/API standard 614, Part 3'

9.2.7.5 (Modification)

The words 'if specified' stand deleted.

9.2.8 PREPARATION FOR SHIPMENT

9.2.8.2 (Modification)

The words 'if specified' stand deleted.

9.2.8.3 (Modification)

The words 'if specified' stand deleted.

9.2.8.4 (Modification)

The words 'if specified' stand deleted.

9.3 Vertically Suspended Pumps (types VS1 through VS7)

9.3.1 GENERAL

9.3.1.1 (Modification)

Hydraulic performance shall also be corrected for friction head losses in the inlet strainer.

9.3.1.3 (New)

Unless otherwise specified, in case of tank-mounted pumps, the setting depth shall be so arrived that the pump minimum submergence is ensured within the boot of the vessel, i.e. minimum liquid level shall be considered to correspond to bottom of the tank level for ensuring complete evacuation of the tank.

9.3.1.4 (New)

Single casing Vertically suspended Pump speed shall be less than or equal to 1500 RPM.

9.3.2 PRESSURE CASINGS

9.3.2.4 (New)

Bowls and columns shall be flanged and bolted.

9.3.3 ROTORS

9.3.3.2 (Addition)

Multi-piece vertical pump line shaft shall not be joined by threaded couplings.

9.3.6 BUSHINGS AND BEARINGS

9.3.6.2 (Modification)

Pump thrust shall not be transferred to driver motor. Vertical pumps shall be provided with their own thrust bearing to carry rotor weight and pump generated axial forces. Thrust bearing shall be positively locked on the pump shaft (shouldered shaft) and the bearing housing.

9.3.7 LUBRICATION (Addition)

For self-lubricated vertical pumps, the guide bushings / line shaft bearings shall be suitable for dry running during start-up. For vertical pumps handling liquid containing solids, external lubrication arrangement for line-shaft bearings may be provided.

9.3.8 ACCESSORIES

9.3.8.1.1 Drivers (Modification)

For vertical pumps, not provided with non-reverse ratchet, vendor shall describe the precaution taken, to prevent damage due to reverse rotation.

9.3.8.3 Mounting Plates

9.3.8.3.1 (Modification)

The words 'if specified' stand deleted.

9.3.8.3.3 (Modification)

The words 'if specified' stand substituted with 'unless otherwise specified'.

9.3.10 SINGLE CASE DIFFUSER (VS1) AND VOLUTE (VS2) PUMPS

9.3.10.5 (Modification)

The words 'if specified' stand deleted.

9.3.13 DOUBLE CASING DIFFUSER (VS6) AND VOLUTE (VS7) PUMPS

9.3.13.2 (Modification)

The words 'if specified' stand deleted.

9.3.13.5 (Modification)

The words 'if specified' stand deleted.

10 Vendor's Data

10.1 General.

10.1.2a) (Substitution)

The purchaser's/owner's/consultant's corporate name

10.1.3 CO-ORDINATION MEETING (Substitution)

When specified, a co-ordination meeting shall be held at Purchaser's office, preferably within 4 weeks of order.

An agenda shall be prepared for this meeting and would include the following points related to technical aspects:

- Any clarifications required by the vendor on purchaser's order.
- Document Control Index (DCI).
- Vendor Data Review/approval modalities.
- Sub-vendor lists proposed by vendor.
- Utility requirements.
- Preliminary General Arrangement & layout drawings & purchaser's interface drawings.

10.2 Proposals

10.2.1 GENERAL (Substitution)

The vendor's proposal shall as a minimum include the following:

- All data sheets, drawings and documents specified under "WITH BID" Section in the Vendor Data Requirement Form.

Note: Clearance less than those required by Table 6 shall be stated as an exception to API 610.

10.2.4 (Modification)

The second line of this clause "Except for low specific speed design shall be indicated" stands deleted.

10.3 Contract Data

10.3.1 GENERAL (Substitution)

- 10.3.1.1 Drawings and data as required after purchase order has been specified in Vendor Data Requirement. Vendor to note that the drawing/document descriptions/titles as given in the Vendor Data Requirement are generic in nature. It is possible that against one drawing / document specified there are several drawings to be furnished by the vendor or vice versa.
- 10.3.1.2 All vendor data/drawings/documents shall be in English Language and in Metric Systems. All post order documents shall be submitted / approved through EIL VDM portal.
- 10.3.1.3 Final documentation shall be submitted in hard copy and soft (CDs/ DVDs) in addition to submission through EIL VDM portal. The number of prints and/or reproducible required to be submitted by vendor are specified in Purchaser's inquiry/order.

Annex-C: Hydraulic power recovery turbines

C.1 General

C.1.1 EXPERIENCE CRITERIA

- C.1.1.1 The HPRT model offered shall be from the existing HPRT model series and shall be from the regular manufacturing range of the vendor (Prototypes are not acceptable).

The mechanical design as well as the hydraulic performance for the complete range of operation of the offered model shall have been established in the shop test. (Details to be furnished, if required).

The offered HPRT model shall be field proven (at least ONE unit) with minimum operating experience of one year for similar operating/design conditions & power generated, rotor dynamics, mechanical design, pumping liquid and material of construction, supplied in the last Ten (10) years, from the proposed manufacturing plant, as on bid due date.

(Note: Similar operating/design conditions & power generated would mean approx. 80% or higher)

- C.1.1.2 The vendor shall complete the Experience Record Proforma enclosed with the inquiry document to amply prove that the offered HPRT model meets the above criteria by furnishing details of similar operating/design conditions {flow, head, operating/design pressures & temperatures, % vapour handled at discharge, speeds, efficiencies, power generated, no. of stages, bearing span etc.}, Rotor Dynamics {Impeller Arrangement, No. of Impellers, Bearing Span, Speeds etc.}, Mechanical Design {Bearing Type & Lubrication, MAWP etc}, pumping liquid & material of construction etc. as applicable in the format.

Past Test Curves of HPRT tested as HPRT shall also be submitted (when requested) to justify the quoted efficiencies.

Multiple references may be furnished to justify the above. Only pumps working as HPRT will be construed as valid reference.

In addition, manufacturer's catalogue and general reference list for "Centrifugal Pumps-Special Purpose Process Service working as HPRT" shall also be furnished along with the proposal.

C.2 Terminology (Addition)

Unless otherwise specified, all the requirements for centrifugal pumps, specified herein this Standard Specification, shall be applicable for HPRT, as applicable. However, the word 'Centrifugal Pump' shall be read as 'HPRT'.

C.3 Design

C.3.1 Liquid Characteristics

C.3.1.2 (Addition)

Vendor shall estimate the vapour volumes expected at each stage of the HPRT and furnish a stage- wise profile of the vapour evolution. Vendor shall justify that the HPRT is capable of handling the expected vapour volumes with suitable references and supporting design documents.

C.3.3 Overspeed Trip

C.3.3.1 (Addition)

The Hydraulic Power Recovery Turbine (HPRT) shall be provided with a speed detector and a non- over latching over- speed trip contact (Mechanical/ Electronic through Speed Transmitters (2oo3 voting logic)) and an additional contact for pre- alarm. The over- speed trip contact will be incorporated into shutdown system by the Purchaser to close the inlet valve of the HPRT. Pump operation shall, however, be allowed without interruption.

The over speed trip setting for HPRT shall be verified at Manufacturer's test bed during Performance Testing. In case of any limitation at Vendor's Works, the same shall be demonstrated during Field Trial Run Test.

C.3.4 Dual Drivers

C.3.4.2 (Substitution)

Power availability from HPRT shall not be considered for the purpose of motor sizing as pumps are supposed to run even without HPRT and motor shall be sized for full load.

C.3.4.3 (Substitution)

The HPRT shall be equipped with an overrunning (one way i.e., a clutch that transmits torque in one direction and freewheels in the other) clutch- coupling for connection with the Electric Motor driving the Pump. The clutch coupling shall be designed for 1.7 times the maximum recoverable kW of the HPRT. Vendor shall propose clutch Manufacturer having suitable past supply references for similar power ratings and speed and same shall be subject to Purchaser's review and approval during Detailed Engineering Stage.

C.3.4.5 (Substitution)

Unless otherwise specified, the HPRT cum Electric Motor driven Pump trains shall consist of a double ended motor with pump on one side and an overrunning clutch with HPRT on the other side.

Train configuration with HPRT + PUMP + Single Ended Motor may be permitted only in case of axially split pump design.

Pump operation shall, however, be allowed without interruption, in case of HPRT outage.

C.3.6 Throttle Valves (Addition)

All the trips connected to the HPRT will only be configured to shutdown the inlet valve of the HPRT, thereby allowing the pump operation without interruption.

C.3.9 Miscellaneous Technical Requirements (New)

C.3.9.1 The rated speed of the Pump- HPRT Train shall not exceed 3000 rpm (synchronous). No gear box is normally envisaged.

C.3.9.2 Dual Pressure Rating (Suction/ Discharge) for HPRT is not acceptable

C.3.9.3 Impeller of HPRT shall also be positively locked against axial movement in the direction opposite to normal hydraulic thrust.

C.3.9.4 Maximum Allowable Working Pressure (MAWP) & Maximum Allowable Working Temperature (MAWT) of HPRT shall neither be less than the Upstream Design Pressure/ Maximum Suction Pressure (as the case may be) & Design Temperature, as specified in the respective Process Datasheets nor less than those specified in specifications, codes & standards.

The HPRT casing shall also be suitable for operation at maximum pressure available at HPRT minimum flow with Specific Gravity= 1.0 (i.e. water). This is required during Shop Performance test with water at Rated Speed.

C.3.10 Base plate (New)

The Pump, Electric Motor and HPRT with Clutch assembly shall be mounted on a common base plate, to be erected at site at Grade. However, if found infeasible due to transportation constraints, the Pump and Electric Motor shall be mounted on one base plate and the HPRT with clutch assembly may be mounted on one separate base plate for ease of assembly at site. Vendor shall provide both the base plate sections with machined mating surfaces and all provisions for integrating (dowelling/ bolting etc.) and matching for accurate field reassembly and unitizing the two base plate sections to make one single common base plate under pump train at site. For this, horizontal and vertical jack screws shall be provided for ease in alignment. LO Console & SO Console may be mounted on separate base plates subject to Purchaser's approval.

C.4 Testing

C.4.1 Performance Test (Substitution)

a) Test Facilities, Arrangements & Procedures:

The vendor shall have the testing facility for testing HPRT as HPRT and not as a Centrifugal Pump to establish Guaranteed Power recovered from HPRT. A high pressure source (or another pump) shall be used to run the HPRT for Performance Test and power output from HPRT shall be measured at various points as per details below.

Vendor shall furnish the details of the proposed test arrangements and testing procedures to be followed on conducting the Performance Tests of HPRT and the Complete Unit Test (Mechanical Run), during detailed engineering stage. However, detailed test procedures for testing of HPRT shall be subject to Purchaser's review/ approval.

Note: Sample test procedures of test conducted in the past by the vendor should be furnished in proposal. Past supply references of jobs wherein proposed testing of HPRT is carried out as HPRT should also be furnished by the vendor, in the proposal.

b) Performance Test of Hydraulic Power Recovery Turbines (HPRTs):

Performance test of the HPRT at its full load and full speed with Job / Contract Mechanical Seals, shall be carried out at Manufacturer's shop either as separate performance test as HPRT or during complete pump-HPRT train complete unit test. HPRT shall be performance tested as HPRT and not as a pump.

The performance Test shall establish the guarantee power output and shall also fully establish the performance curves covering at least four (4) points. Dismantling inspection of all close clearance parts, bearings & seals, shall follow the performance test in case abnormality in mechanical behavior such as excessive noise, bearing temperature rise, etc. is encountered.

Note: Vendor shall provide brief technical proposal for the HPRT performance test along with the Bid.

Performance Test shall be followed by Mechanical Run Test for four (4) hours and Over-speed trip demonstration test.

C.4.2 Performance Tolerances (Addition)

No negative tolerance on power for the specified operating conditions, as per Process/ Mechanical Datasheet is permitted.

C.4.5 Complete Unit Test (New)

Unless Otherwise specified/ agreed, Complete Unit Test (applicable for all the Pump-HPRT Trains) of the Pump, along with Job Coupling, Job Mechanical Seal, Job Electric Motor driver, Job HPRT and Job Probes (except Job Lube Oil System & Job Seal System), shall be performed for at least four (4) hours at Pump Manufacturer's Shop. Use of Shop Panel/ Monitoring System & Shop Strainers, is acceptable.

डोजिंग पैकेज(स्किडमाउंटिड) हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR DOSING PACKAGES (SKID MOUNTED)

1	09.02.2021	REVISED AND ISSUED AS STANDARD SPECIFICATION	MK	AM	NK	SM
0	03.07.2014	ISSUED AS STANDARD SPECIFICATION	SKK	AM	DB / AKN	SC
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

ANSI : American National Standard Institute

API : American Petroleum Institute

ASTM : American Society for Testing and Materials

ASME : American Society for Mechanical Engineers

EC : Experience Criteria

NPSHA: Net Positive Suction Head Available

NPSHR: Net Positive Suction Head Required

PWHT : Post Weld Heat Treatment

PTR : Proven Track Record

VDM : Vendor Document Management

VDR : Vendor Data Requirements

B/L : Battery Limit

P&ID : Piping and Instrumentation Diagram

PMS : Piping Material Specification

VMS : Valve Material Specification

eDMS : Electronic Document Management System

Rotating Equipment Standards Committee

Convener: Mr. Nalin Kumar

Members: Mr. Tarun Kumar
Mr. Anukul Mandal
Mr. J S Duggal
Mr. Abhay Kumar
Mr. Mahesh Easwaran
Mr. Mahesh Gupta
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1.0 GENERAL

1.1 Scope

This specification describes the minimum requirements for engineering, manufacture, packaging, shop inspection & testing and supply of Skid Mounted Dosing Packages.

The Dosing package(s) shall be used to dose metered quantity of chemicals as per the requirements specified in the process data sheets, process P&IDs and other specifications forming part of inquiry document.

1.2 Conflicting Requirements

In case of conflict between this specification and the attendant data sheets, job specifications (if any) and other attached specification the following order of precedence shall govern:

1. Process Data Sheet / P&IDs / Process Package
2. Mechanical Data Sheets.
3. Job Specifications/scope of work (if any)
4. This specification
5. Other standards & specifications
6. Other referred codes and standards

The editions of referenced publication that are in effect at the time of inquiry or at a date specified in the inquiry documents shall be applicable.

In case of any ambiguity in the above documents, the vendor/supplier shall seek clarification from the owner/purchaser and the decision of the owner/purchaser shall be final and binding.

2.0 CODES AND STANDARDS

a) Codes, Standards and Regulations

The following codes and standards-latest edition (as applicable) shall apply. In case any additional codes and standards are mentioned in the list of attachments, the same shall also be applicable.

Code	Title
API 675	Positive Displacement Pumps-Controlled Volume
ASME Section VIII Div.1	Rules for Construction of Pressure Vessels
ASME Sec. II A	Ferrous Material Specification
ASME Sec. II C	Specifications for Welding Rods, Electrodes, and Filler Metals
ASME Sec. II D	Material Properties
ASME Sec. V	Non Destructive Examination
ASME Sec. IX	Welding and Brazing Qualifications
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.47	Large Diameter Steel Flanges
ASME B16.20	Metallic Gaskets for Pipe Flanges
ASME B 16.21	Non -Metallic Gaskets for Pipe Flanges
ASME B 31.3	Process Piping

Code	Title
IS 4049 (Part-II)	Specification for Formed Ends for Vessels
API 650	Welded Tanks for Oil Storage
IS : 803	Code of Practice for Design, Fabrication, Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks
IS 4682	Code of Practice for Lining Vessels & Equipments for Chemical Process

Other international standards may be acceptable subject to their being equivalent or superior backed by proven track record for the application and prior approval of the Company.

b) Standard Specifications

Standards	Title
6-41-0021	Standard Specifications for Positive Displacement Pumps Controlled Volume
6-81-0052	Inspection and test plan for Pump Reciprocating (Controlled Volume)
6-78-0001	Specification for Quality Management System Requirements from Bidders
6-78-0003	Specification for Documentation Requirements from Suppliers
6-51-0064	Specification for energy efficient medium voltage induction motors
6-51-0006	Specification for Flameproof Control Stations
6-81-1064	Inspection and test plan for energy efficient medium voltage motors
6-81-1006	Inspection & Test Plan for Flame Proof Control Stations
7-12-0001	Vessel Tolerances
7-12-0002	Support for Horizontal Vessel
7-12-0004	Skirt Base Details
7-12-0006	Angle Leg Support
7-12-0007	Pipe Leg Support
7-12-0008	Bracket Support for Vertical Vessels
7-12-0009	Manhole with Hinged Cover
7-12-0010	Manhole with Davit
7-12-0013	Nozzle Reinforcement and Projection
7-12-0015	Standard Bolt Hole Orientation
7-12-0018	Internal Flanges
7-12-0024	Lifting Lug Top Head Type
7-12-0026	Earthing Lug

Standards	Title
7-13-0001	Earth Connections
7-13-0002	Anchor Chair
7-13-0006	Level Indicator Supports
7-13-0007	Gauge Hatch with Cover
7-13-0010	Cage Ladder for Fixed Roof Tank
7-68-0509	Steel Ladder Joint Details
7-68-0663	Structural Arrangement of Cone Roof – (2.5 M < Dia < 6.0 M)
7-68-0680	Roof Structure for Cone Roof Tank, Joint Details (Dia ≤40 M)
7-68-0681	Roof Structure for Cone Roof Tanks Central Drum (Detail B).
7-68-0682	Cone Roof Structure Schematic Joint Details & Central Drum.
6-26-0001	Standard Specification for Mechanical Agitators

Following project specifications attached elsewhere in the bid package are referenced to and made a part of this specification. In case any additional standard specifications are mentioned in the list of attachments, the same shall also be applicable

3.0 EXPERIENCE CRITERIA

3.1 Dosing Skid-Supplier/Packager

- 3.1.1 The Supplier of the Dosing Package (Skid Mounted) shall be a packager of Dosing Packages (Skid Mounted) with API 675 Pumps and shall be the Single Point Responsibility Vendor (SPRV) of the complete Dosing Package (Skid Mounted).
- 3.1.2 The vendor shall have designed, engineered, packaged, tested and supplied, in the last Ten (10) years, at least ONE (1) unit of Dosing Package (Skid Mounted) similar in terms of skid size & weight, fluid/chemical handled, capacity of dosing vessels/tanks and type, capacity & capacity control method of metering pumps (API 675), from the proposed manufacturing plant, with minimum operating experience of one year, as on bid due date.
- 3.1.3 The vendor shall complete the Experience Record Proforma enclosed with the inquiry document to amply prove that the offered Dosing Package (Skid Mounted) meets the above experience requirement furnishing details of skid size & weight, fluid/chemical handled, capacity of dosing vessels/tanks, type, capacity & capacity control method of metering pumps etc., as applicable in the format. In addition, manufacturer's catalogue and general reference list for Dosing Package (Skid Mounted) shall also be furnished along with the proposal.

3.2 Positive Displacement Pumps (Controlled Volume)

- 3.2.1 Pumps shall be procured from CONSULTANT /OWNER approved vendor list.
- 3.2.2 The Experience Criteria (EC) as specified in the Standard Specification for Positive Displacement Pumps (Controlled Volume) [Spec.# 6-41-0021], shall be met for the offered model of pump.

3.3 Static Equipment

3.3.1 Vessel/Tank shall be procured from CONSULTANT /OWNER approved vendor list.

In case, Package vendor fabricates the vessel/tank on his own or sources it from his approved sub-supplier, following experience criteria shall be met:

Vendor shall have fabricated and supplied at least one number vessel/tank of similar material of construction, dimensions and thickness in the last ten (10) years.

Reference list for the similar supplied vessel/tank shall be provided to establish experience of fabrication of similar vessels/tank.

3.3.2 Mixers/Agitators shall be procured from CONSULTANT /OWNER approved vendor list.

In case, Package vendor manufactures the Mixers/Agitators on his own or sources it from his approved sub-supplier, following experience criteria shall be met:

Vendor shall have manufactured and supplied at least one number Mixer/Agitator of similar material of construction, dimensions and operating speed in the last ten (10) years.

Reference list for the similar supplied Mixers/Agitators shall be provided to establish experience of manufacture of similar Mixers/Agitators.

3.4 Vendor may procure material/equipment from any of CONSULTANT /OWNER approved vendors. However current validity of vendor approval & their approved product range and the conditions imposed while according vendor approval as per the approved letter shall be verified by the vendor before the placement of order.

4.0 SCOPE OF SUPPLY/WORK

Package vendor scope has been defined broadly in document “Scope of Supply”. However, vendor shall refer the entire enquiry specification for complete vendor’s scope of supply/work.

5.0 BASIC DESIGN

5.1 General

5.1.1 The Process datasheets and P&IDs shall be referred to, for operating conditions.

5.1.2 The equipment shall be suitable for outdoor (without-roof) installation.

5.1.3 All controls shall operate in a fail-safe mode.

5.1.4 All Electrical Devices and instruments shall meet the requirements for the specified area classification in which they are installed.

5.2 Positive Displacement Pumps (Controlled Volume)

5.2.1 Pumps shall be designed, manufactured and tested in accordance with API Std. 675 and as modified as per the attached EIL Standard specification no. 6-41-0021.

5.2.2 Maximum allowable working pressure (MAWP) & temperature of the equipment shall not be less than the design pressure & temperature specified in the data sheet nor less than those specified in specifications, codes & standards.

- 5.2.3 The dosing package vendor shall calculate the acceleration head for each pump item, based on the system configuration. Calculations for Acceleration head & NPSHR shall be furnished. The dosing package vendor shall ensure that NPSHA is greater than “Acceleration Head + NPSHR” by a margin of at least 1.0 meter, either by proper selection of pump speed or by proper valve design or else by providing a suction side Pulsation dampener.
- 5.2.4 Pulsation dampeners shall be provided as per pump data sheets and P&ID.
- a) The suction side pulsation dampener (if provided) shall be as per the following details:

Design Code:	ASME Sec. VIII Div.I
Allowable pulsation level:	± 3%
Material of construction:	As per applicable Piping Material Specification (PMS) indicated in P&IDs
Type of pulsation dampener:	Inverted Bottle, Direct Contact type.
 - b) The discharge side pulsation dampener (if provided) shall be as per the following details:

Design Code:	ASME Sec. VIII Div.I
Allowable pulsation level:	± 3%
Material of construction:	As per applicable Piping Material Specification (PMS) indicated in P&IDs
Type of pulsation dampener:	Inverted Bottle, Direct Contact type/Bladder Type.
 - c) Note: In case Discharge Pulsation dampeners are of bladder type with gas charging, bidder shall provide a gas charging kit which should include pressure gauge, pressure regulator etc. Unless otherwise specified, one number gas charging kit shall be supplied against each order.
- 5.2.5 All coupling and exposed rotating parts shall be provided with suitable guards of non-sparking type.
- 5.3 Drum Unloading Pump and Connecting Hoses**
- 5.3.1 Drum unloading pumps shall be of “Air Operated Double Diaphragm (AODD)” type and shall be as per manufacturer’s standard.
- 5.3.2 Typical data sheet(s) for AODD pumps is enclosed with the inquiry document. The dosing package vendor is advised to refer the inquiry specifications and completely fill-up the same with operating data and data related to construction, performance of pump & submit the same during detailed engineering stage. Technical literature, manufacturer’s standard performance curve, Plant air consumption data etc. for the AODD pumps shall also be submitted for purchaser’s review during detailed engineering stage.
- 5.3.3 The drum unloading pumps wherever specified shall be of portable type, driven pneumatically i.e. by plant air.
- 5.3.4 These pumps shall be used for transfer of chemicals to the dosing vessel/tank from the chemical drum / barrel (By Purchaser) (standard capacity of 200 litres). Pumps shall be selected for a transfer rate of minimum 1000 litres per hour.

- 5.3.5 For connecting the plant air supply to the air inlet side of each drum unloading pumps, air inlet shall be provided with an air dryer requiring no electric power, air filter cum regulator with pressure gauge, bleed type master air valve, pressure relief valve & flexible hoses. The air outlet shall be equipped with air discharge muffler.
- 5.3.6 For transferring the chemical from the drum/barrel to the dosing tank/vessel through drum unloading pump, flexible metallic hose with quick coupling connection (suitable for handling the particular chemical) with liquid filter, shall be provided in the inlet line. The outlet line should also be provided with a flexible metallic hose with quick coupling connection, (suitable for handling the particular chemical) check valve, isolation valve and a flanged connection which can be connected to the nozzle on the dosing vessel / tank.
- 5.3.7 The pump shall be provided with a suitable adapter such that it can fit on the top of chemical drum. Liquid inlet, outlet and air inlet connections of the pump shall be suitable for fitting the respective flexible metallic hoses.
- 5.3.8 The drum unloading pump shall be procured from a reputed AODD pump manufacturer having proven experience for similar services. The dosing package vendor shall furnish, AODD pump manufacturer's general reference list for the proposed pump model during detailed engineering.

5.4 Calibration Pot / Graduated Cylinder

Unless otherwise specified, calibration pot / graduated cylinders shall be provided for calibration of each controlled volume pump as specified in the Scope of supply. For multi head pumps, separate calibration cylinders or necessary piping arrangement with isolation valves shall be provided so that flow through each head can be calibrated. This requirement shall govern over and above the P&ID.

5.5 Skid

- 5.5.1 The skid shall be designed and built to ensure that all the equipment along with accessories, local control station(s) and piping are located and mounted suitably for ease of operation and maintenance.
- 5.5.2 All the components of a particular chemical dosing package shall be assembled & mounted on the skid, and shall be duly interconnected with piping & power/control cabling. The inlet and outlet connections for purchaser's interface shall be terminated at the skid edge with flanges of the specified sizes & ratings. The local control station(s) & the junction box(es) for instrumentation shall be located at the edge of skid.
- 5.5.3 The skid shall be suitable for four point lift & shall be provided with lifting lugs.
- 5.5.4 The skid shall be provided with cable trays for routing of purchaser's power / control cables.

5.6 Static Equipment

5.6.1 Mixers/ Agitators

- 5.6.1.1 The Vendor/Supplier shall furnish the Filled in Mixer Data sheet in the format provided after award of contract.
- 5.6.1.2 Unless otherwise specified, all mixers/agitators shall be provided with dry running mechanical vapor seals (cartridge type).

5.6.2 Design

5.6.2.1 Pressure Vessels

5.6.2.1.1 Minimum Wall Thickness

Vessel shell and heads shall have minimum wall thicknesses calculated with Design pressure and temperature, in accordance with the codes, but in no case, shall the thickness be less than the criteria indicated below:

- a) For Carbon steel vessels: 6mm (including corrosion allowance not exceeding 3.0 mm), but not less than that calculated as per below formula :

For Vessels with Diameter less than 2400 mm,

$$\text{Wall Thickness} = \{(\text{Dia.}/1000) + 1.5 + \text{C.A.}\}$$

For Vessels with Diameter 2400 mm & above,

$$\text{Wall thickness} = \{(\text{Dia}/1000) + 2.5 + \text{C.A.}\}$$

- b) For Stainless Steel vessels: 3 mm, but not less than that calculated as per following for Vessels with Diameter more than 1500 mm

$$\text{Wall thickness} = \{(\text{Dia}/1000) + 2.5\}$$

5.6.2.1.2 Design Pressure

Design pressure shall be calculated as per the following, unless otherwise specified elsewhere in the package:

- a) Design pressure shall be the highest of the following:
- Maximum operating pressure (kg/cm²g) x 1.1
 - Maximum operating pressure + 2.0 kg/cm²
 - 3.5 kg/cm²g
- b) Design pressure at any lower point is to be determined by adding the maximum operating liquid head and any gradient within the vessel.
- c) Vessel operating under vacuum (or partial vacuum) shall be designed for differential external pressure of 1.055 Kg/cm².

5.6.2.1.3 Design Temperature

Design temperature shall be calculated as per the following, unless otherwise specified elsewhere in the package:

- a) For Vessels operating at 0° C and over, the design temperature shall be operating temperature plus 15° C. However, design temperature shall not be less than 65°C.
- b) For Vessels operating below 0° C, design temperature shall be lowest operating temperature.
- c) Minimum Design Metal Temperature (MDMT) shall be lower of minimum atmospheric temperature and minimum temperature envisaged during operation.

5.6.2.1.4 Corrosion Allowance

Minimum Corrosion allowance for Carbon steel vessels shall be 3.0 mm, unless otherwise specified elsewhere in the package.

All internals shall be designed for full load condition. For Welded internals, twice the corrosion allowance shall be considered. For Removable internal parts, single corrosion allowance shall be considered. All bolted internals shall be provided with SS bolts and two nuts.

5.6.2.1.5 Vessels shall be designed as per ASME Sec. VIII Div. 1 (latest edition including latest addenda in accordance with design data enclosed with the package). All Design calculations shall be carried out considering all loads for erection, operation and hydro test condition.

5.6.2.2 Storage Tanks

5.6.2.2.1 Any pressurized tank (irrespective of diameter) and atmospheric storage tanks (diameter more than 2.0 m) shall be designed and fabricated as per API 650 code. However, small atmospheric tanks can be designed & fabricated as per manufacturer's standard & good engineering practice.

5.6.2.2.2 All internals shall be designed for full load condition. For Welded internals, twice the corrosion allowance shall be considered. For Removable internal parts, single corrosion allowance shall be considered. All bolted internals shall be provided with SS bolts and two nuts.

5.6.2.2.3 The Corrosion allowance for Tanks shall be as given in respective Tank data sheets attached with the bid package. Otherwise, it shall be determined by its intended service conditions and service life.

5.6.3 Fabrication

5.6.3.1 Materials

Materials of various pressure parts of equipment shall be selected as follows for general industrial condition/services, unless otherwise specified in respective Process data sheets. Minimum grade for Stainless Steel shall be SS 304.

Plates : SA 516 Gr. 60/70 (for CS vessels)/ IS 2062 Gr. B (for CS tanks)/ SS 304 (for SS Vessels/Tanks)

SA 516 Gr.60 for Caustic/Sour/Amine service tanks & vessels

Forgings : SA 105/SA 182 F 304

Pipes : SA 106 Gr. B/SA 312 TP 304

External bolting : SA 193 Gr. B7/ SA 194 Gr. 2H

Gasket : As per PMS

MOC of internals shall be as per respective Process Data Sheets attached with the bid package.

5.6.3.2 CS Plates used shall conform to the latest issue of specification SA-20 with additional requirements mentioned herein.

- a) Only normalized plates free from injurious defects with workmanlike finish shall be used. Reconditioning/repair of plates by welding shall not be permitted.
- b) One product analysis of each heat shall be carried out and reported. Chemical analysis shall be as per applicable specifications with carbon content not exceeding 0.23%.

Additionally, one of following requirements for carbon equivalents (Ceq) based on heat analysis shall be satisfied.

$$Ceq = C + Mn/6 < 0.42 \quad \dots(1)$$

$$Ceq = C + Mn/6 + (Cr + Mo + V)/5 + (Cu + Ni)/15 < 0.43 \quad \dots(2)$$

Equation -(1) shall be used when applicable material specify C and Mn only.

Equation -(2) is applicable for restricted chemistry requirements or for supplementary requirements of S19 & S21 of specification SA-20.

SS plates shall conform to Specification SA 480 with additional requirements mentioned herein:

- a) All plates shall be hot rolled, pickled & shall have No. 1 finish on both sides with reference to Specification SA-480. In addition, all stabilized grades of SS (SS 347, SS 321 etc.) shall be given stabilization heat treatment.
- b) Unless otherwise specified; plates, pipes, forgings & fittings representative of each heat shall be subjected to Inter granular corrosion tests as per ASTM A262 practice E for all 300 series material. The bend test specimen shall be examined at a magnification of 200X.

5.6.3.3 Heads

- a) All Carbon steel cold formed dished heads or knuckles shall be stress relieved. Hot formed dished ends or knuckles which have not been uniformly heated in the normalizing range in the final stages of manufacturing shall be normalized. When completed vessel involves PWHT, heat treatment intended above for cold formed dished heads or knuckles is not applicable.
- b) Cold formed dished ends of SS vessels shall not be solution annealed unless any of the following condition exists:
 - Specifically called for any Equipment/service.
 - Hardness value after forming exceeds 235 BHN.
 - Nominal thickness of plate is 16 mm or above.
- c) Hot formed dished ends of SS vessels shall be solution annealed.
- d) Whenever Heat treatment on Stainless Steel is carried out, it shall be followed by micro etching test & IGC test as per ASTM A 262 practice E unless otherwise specified to ascertain suitability & effectiveness of Solution annealing. The bend test specimen shall be examined at a magnification of 200X.

5.6.3.4 Material Certificates shall conform to EN 10204 Type 3.1 and shall be submitted to EIL/Owner/Third party.

- 5.6.3.5 Material of construction (MOC) of the Mixers shall be compatible with the process service applicable.
- 5.6.3.6 Pipes for nozzles shall conform to API 5L, IS: 1978, A-53 or A-106. For Caustic, Sour and Amine services, all nozzle pipes shall be A-106. Pipes for nozzle & heating coil shall be of seamless quality. SS tanks shall have SS nozzles of compatible grade.
- 5.6.3.7 All Vessels/ Tanks shall be provided with lifting lugs.
- 5.6.3.8 Unless otherwise specified, Bottom plate slope shall be 1:50 from the centre of the tank towards the shell.
- 5.6.3.9 For vessels, all Nozzle Flanges shall be of Weld Neck type. For Caustic, Sour and Amine services all nozzle flanges shall be WN type in Vessels as well as Tanks.
- 5.6.3.10 Nozzles upto 50 mm NB size shall be stiffened with 2 numbers of 40 mm wide x 6 mm thick stiffeners welded at 90 apart.
- 5.6.3.11 Rolling direction of plate for shell shall be lengthwise.
- 5.6.3.12 All Tanks shall be provided with Vent connection, level indicators & earthing connections. A gauge hatch with cover for gauging & sampling purpose is to be provided on the tank, if specified on the Tank datasheet
- 5.6.3.13 All vessels shall be transported to site in single piece.
- 5.6.3.14 Roof Supporting Structure for Storage Tanks, if provided internally, shall be protected with proper primer and painting as per the provisions of painting specification, as these structures are designed without corrosion allowance.

5.6.4 Tolerances

- 5.6.4.1 Equipments tolerances shall be as per attached Standards/applicable code.

5.6.5 Cleaning and Painting

- 5.6.5.1 Vessels shall be cleaned internally to remove scale, rust, dirt, foreign material by wire brushing.
- 5.6.5.2 All external surfaces shall be cleaned, primed and painted in accordance with painting specification for specified environment.
- 5.6.5.3 SS surfaces both inside & outside shall be pickled & passivated in accordance with Specification ASTM 380 after hydro test.

5.7 Piping

5.7.1 Piping Design Codes

The design and engineering shall conform to the following standards as applicable:

- ASME B 31.3 “Process Piping”
- IBR “Indian Boiler regulations”

5.7.2 **Piping Design Basis**

- 5.7.2.1 Preferred level of bottom of piping from skid top shall be 500 mm.
- 5.7.2.2 Minimum level of overhead piping shall be such that clear 2.2 M headroom is available below pipe/insulation/supports.
- 5.7.2.3 All hydrocarbon vents to atmosphere should be vented at minimum 3 meters above the nearest operating platform, existing within a radius of 12 meters. A 3/8" diameter weep hole in the tail pipe for drainage to safe location at low point of line shall be provided. All steam vents to atmosphere should be vented at minimum 3 meters above the nearest operating platform, existing within a radius of 8 meters. A 3/8" diameter weep hole in the tail pipe for drainage at low point of line shall be provided.
- 5.7.2.4 All PSVs and Control valves discharging to flare header shall be located close to and above flare header for maintaining free draining requirement. PSVs and control valve assembly along with prefabricated spools, valves, flanges, gaskets and bolts shall be supplied loose by vendor for installation by owner. Size of PSV inlet line shall be decided considering far away location of the PSV.
- 5.7.2.5 Hydrostatic test, Leak test, Non destructive Examination shall be carried out as per applicable piping design codes.
- 5.7.2.6 Hydrostatic Vents and Drains shall be provided at High Point and Low points respectively as per PMS and or good engineering practice.
- 5.7.2.7 Piping systems shall be adequately flexible to cater for thermal expansion/contraction under start-up, operating and shut down conditions to ensure that the stresses and loads do not exceed the values permitted in the applicable code.
- 5.7.2.8 All instruments and valves requiring attention during normal operation shall be conveniently operable.
- 5.7.2.9 Adequate space shall be provided for removal of equipment components for routine maintenance.

5.7.3 **Pipe Support Design Basis**

All piping shall be adequately supported, guided or anchored so as to prevent undue vibration, deflection/expansion or loads on connected equipment and leakage at flanged joints. Piping at valves and equipments such as pumps, requiring periodic maintenance, shall be supported in such a way so that the valves and Equipments can be removed with a minimum necessity of installing temporary pipe supports.

5.7.4 **Piping Material Specification/ Valve Material Specification**

The job piping material specification as applicable to incoming and outgoing lines is provided. Vendor shall follow these piping classes if shown in P&IDs. Basic details for valves are provided in the Piping Material Specification. Detail Valve material specification shall be provided to the successful bidder. In case of variation in material/components from this specification it shall be the responsibility of the vendor to ensure suitability and establish equivalence of proposed material.

5.7.5 Battery Limit

All incoming and outgoing Piping shall be terminated by the vendor at one location with isolation valves/flanges as per the approved P & IDs. B/L interface orientation shall be finalized during detail engineering. Battery Limit Drawing shall indicate exact location, levels and scope of package piping for all incoming and outgoing lines. All piping at Battery Limit shall be anchored.

5.7.6 Painting

The protective paint system shall be provided to protect external surface of uninsulated low alloy steel and carbon steel piping and equipments and insulated surface of low alloy steel, carbon steel and stainless steel piping and equipments. The painting system shall be suitable for the type of environment where package unit is to be installed.

5.7.7 Welding

Welding procedure qualification, welder's qualification, all welding work, equipment for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the accepted national/international standards and practices.

5.8 Electrical

5.8.1 Following minimum electrical facilities shall be provided by Vendor on local control station:

- a) Start
- b) Stop
- c) Field ammeter, as required.

Selector switch shall be provided, as required, as per P&ID & operational requirements. The interlocking between the MCC feeder and field equipment shall be arranged in Local Control Station by the Vendor.

5.8.2 All motors shall have a enclosure protection Ex-d with efficiency class IE-3 as per IS 12615-2011/IEC 60034-30 and shall meet the requirements of IS/IEC 60079-1 & 60079-0.

5.8.3 All the 415 Volts supply feeders, to feed Dosing Pumps & Agitator Motors shall be arranged by Purchaser. kW rating of motors for Dosing System shall be decided by Bidder for the starting and running conditions specified in pump/ agitator datasheet. Vendor to furnish Motor List, indicating kW rating, enabling Purchaser to provide MCC with required number & rating of feeders as per the format mentioned in the Job Specification-Electrical for Dosing Package.

5.8.4 The power & control cables from Purchaser's MCC to individual motor & local control stations, shall be supplied, laid & terminated by the Purchaser. However, Vendor shall supply all cable glands and lugs, as required. All cable glands shall be flameproof Ex (d) double-compression type of Ni-plated Brass. The cable-lugs shall be of tinned Copper and crimping type. Exact size of Purchaser-supplied power and control cables shall be finalised during detail engineering. Provisions, as required, in Vendor's equipment for termination of the same, shall be made accordingly without any cost & time implications to Owner.

5.8.5 Purchaser's power cables will be 1100V grade, Copper or Aluminum conductor, XLPE or PVC insulated, PVC extruded inner sheath, armoured with overall FRLS PVC sheath.

- 5.8.6 Purchaser's control cables will be 1100V grade, Copper conductor, overall shielded, twisted pair, XLPE/ PVC insulated, armoured with overall FRLS PVC sheath.
- 5.8.7 Cable size for motor space heater shall be 3 x 2.5 mm² with Cu Conductor, 3/4-inch entry.
- 5.8.8 The cable trenches/ trays from sub-station to battery limit of individual package shall be in the scope of Purchaser. Cable trays on Dosing Skids shall be provided by Vendor, as required, for routing of Purchaser-supplied power & control cables within skid.
- 5.8.9 Earthing of all package equipments within the skid shall be done by the bidder. Earth terminals shall be provided on skid for connection by Purchaser to main plant earth grid.
- 5.8.10 Earthing shall be carried-out as per standard IS: 3043. All hardware for earthing shall be hot dip galvanized @ 610 gm/m². GI Earth Plate shall be provided and all non-current carrying parts of electrical apparatus, vessels and skid structure shall be bonded with this GI earth plate. Purchaser shall connect earth plate with main plant earth network. Sizes of earth conductors to be used shall be as per Job Specification-Electrical for Dosing Package.
- 5.8.11 All the equipment, indigenous and imported, shall have a valid statutory approval of PESO/CCOE towards explosion protection and copies of the same (PESO/CCOE approvals) shall be furnished during detailed engineering stage.
- 5.8.12 All local control stations shall be flameproof Ex (d) type.
- 5.8.13 For project specific requirement, Bidder shall refer Job Specification-Electrical for Dosing Package
- 5.8.14 In case of any conflict between various requirements/ parameters, the most stringent one shall be applicable.

5.9 Instrumentation and Controls

5.9.1 General

- 5.9.1.1 All electronic field instruments shall be certified for installation in hazardous area classification of Location as per Job specification sheet. Instrument shall also be weatherproof to IP-65 as a minimum. For environmental conditions, refer elsewhere in the package.
- 5.9.1.2 SS Tag plate shall be provided for all instruments.
- 5.9.1.3 The instrumentation selected for the package shall be rugged in design and must be well proven for use in similar applications. Items of Prototype design or items of experimental nature or design undergoing testing etc. shall not be selected and supplied by bidder. The instruments as being offered / supplied should have been operating satisfactorily in hydrocarbon industry like Refinery, Petrochemical and Gas Processing Plant for a period of minimum 6 months on the bid due date under similar conditions as specified in purchasers datasheet.
- 5.9.1.4 Bidder shall supply 10% subject to minimum 1 no. of each type of instrument installation materials such as fittings, valves, tubes, etc. as loose supply. Prices for these spares shall be included in the base price.

5.9.1.5 Bidder shall supply instruments from EIL approved vendors. For items not appearing in approved vendor list, bidder shall furnish proposed sub-vendor list for purchaser's approval.

5.9.1.6 For Caustic and NACE services, minimum wetted parts/ Sensor material shall be SS316L against SS316 material indicated in respective instrument specifications.

5.9.2 Instrument Specifications

5.9.2.1 Transmitters

- a) The SMART transmitter shall be two wire microprocessor based type and it shall incorporate a non-volatile memory which shall store complete configuration data of transmitter and sensor characterization. All necessary signal conversions, including conversion to produce output with the required protocol shall be carried out in the transmitter electronics. The configuration data of the instruments shall be stored in a non-volatile memory such that this remains unchanged because of power fluctuations or power off condition. In case vendor standard instrument has battery backed RAM, bidder to ensure that battery drain alarm is provided as diagnostic maintenance message. Transmitter body material shall be metallic. Integral output LCD display shall be provided for all transmitters.
- b) SMART Transmitters shall be able to communicate to Universal Hand Held communicator (HHC Model no. : HART 475 or equivalent model, not in Vendor's scope). In case any of transmitter is not able to accept commands from HHC, vendor shall supply suitable intrinsically safe dust proof hand held configurator (one no. suitable for HART transmitters) with complete license and upgrade packing rechargeable battery charger and other accessories suitable for the specified area classification along with suitable carry case for easy mobility.
- c) When HART protocol is specified, the following features must be ensured;
 - i) It shall allow multi masters (two for example, primary and secondary) for configuration, calibration, diagnostics and maintenance. The primary could be the control system or host computer and the secondary could be the hand-held communicator.
 - ii) It shall be capable of implementing universal commands from either of these locations.
 - iii) All HART transmitters shall be configurable for under current and over current.
 - iv) All HART transmitters shall be compliant to NAMUR NE 43 recommendations.
- d) The Overall rangeability shall be 1:100 for Normal transmitters with calibrated accuracy of $\pm 0.065\%$ of span. The Overall rangeability shall be 1:100 for Diaphragm seal transmitters with calibrated accuracy of $\pm 0.2\%$ of span.
- e) Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness. In the event of detection of failure, the output shall be driven to a predefined value, which shall be field configurable.
- f) The over-range/ static pressure protection of the transmitter shall be 130% of maximum operating range.

5.9.2.2 Level Instruments standpipe philosophy

5.9.2.2.1 Standpipe shall be used for clean, non-viscous and non-crystallizing services for installation of level instruments on vessels/ equipments if more than 4 nozzles are required for level instruments on a vessel. Standpipe shall also be used wherever shown in Licensor's drawings. Size of standpipe shall be 2" minimum.

5.9.2.2.2 Maximum number of nozzles allowable on standpipe is as follows:

- a) 8 with no displacer / guided wave radar type level instrument on standpipe.
- b) 6 with displacer/ guided wave radar type level instrument on standpipe

5.9.2.3 Level Gauge

a) Level gauges shall be steel armored reflex or transparent type with body and cover material of forged carbon steel as a minimum and shall have tempered borosilicate glass with asbestos free gasket. Transparent type of gauges shall be provided with integral illuminators operating at 230V, 50 Hz supply and suitable for electrical area classification. All gauge glasses must have a rating equal to or more than the vessel design pressure and temperature. SS Calibrated scale shall be provided with scale graduations in mm.

b) Reflex type will be used for clean and colorless liquids, except liquids level interface. Transparent type will be used on acid, caustic, dirty or viscous, coloured liquids and liquid interface. Transparent type with Mica or Kel-F shields shall be used for treated water, boiler and condensate services, and for corrosive liquids, which will attack glass.

c) The visible range of level gauge shall be selected to cover the complete operating level as well as measuring range of the other level instruments provided for the same purpose.

In general, the visible length of the level gauges shall be 220, 470, 720, 980, 1230 mm. In any case, the maximum visibility length shall not exceed 1500 mm for a single gauge.

d) For level gauging in very viscous liquids, liquids with crystals and high pressure rating (600# and above), float operated magnetic gauges with 2" (50 mm) flanged end connections, shall be used. C to C length of single magnetic level gauge shall not be more than 2500mm. The float and chamber material of magnetic level gauge shall be non magnetic type. Float chamber (or cage) shall be provided with 3/4" flanged end vent and drain connections. The design shall also facilitate float removal.

5.9.2.4 Level Transmitter

a) Guided Wave Radar type instruments with external chamber and side-side connections, complete with isolation valves, vent and drain details shall be used for level measurement upto 2400 mm. In general, Guided Wave Radar instruments shall be used with C-C lengths of 356 mm, 813 mm & 1219 mm etc.

b) Guided Wave Radar instrument shall have ± 3 mm accuracy.

c) Differential pressure transmitter shall be used for level instruments above 2400 mm, for services requiring purge or where liquid might boil in external portion.

d) Differential Pressure transmitters for use on corrosive or fouling service shall generally be diaphragm with extended filled capillary type. Flush or extended diaphragm type differential pressure transmitter shall be considered for special

applications only. Diaphragm material shall normally be stainless steel or any other special alloy.

- e) Transmitters shall also meet the requirements specified in clause no. 6.9.2.1 as applicable.

5.9.2.5 Pressure Gauges

- a) Pressure gauges shall be weatherproof with dial size of 150 mm and shall have features like screwed bezels, externally adjustable zero, over range protection (at least 130% of max. operating pressure), blowout discs and Shatter proof glass window. Pressure gauge sensing element shall be of SS 316 and movement & Case of SS 304, as a minimum.
- b) Pressure gauge dial shall be white, non-rusting plastic with black figures. The dial face shall be marked with pressure element material. Pointers shall have micrometer adjustment.
- c) Pressure gauge shall have 1/2" NPT (M) bottom connection.
- d) Pressure gauge shall have an accuracy of $\pm 1\%$ of URV (Upper Range Value).
- e) Ranges shall be so specified that the gauge normally operates in the middle third of the scale and shall conform to IS-3624 standard dials, wherever possible. Pressure gauge with design pressure more than 130% of range shall be provided with Gauge saver. The material of construction of gauge saver shall be same as socket material or superior.
- f) Diaphragm seals, filled type or mechanical type shall be provided where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be of the clean out type with flushing connection.
- g) Pressure gauges shall be weather proof to IP-55 as per IEC-60529/IS-2147 as a minimum. Pressure gauge case material shall be minimum SS304.
- h) The pressure sensing element shall be bourdon, diaphragm or bellows depending upon process conditions.

5.9.2.6 Pressure Transmitter

- a) Pressure transmitter shall have electronic state-of-art capacitance or any other type of sensor meeting all functional specifications. Body & Element material for transmitters shall be SS316, as a minimum, and shall be able to withstand over pressure of at least 30% of range or maximum working pressure whichever is higher.
- b) All transmitters shall have an integral LCD display. Remote mounted meters may be provided if required in addition.
- c) Threaded end connections shall be NPT as per ANSI B 1.20.1. Flanged end connections shall be as per ANSI B 16.5.
- d) Diaphragm seal element with capillary shall be used for congealing, corrosive and highly viscous services.
- e) Transmitters shall also meet the requirements specified in clause no. 6.9.2.1 as applicable.
- f) Pressure transmitters used for diaphragm rupture detection shall have dedicated instrument isolation valve in addition to manifold.

5.9.2.7 Pressure Relief Valve & Rupture Disc

- a) All pressure relieving devices shall be designed in accordance with ASME code for 'Boilers and Pressure Vessels', API-521. Pressure Relief Valve shall meet relief valve requirements as defined in API RP-520 (Part-I & II) and in API-526.
- b) Pressure relief valves shall be full nozzle full lift type except for thermal relief valves which shall be modified nozzle type. Type of Pressure relief valve such as Conventional, bellows & pilot shall be decided by vendor based on process parameters such as set pressure, back pressure, etc.
- c) Percentage Accumulation shall be 10% for Pressure Relief Valve and 10% / 25% (as per process requirement) for Thermal relief Valve.
- d) Body materials shall be as per piping material specification. Nozzle and disc material shall be SS 316 as a minimum with machined SS guide and spindle. Whenever semi nozzle designs are unavoidable, body material shall be at least same as nozzle and disc material.
- e) Spring material shall be selected as per operating conditions. Normally it shall be Cadmium / Nickel / Zinc / Aluminum plated Carbon Steel.
- f) Pressure Relief Valve shall have flanged connections for sizes 1" and above and shall have screwed connection for sizes 3/4" and below. Thermal Relief Valve shall have screwed connection with 0.38 cm² orifice size and inlet outlet shall be of 3/4" NPT(M) X 1" NPT(F) sizes.
- g) Rupture discs shall be reverse buckling type, in general and shall be supplied in pre-torqued holder assembly, mounted between standard ANSI flanges. Disc material shall be compatible with the vessel contents and shall be consistent with the bursting requirements. Disc shall be supplied with tell-tale assembly.
- h) The bursting tolerance of the rupture disc shall be 5% of the specified bursting pressure or less.
- i) Vendor shall supply three nos. spare discs along with each Rupture disc assembly ordered.

5.9.2.8 Variable Area Flowmeter (Rotameter) and Transmitter

- a) Variable area flow meters or rotameters shall be as per ISA-RP 16.1, 16.2, 16.3, 16.4, 16.5 and 16.6. Rotameter shall be of flanged body construction.
- b) Rotameter shall be of metal tube type with local indication.
- c) The material for tube & float shall be SS 316 as a minimum (or better material as per piping material specification).
- d) The packing material shall be PTFE if the liquid temperature is below 230 C. For temperatures above 230 C, packing shall be of GRAFOIL.
- e) Rotameter shall have an accuracy of minimum $\pm 2\%$ FSD.
- f) Rotameter transmitter shall be SMART type with HART protocol with integral LCD display. Rotameter transmitters shall be intrinsically safe, 4-20mA two wire type capable of operation on 24VDC power supply with a load capacity not less than 600 ohms.

5.9.2.9 Orifice Plates and Flanges

- a) Flow measurement shall normally be carried out by using thin, square-edge concentric orifices plate mounted between a pair of weld-neck type orifice flanges with flange taps. The minimum pressure rating of flanges shall be 300 lb ANSI.

Where D, D/2 taps are required, the ratings of the orifice flanges shall be same as that of the pipe class. Flanged end connections shall be as per ASME B16.5

- b) Eccentric type of orifice plates shall be used for specific applications, like dual phase.
- c) Segmental type shall be used for specific applications.
- d) Quadrant edge or conical entrance orifice plates shall be used for services with low Reynolds number.
- e) Orifice Plate material shall be SS 316 as a minimum or better
- f) Each Orifice Plate shall have an integral handle, which shall, upon assembly with flanges, extend to a distance of 50 mm. with following information punched on it:
 - Tag Number.
 - Nominal flange size in inches and rating in pounds.
 - Plate and flange material to ASTM specifications.
 - Bore dia in mm.
- g) Sizing of orifice plate shall be carried out in accordance with ISO-5167(latest edition).

5.9.2.10 Restriction Orifice Plates

- a) The material of the orifice plates shall be normally SS 316, as a minimum. Flange material & rating shall be as per piping specification.
- b) Sizing of orifice plate shall be carried out in accordance with ISO-5167 (Latest Edition).
- c) Each Orifice Plate shall have an integral handle, which shall, upon assembly with flanges, extend to a distance of 50 mm beyond flange edge with Tag no., nominal pipe size in inches, rating in psi and material of plate punched on it.
- d) Thickness of the orifice plate shall be calculated to meet the service condition requirement. Minimum thickness shall be 3.18mm.

5.9.2.11 Self Actuated Pressure Control Valve

- a) Body material shall be as per piping material specification. Trim material shall be Stainless Steel SS 316 as a minimum. Actuator shall be diaphragm type and diaphragm material shall be Stainless Steel as a minimum.
- b) All pressure parts shall be designed to withstand maximum shut off pressure.
- c) Valve shall have flanged connections for sizes 1" and above and shall have screwed connection for sizes 3/4" and below.
- d) The line pressure sensing for the self actuated control valve/regulator shall be internal, in general.
- e) The set pressure of the self actuated control valve shall be adjustable throughout each spring range externally. A locking mechanism shall be provided to avoid inadvertent set point adjustment.
- f) Flow direction shall be clearly stamped or cast on the valve/regulator body to ensure correct installation.

5.9.2.12 Temperature Gauge

- a) Local temperature gauges shall be in general bimetallic type. The temperature bulb shall be of stainless steel construction. The case of bimetallic type temperature

gauges shall be all angles rotatable type. The gauge movement material shall be of stainless steel, as a minimum.

- b) Temperature gauges shall have accuracy of $\pm 1\%$ of URV (Upper Range Value). All local temperature gauges shall have 150 mm dial size. The bulb size shall be selected to suit the Thermowell.
- c) All gauges shall be of weatherproof construction to IP 55 as a minimum.
- d) Thermometer stem adjustable gland with union connection and bushing shall be suitable for 1/2" NPTF connection.
- e) The temperature gauges shall be provided with 1 1/2" flanged thermowell with 1/2" NPT (F) connection for temperature gauges. .
- f) Zero adjustment screw for temperature gauge shall be external type.
- g) Unless otherwise specified, the temperature gauge shall have an over range protection of at least 130% of specified range or maximum working temperature, whichever is higher.

5.9.2.13 Thermowell

- a) Thermowells and flanges shall be minimum of 316 SS or better material to suit the service conditions. Pressure rating of flanges shall be as per respective piping specification. Thermowell shall be fabricated from bar-stock.
- b) Immersion length of Thermowells for different line sizes shall be as follows:-

<u>Line Size</u>	<u>Immersion length (U)</u>
4" to 6"	280 mm
From 8 "to 20"	320 mm
>20" & Vessels/columns	400 mm

- c) Immersion length is based on 200 mm length between flange face and inner well of pipe. In vessels, where fouling with vessel internals is expected, the immersion length shall be suitably modified. The minimum line size shall be of 4" for installation of Temperature element. Any pipe of less than 4" nominal bore shall be blown to 4" size to install thermowell.

5.9.2.14 Control Valves

- a) Control valves shall normally be Globe type single seated or double seated. For clean services, guiding shall be top and bottom/ cage type. For highly viscous services, cage guiding shall be avoided.
- b) Flanged control valves shall be used. Body material, body rating and flange rating, shall be as per piping specifications as a minimum. Minimum control valve body size shall be 1" in general. Reduced trims can also be considered.
- c) Trim characteristics shall be equal percentage type unless required otherwise. Anti-cavitation trim shall be selected wherever cavitation is expected in the valve. Control valve body and flange rating shall be minimum 300#.
- d) Noise from control valve during operation shall be limited to OSHA specified level or better. The maximum allowable noise is 85 dBA SPL (Sound Pressure Level). Low noise trim shall be considered where noise level exceeds maximum limit.

- e) Valve seat leakage shall be as per ANSI/FCI 70.2 and shall be selected with due consideration to meet the requirement. Minimum class IV leakage shall be provided.
- f) Flanged bolted type gland packing boxes shall be used. Packing shall normally be PTFE on liquid and gas service up to 200°C (design). For high temperature application (above 200 °C (design) temperature, grafoil or equivalent gasket suitable for the specified service shall be provided. Asbestos based packing material shall not be used.
- g) Material used for trim shall be minimum 316 SS, with guide bushing of hardened stainless steel like 440 C, 17-4 PH, etc. upto a pressure drop of 10 kg/cm². Stellite trims shall be provided for higher pressure drops (more than 10 kg/cm²) and wherever required to meet service conditions.
- h) Valve actuator shall be pneumatic spring opposed diaphragm type, in general. Piston type actuators may be used for very high shut off pressure requirements. Additional equipment necessary to meet fail safe condition shall also be included in case double acting piston type actuator is selected. In either case, actuator shall be able to withstand maximum shut-off pressure (1.5 times of design pressure) with the minimum instrument air pressure specified. The actuator shall be painted as below:
 - Direct action (open on air failure) valves - Green color.
 - Reverse acting (close on air failure) valve - Yellow color.
- i) Control valve positioner shall be Smart type with HART protocol (latest version). The positioner shall be provided with necessary hardware/ software for maintenance, diagnostics, programming etc.
- j) Positioner output shall include but not limited to actual valve stem travel, input current, actuator pressure, travel direction, accumulated travel, cycle counter etc.
- k) Positioner shall provide diagnostic information such as Valve signature data with seat load, bench set and valve friction, dynamic error and dynamic linearity of control valve, diagnostic graphics with adequate resolution. When mounted on control valve, the factory valve signature test report shall be provided.
- l) All control valve supplied by bidder must comply with fugitive emission requirements as per leakage class-C of ISO-15848-1(Latest edition).

5.9.3 Installation Requirement

- 5.9.3.1 Bidder shall ensure and supply all erection hardwares required for the installation of complete instrumentation items which form part of the package unit. This includes items like instrument valves and manifolds, mounting accessories, impulse piping, tubing, pipe/tube fittings, canopies for instruments, identification tags etc. as a minimum.
- 5.9.3.2 All instruments shall be provided with isolation, vent / drain and equalizing arrangement.
- 5.9.3.3 Instrument connection sizes shall be as follows:
 - a) On Vessel/ Equipment- 2"
 - b) On Pipe - ¾" NPT for direct type. 1.5" flanged for Diaphragm seal type and thermowells.

6.0 INSPECTION AND TESTING

- 6.1** All Equipments shall be subjected to inspection by EIL/Owner /Third party. The Inspector shall have free access to the Contractor/Vendor's shop/work site. The Contractor/Vendor shall provide all facilities like tools and tackles, instruments and personnel to inspector. All the Inspection shall be carried out in accordance with the relevant Codes & requirements of Drawings & Specifications. Approval of Inspector shall in no way relieve the Contractor/Vendor of his responsibility for proper execution of work. Manufacturer's Quality Assurance (QA) plans shall be submitted for Owner / Consultant or his authorized inspection agency's approval before taking up manufacturing.
- 6.2** The Inspection shall include but not be limited to:
- Examination of materials of construction.
 - Welding procedure and Welder's qualification tests.
 - Various non-destructive tests like radiography etc. as per code.
 - Checking of dimensions
 - Pressure testing and certification etc.
 - Hardness testing
- 6.3** Wherever specified in code, dye penetrant/magnetic particle examination shall be carried out on the welds. Spot radiography shall be minimum requirement for all Equipments. Extent of radiography and acceptance criteria shall be as per the relevant provisions of the code.
- 6.4** All nozzles fabricated from plate, irrespective of thickness, shall be 100% radiographed.
- 6.5** The inner fillet of bottom or annular plate to shell weld shall be leak tested with penetrating oil after removal of slag prior to welding of outside fillet weld.
- 6.6** After completion, tank shall be hydrostatically tested by filling water and all weld joints shall be hammered and inspected for any leakage. In case of any defect it shall be repaired and retested as per the instructions of Inspector.
- 6.7** Equipments under Caustic, Amine & Sour (H₂S) service shall essentially be PWHT. The Hardness of the PM, Weld & HAZ shall be limited to 200 BHN in such cases.
- 6.8** It shall be the responsibility of Contractor/Vendor to prepare a Detailed Inspection and Test plan as per applicable Code and Specifications and get the same reviewed by EIL/Owner/Third party prior to execution of work.
- 6.9** Fittings, valves, instruments, other accessories like electric motor etc. shall be duly tested and manufacturer's test certificates shall be furnished.
- 6.10** Any other tests as per the Process Data Sheet / EIL standard / applicable codes shall also be performed.

Following "Witness" inspection & tests shall be carried out for the completely assembled chemical dosing package:

- Dimensional Inspection
- Cleanliness

- Hydro test / Pneumatic Leak test of assembled piping / joints

The dosing package vendor shall further note that “Witness” inspection is also specified for certain equipment i.e. controlled volume pumps, Mechanical Agitators etc. in the respective equipment data sheets which shall also be carried out.

Vendor shall provide test/ calibration/ inspection certificates of all the instrument items under dosing package scope for purchaser’s review/ record

7.0 COMMISSIONING SPARE PARTS

The vendor shall include in his scope of supply, spares required for erection and commissioning of the dosing package (inclusive of mechanical, electrical and instrumentation spares). List for the same shall be furnished by the dosing package vendor along with the bid.

If however, any additional spare is consumed during erection and commissioning, over and above the quoted erection and commissioning spares, the same shall be provided free of cost by the dosing package vendor.

8.0 RECOMMENDED SPARE PARTS FOR TWO YEARS NORMAL OPERATION

- 8.1** The vendor shall furnish a quotation for spare parts required for two years normal operation as per the equipment manufacturer’s recommendation along with unit rates for the package (inclusive of mechanical, electrical and instrumentation spares).
- 8.2** The recommended spares for two years operation for each rating and type of motor shall include the following as a minimum:
 - a. Bearings for DE & NDE
 - b. Cooling fan
 - c. Terminal block
 - d. Terminal box cover with screws.

9.0 SPECIAL TOOLS/TACKLES

Any special tools and tackles required for erection, site assembly and maintenance of dosing package (inclusive of mechanical, electrical and instrumentation spares) shall be included in the dosing package vendor’s scope of supply.

An itemized list of special tools/tackles included in the scope of supply, shall be furnished along with the bid.

10.0 EQUIPMENT LAYOUT

Vendor shall furnish the tentative equipment layout for dosing package(s) along with the bid. If any tentative skid size/layout is enclosed with the inquiry document vendor shall ensure that the proposed dosing package skid is accommodated within the space allocated for the specified dosing package

11.0 VENDOR DATA AND DRAWINGS

11.1 PROPOSALS

The vendor's proposals shall as a minimum include all data sheets, drawings and documents listed under "WITH BID" in the enclosed Vendor Data Requirements.

11.2 CONTRACT DATA

11.2.1 General

11.2.1.1 Drawings and data as required after purchase order has been specified in Vendor Data Requirements. Vendor to note that the drawing/ document descriptions/titles as given in the Vendor Data Requirement are generic in nature. It is possible that against one drawing/ document specified there are several drawings to be furnished by the vendor or vice-versa.

Vendor shall complete & forward a document "DOCUMENT CONTROL INDEX" to the purchaser (Destination & contact person as per order).

This document shall list out in consolidated form all drawings and documents required by purchaser (As specified in Data Sheets, Specifications and Vendor Data Requirements enclosed with the order).

Against each drawing/document vendor shall indicate the vendor's drawing numbers, titles, Rev. No., category (whether for information or approval) and schedule of submission.

This shall be the first document to be submitted by vendor within two weeks of order.

No drawing shall be taken up for review till DCI for the inquiry/order is finalized by the vendor.

11.2.1.2 All drawings and data shall have a title block (in addition to vendor's standard title block) which shall as a minimum contain the following contract information:

- i) Purchaser's and Consultant's Corporate Name
- ii) Project Name.
- iii) Client / Customer's Name.
- iv) Equipment Name and Item No.
- v) Purchase Order No.
- vi) Purchase Requisition No.

Title Block on drawings shall be placed on the lower right hand corner.

11.2.1.3 All vendor data/drawings/documents shall be in English Language and in Metric Systems.

11.2.1.4 Data specified in the VDR document is the minimum requirements of Purchaser. Any additional document/data required or requested by Purchaser for engineering or construction shall also be made available by the vendor.

11.2.1.5 Whether or not specified, the vendor shall furnish the following, before shipment:

- A supplementary list of spare parts other than those included in his original proposal. The supplementary list shall include recommended spare parts, cross-sectional or assembly type drawings, parts numbers, materials, prices and delivery period. The vendor shall forward this supplementary list to the purchaser promptly after receipt of the reviewed drawings and in time to permit order and delivery of parts before field startup.
- A parts list for all equipment supplied. The list shall include pattern, stock, or production drawing numbers and materials of construction. The list shall completely identify each part so that the purchaser may determine the interchangeability of the parts with other equipment furnished by the same manufacturer. Standard purchased items shall be identified by the original manufacturer's name and part number.

- At least 8 weeks before shipment, the vendor shall submit his preservation, packaging and shipping procedures to the purchaser's for his information.

11.2.2 Drawings

11.2.2.1 Drawing review shall be through eDMS/ VDOCS in soft as per the details provided elsewhere in the inquiry document.

11.2.2.2 The purchaser's review of the vendor's drawings shall not constitute permission to deviate from any requirements in the purchase order/specifications unless specifically agreed upon in writing. After the drawings have been reviewed, the vendor shall furnish certified copies in the quantity specified in VDR.

11.2.2.3 Drawings/documents with following titles shall contain as a minimum the following information:

a) General Arrangement Drawing

A general arrangement drawing shall indicate:

- i) Outline dimensions (minimum three views) (All principal dimensions).
- ii) Location (in all three planes), size, type, rating and identification of all purchaser's interface connections including those of vents, drains lubricating oil, cooling water, steam & Electrical/Instrumentation.
- iii) Weight of each equipment/assembly/component.
- iv) The weight & location of center of gravity of the heaviest equipment/assembly/components that must be handled for erection.
- v) Identification and weight, dimensions of the heaviest equipment/assembly / subassembly /component required to be handled for maintenance.
- vi) Maintenance clearances and dismantling clearances.
- vii) Layout of auxiliary equipment and operating platform.
- viii) A list of reference drawings if any.
- ix) A list of any special weather-protection and climatic features.

b) Foundation Drawing

A foundation drawing shall indicate complete information required for foundation design by purchaser including the following:

- i) Foundation bolt sizes & pipe sleeve details and pocket sizes & locations.
- ii) Grouting thickness and other necessary technical details.
- iii) Static weight of each independently grouted item and location of center of gravity of each item in all three planes.
- iv) Weight distribution for each bolt/sub sole-plate location and total static weight.
- v) Dynamic loads, if any, caused due to various items grouted independently. (The cause of generation of such loads shall also be indicated).
- vi) The direction and magnitude of unbalance forces and moments (with their phase angles) generated by the out of balance of the rotating / moving parts of the machine at the relevant operating conditions. [These loads and their locations are to be given in all three planes. These shall be utilised for computing the amplitudes of vibration of the foundation].
- vii) Maximum permissible amplitude of vibration on the foundation at the base level. (The location of the points on the foundation base where such amplitudes are not to be exceeded shall be given in all three planes). The reference of relevant code, if any, shall also be indicated.
- viii) Total mass of static parts.
- ix) Total mass of reciprocating parts
- x) Suggested dynamic factor and ratio of weight of foundation to weight of skid/ equipment.
- xi) Scope of Supply of the Foundation Bolts (unless otherwise specified, by vendor).

c) **P&I Diagrams (with Bill of Materials)**

Vendor shall furnish **P&I** Diagrams along with Bill of Materials of each system in the vendor's scope of supply or specified in the order. **P&I** Diagram shall indicate the system details, location of various auxiliaries, instruments, controls and safety devices as required. Line sizes, piping class, valve sizes and class shall be clearly marked on the P&ID. Vendor's scope and purchaser's scope shall be clearly demarcated. Each item shall be identified by an item No./item tag no., which shall correspond to the item no. shown on the bill of materials. The bill of materials shall include items number, normal value, set value, range, quantity per unit, make and other specifications as applicable.

Legends adopted shall be indicated either at the bottom of drawing or on a separate drawing.

The legends shall be as per ISA.

d) **Data Sheet**

The Vendor shall provide completely filled in data sheets first for "as purchased" and then for "as built". This shall be done by the vendor correcting and filling out the data sheets and submitting copies to the purchaser.

e) **Technical Data Manual/Mechanical Catalogues**

Technical Data Manual/Mechanical Catalogue is a compilation of "as built" drawings and data, manufacturing and test records, installation, operating and maintenance instructions.

The vendor shall furnish the required number of Technical Data Manual/Mechanical Catalogues for the equipment, any auxiliaries and instruments that the vendor is providing. The Technical Data Manual/Mechanical Catalogue shall include the following documents as a minimum:

- i. All drawings and data as listed in the vendor data requirements.
- ii. All manufacturing, inspection and test data and records.
- iii. Installation and Instruction Manual
The vendor shall provide sufficient written instructions, including a cross-reference list of all drawings, to enable the purchaser to correctly install the skid and prepare the equipment for start-up. It shall also contain the following information:
 - (a) Instructions for erecting, piping, aligning.
 - (b) Pre-commissioning/commissioning/functional test procedures and acceptance criterion.
- iv. Operation and Maintenance Manual
This manual shall provide sufficient written instructions and data to enable purchaser to correctly operate and maintain the equipment ordered.

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04AA				

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04AB		Description : PUMP-CENT.HOR(SPP)		
Approved Suppliers				
1	S684	SHIN NIPPON MACHINERY CO LTD	JAPAN	
2	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	UNITED KINGDOM	
3	R611	RUHRPUMPEN GMBH(FORMERLY THYSSENT509)	GERMANY	
4	E501	EBARA CORPORATION (JAPAN)	JAPAN	
5	27455	HYOSUNG GOODSPRINGS INC.	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
6	K018	KSB LIMITED	INDIA	
7	27441	SULZER PUMPEN DEUTSCHLAND GMBH	GERMANY	
8	3629	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	
9	F156	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
10	S401	SULZER PUMPS INDIA PRIVATE LIMITED	INDIA	
11	3978	VARAT PUMP & MACHINERY PVT LTD	INDIA	
12	27505	RUHRPUMPEN S.A DE C.V	MEXICO	
13	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
14	27504	RUHRPUMPEN INC.	UNITED STATES	
15	I198	ITT CORPORATION INDIA PVT LTD	INDIA	
16	3786	DMW CORPORATION INDIA PVT.LTD.	INDIA	
17	3767	KSB LIMITED	INDIA	
18	G510	GOULDS PUMPS INC	UNITED STATES	
19	3739	KSB LIMITED	INDIA	
20	D501	DMW CORPORATION	JAPAN	
21	K087	KIRLOSKAR EBARA PUMPS LTD	INDIA	
22	S744	SULZER PUMPS (US) INC	UNITED STATES	
23	G629	GOULDS PUMPS CO.LTD.	KOREA, REPUBLIC OF	
24	T535	FLOWSERVE(THOMPSONS KELLY&LEWIS PTY LTD)	AUSTRALIA	
25	W602	WEIR MINERALS NETHERLANDS BV (FMLY E620)	NETHERLANDS	
26	A550	ARAI PUMP MANUFACTURING COMPANY LTD	JAPAN	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04AC		Description : PUMP-CENT.HOR(GWS)		
Approved Suppliers				
1	E501	EBARA CORPORATION (JAPAN)	JAPAN	
2	F156	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
3	3739	KSB LIMITED	INDIA	
4	3767	KSB LIMITED	INDIA	
5	3629	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	
6	27505	RUHRPUMPEN S.A DE C.V	MEXICO	
7	3804	FLOWMORE LIMITED	INDIA	
8	3760	C.R.I. PUMPS PRIVATE LIMITED	INDIA	
9	27455	HYOSUNG GOODSPRINGS INC.	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
10	3863	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
11	K003	KIRLOSKAR BROTHERS LTD	INDIA	
12	W012	WPIL LTD	INDIA	
13	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	UNITED KINGDOM	
14	G510	GOULDS PUMPS INC	UNITED STATES	
15	S014	SU MOTORS PVT LTD	INDIA	
16	S744	SULZER PUMPS (US) INC	UNITED STATES	
17	F127	FLOWMORE LIMITED	INDIA	
18	T535	FLOWSERVE(THOMPSONS KELLY&LEWIS PTY LTD)	AUSTRALIA	
19	T756	TMP S.P.A TERMOMECCANICA POMPE	ITALY	
20	K018	KSB LIMITED	INDIA	
21	S065	SAM TURBO INDUSTRYPVT. LTD(ENQ-ACE MKTG)	INDIA	
22	D501	DMW CORPORATION	JAPAN	
23	I198	ITT CORPORATION INDIA PVT LTD	INDIA	
24	S684	SHIN NIPPON MACHINERY CO LTD	JAPAN	
25	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
26	M013	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
27	R611	RUHRPUMPEN GMBH(FORMERLY THYSSENT509)	GERMANY	
28	S401	SULZER PUMPS INDIA PRIVATE LIMITED	INDIA	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04AD		Description : PUMP-CENT.HOR(LCWS)		
Approved Suppliers				
1	D501	DMW CORPORATION	JAPAN	
2	R611	RUHRPUMPEN GMBH(FORMERLY THYSSENT509)	GERMANY	
3	F635	FLOWERVE CORPORATION (FORMERLY I571)	UNITED STATES	
4	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	UNITED KINGDOM	
5	G510	GOULDS PUMPS INC	UNITED STATES	
6	W012	WPIL LTD	INDIA	
7	3804	FLOWMORE LIMITED	INDIA	
8	K003	KIRLOSKAR BROTHERS LTD	INDIA	
9	T756	TMP S.P.A TERMOMECCANICA POMPE	ITALY	
10	T535	FLOWERVE(THOMPSONS KELLY&LEWIS PTY LTD)	AUSTRALIA	
11	S684	SHIN NIPPON MACHINERY CO LTD	JAPAN	
12	S744	SULZER PUMPS (US) INC	UNITED STATES	
13	F127	FLOWMORE LIMITED	INDIA	
14	E501	EBARA CORPORATION (JAPAN)	JAPAN	
15	M013	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
16	F156	FLOWERVE INDIA CONTROLS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04BA		Description : PUMP-CENT.VERT(GPP)		
Approved Suppliers				
1	T756	TMP S.P.A TERMOMECCANICA POMPE	ITALY	
2	S684	SHIN NIPPON MACHINERY CO LTD	JAPAN	
3	G510	GOULDS PUMPS INC	UNITED STATES	
4	D501	DMW CORPORATION	JAPAN	
5	T535	FLOWERVE(THOMPSONS KELLY&LEWIS PTY LTD)	AUSTRALIA	
6	3629	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	
7	M013	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
8	R611	RUHRPUMPEN GMBH(FORMERLY THYSSENT509)	GERMANY	
9	S744	SULZER PUMPS (US) INC	UNITED STATES	
10	S065	SAM TURBO INDUSTRYPVT. LTD(ENQ-ACE MKTG)	INDIA	
11	K001	KISHOR PUMPS PVT LTD.	INDIA	
12	S401	SULZER PUMPS INDIA PRIVATE LIMITED	INDIA	
13	27505	RUHRPUMPEN S.A DE C.V	MEXICO	
14	27455	HYOSUNG GOODSPRINGS INC.	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
15	F635	FLOWERVE CORPORATION (FORMERLY I571)	UNITED STATES	
16	K087	KIRLOSKAR EBARA PUMPS LTD	INDIA	
17	K003	KIRLOSKAR BROTHERS LTD	INDIA	
18	F156	FLOWERVE INDIA CONTROLS PVT LTD	INDIA	
19	E501	EBARA CORPORATION (JAPAN)	JAPAN	
20	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	UNITED KINGDOM	
21	27504	RUHRPUMPEN INC.	UNITED STATES	
22	I198	ITT CORPORATION INDIA PVT LTD	INDIA	
23	A550	ARAI PUMP MANUFACTURING COMPANY LTD	JAPAN	
24	S014	SU MOTORS PVT LTD	INDIA	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04BB		Description : PUMP-CENT.VERT.(SPP)		
Approved Suppliers				
1	S401	SULZER PUMPS INDIA PRIVATE LIMITED	INDIA	
2	F156	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
3	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	UNITED KINGDOM	
4	T535	FLOWSERVE(THOMPSONS KELLY&LEWIS PTY LTD)	AUSTRALIA	
5	G510	GOULDS PUMPS INC	UNITED STATES	
6	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
7	D501	DMW CORPORATION	JAPAN	
8	A550	ARAI PUMP MANUFACTURING COMPANY LTD	JAPAN	
9	R611	RUHRPUMPEN GMBH(FORMERLY THYSSENT509)	GERMANY	
10	S684	SHIN NIPPON MACHINERY CO LTD	JAPAN	
11	K087	KIRLOSKAR EBARA PUMPS LTD	INDIA	
12	27455	HYOSUNG GOODSPPRINGS INC.	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
13	G629	GOULDS PUMPS CO.LTD.	KOREA, REPUBLIC OF	
14	27441	SULZER PUMPEN DEUTSCHLAND GMBH	GERMANY	
15	3629	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	
16	27505	RUHRPUMPEN S.A DE C.V	MEXICO	
17	27504	RUHRPUMPEN INC.	UNITED STATES	
18	I198	ITT CORPORATION INDIA PVT LTD	INDIA	
19	3767	KSB LIMITED	INDIA	
20	3739	KSB LIMITED	INDIA	
21	S744	SULZER PUMPS (US) INC	UNITED STATES	
22	E501	EBARA CORPORATION (JAPAN)	JAPAN	
23	K018	KSB LIMITED	INDIA	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04BC				

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04BD		Description : PUMP-CENT.VERT(LCWS)		
Approved Suppliers				
1	T756	TMP S.P.A TERMOMECCANICA POMPE	ITALY	
2	S684	SHIN NIPPON MACHINERY CO LTD	JAPAN	
3	3725	WPIL LTD	INDIA	
4	3629	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	
5	3804	FLOWMORE LIMITED	INDIA	
6	E501	EBARA CORPORATION (JAPAN)	JAPAN	
7	K003	KIRLOSKAR BROTHERS LTD	INDIA	
8	T535	FLOWSERVE(THOMPSONS KELLY&LEWIS PTY LTD)	AUSTRALIA	
9	G510	GOULDS PUMPS INC	UNITED STATES	
10	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	UNITED KINGDOM	
11	S744	SULZER PUMPS (US) INC	UNITED STATES	
12	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
13	F156	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
14	F127	FLOWMORE LIMITED	INDIA	
15	W012	WPIL LTD	INDIA	
16	D501	DMW CORPORATION	JAPAN	
17	R611	RUHRPUMPEN GMBH(FORMERLY THYSSENT509)	GERMANY	
18	M013	WILO MATHER AND PLATT PUMPS PVT LTD	INDIA	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04CH				

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04DA		Description : PUMP-ROTARY.SCREW		
Approved Suppliers				
1	R035	ROTO PUMPS LTD	INDIA	
2	3771	DELTA PD PUMPS PRIVATE LIMITED	INDIA	
3	3923	RISANSI INDUSTRIES LTD.	INDIA	
4	A185	ALEKTON ENGG INDUSTRIES PVT. LTD	INDIA	
5	W539	WARREN PUMPS INC	UNITED STATES	
6	S829	SEEPEX GMBH	GERMANY	
7	T194	ALLWEILER INDIA PRIVATE LIMITED	INDIA	
8	P660	PLENTY MIRRLESS PUMPS	UNITED KINGDOM	
9	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
10	P564	POMPE VERGANI SPA	ITALY	
11	U084	UT PUMPS & SYSTEMS PVT. LTD. (BORNEMAN)	INDIA	
12	N151	NETZSCH TECHNOLOGIES INDIA PVT.LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04DB		Description : PUMP-ROTARY.GEAR		
Approved Suppliers				
1	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
2	W599	WITTE PUMPS & TECHNOLOGY GMBH	GERMANY	
3	M580	MAAG PUMPS SYSTEMS AG	SWITZERLAND	
4	D033	DEL PD PUMPS & GEARS PVT. LTD.	INDIA	
5	3771	DELTA PD PUMPS PRIVATE LIMITED	INDIA	
6	V524	VIKING PUMP INC	UNITED STATES	
7	S565	SHIMADZU CORPORATION	JAPAN	
8	T194	ALLWEILER INDIA PRIVATE LIMITED	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04DE		Description : PUMP-ROTARY(LOBE)		
Approved Suppliers				
1	27528	NETZSCH DO BRASIL INDUSTRIA E COMERCIO LTDA.	BRAZIL	
2	B744	BOERGER GMBH		
3	V162	VOGELSANG INDIA PVT LTD	INDIA	

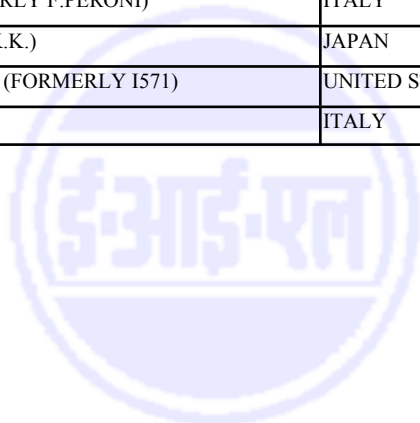


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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04FA		Description : PUMP-RECIPRO(API 675,PLUNGER/DIAPHRAGM)		
Approved Suppliers				
1	27481	TEIKOKU ELECTRIC MGF. CO., LTD.	JAPAN	
2	W570	WILLIAMS INSTRUMENT COMPANY INC	UNITED STATES	
3	O505	ORLITA GMBH & CO KG	GERMANY	
4	P328	POSITIVE METERING PUMPS (I) PVT LTD	INDIA	
5	V005	V K PUMP INDUSTRIES PVT. LTD.	INDIA	
6	S024	SWELORE ENGG. (P) LTD	INDIA	
7	P563	PULSA FEEDER (UNIT OF IDEX CORP)	UNITED STATES	
8	S012	SHAPOTOOLS	INDIA	
9	W602	WEIR MINERALS NETHERLANDS BV (FMLY E620)	NETHERLANDS	
10	M242	ACCUDYNE INDUSTRIES INDIA PVT. LTD.	INDIA	
11	L620	LEWA GMBH	GERMANY	
12	3776	SWELORE ENGG. (P) LTD	INDIA	
13	M709	MILTON ROY EUROPE	FRANCE	
14	O632	OFFICINE MECCANICHE GALLARATESI SPA	ITALY	
15	N505	NIKKISO CO LTD (NIKKISO K.K.)	JAPAN	
16	B522	BRAN + LUEBBE LTD	GERMANY	
17	27524	SEKO SPA	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04FD		Description : PUMP-RECIPRO(API 674)		
Approved Suppliers				
1	27482	WANNER ENGINEERING INC	UNITED STATES	
2	D660	DAWSON DOWNIE LAMONT LTD	UNITED KINGDOM	
3	W602	WEIR MINERALS NETHERLANDS BV (FMLY E620)	NETHERLANDS	
4	G196	GOMA ENGINEERING PVT LTD	INDIA	
5	H143	HIRO NISHA SYSTEMS PVT. LTD.	INDIA	
6	D501	DMW CORPORATION	JAPAN	
7	P667	PERONI POMPE SPA (FORMARLY F.PERONI)	ITALY	
8	N505	NIKKISO CO LTD (NIKKISO K.K.)	JAPAN	
9	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
10	27524	SEKO SPA	ITALY	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04GC		Description : PUMP - AIR OPERATED DIAPHRAGM		
Approved Suppliers				
1	M298	MONIBA ANAND ELECTRICALS PVT LTD	INDIA	
2	H151	HI-LIFE MANUFACTURING CO.	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04JB		Description : COMP-ROT.LOBE/VP(AS)		
Approved Suppliers				
1	3657	AERZEN MACHINES INDIA PVT. LTD.	INDIA	
2	3839	EVEREST BLOWERS PVT LTD	INDIA	
3	3964	KAY INTERNATIONAL PRIVATE LIMITED	INDIA	
4	R580	RIETSCHLE THOMAS GMBH + CO. KG	GERMANY	
5	B732	BUSCH GVT LTD(FORM GRAHAM PRECISION PUMP	UNITED KINGDOM	
6	U516	UNOZAWA GUMI IRON WORKS LTD	JAPAN	
7	A548	AERZENER MASCHINENFABRIK GMBH	GERMANY	
8	U103	USHA COMPRESSORS PVT. LTD.	INDIA	
9	S072	SWAM PNEUMATICS (P) LTD	INDIA	
10	A409	ACME AIR EQUIPMENTS CO PVT LTD	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04JF		Description : COMP-ROT.SCREW(PIAS)		
Approved Suppliers				
1	H509	HOWDEN COMPRESSORS	UNITED KINGDOM	
2	A548	AERZENER MASCHINENFABRIK GMBH	GERMANY	
3	K507	KOBE STEEL LTD	JAPAN	
4	E029	ELGI EQUIPMENTS LTD.	INDIA	
5	I022	INGERSOLL RAND (INDIA) LTD.	INDIA	
6	A060	ATLAS COPCO (I) LTD (PUNE)	INDIA	
7	M696	MAN TURBOMASCHINEN AG	GERMANY	
8	3769	KIRLOSKAR PNEUMATIC COMPANY LIMITED	INDIA	
9	3657	AERZEN MACHINES INDIA PVT. LTD.	INDIA	
10	A704	ATLAS COPCO AIRPOWER N.V (BELGIUM)	BELGIUM	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04MA		Description : FAN-ID/FD		
Approved Suppliers				
1	F028	HOWDEN SOLYVENT (INDIA) PVT. LTD.	INDIA	
2	A375	BOLDROCCHI INDIA PRIVATE LIMITED	INDIA	
3	A025	AIR CONTROL & CHEMICAL ENGG.CO.LTD.	INDIA	
4	T120	TLT ENGINEERING INDIA PVT LTD	INDIA	
5	A057	ANDREW YULE & CO LTD-KOLKATA	INDIA	
6	B716	BOLDROCCHI SRL	ITALY	
7	B131	BHEL (RANIPET)	INDIA	
8	T564	TURBO LUFTECHNIK GMBH	GERMANY	
9	I584	ILLINOIS BLOWERS INC	UNITED STATES	
10	A757	AEROMECCANICA STRANICH SPA	ITALY	
11	V576	SICCADANIA/VTK B.V.	NETHERLANDS	
12	D501	DMW CORPORATION	JAPAN	
13	R207	REITZ INDIA LTD	INDIA	
14	M502	MITSUBISHI HEAVY INDUSTRIES LTD	JAPAN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04MG		Description : BLOWER-TURBO CENTRIFUGAL		
Approved Suppliers				
1	N510	NUOVO PIGNONE INTERNATIONAL S.R.L.	ITALY	
2	T564	TURBO LUFTTECHNIK GMBH	GERMANY	
3	A757	AEROMECCANICA STRANICH SPA	ITALY	
4	V576	SICCADANIA/VTK B.V.	NETHERLANDS	
5	H509	HOWDEN COMPRESSORS	UNITED KINGDOM	
6	I584	ILLINOIS BLOWERS INC	UNITED STATES	
7	M696	MAN TURBOMASCHINEN AG	GERMANY	
8	P300	Patels Airflow Ltd.	INDIA	
9	K522	KAWASAKI HEAVY INDUSTRIES LTD	JAPAN	
10	F028	HOWDEN SOLYVENT (INDIA) PVT. LTD.	INDIA	
11	G619	GARDNER DENVER WITTIG GMBH	GERMANY	
12	A375	BOLDROCCHI INDIA PRIVATE LIMITED	INDIA	
13	M502	MITSUBISHI HEAVY INDUSTRIES LTD	JAPAN	
14	M282	MARATHON ELECTRIC MOTORS (INDIA) LTD.	INDIA	
15	D501	DMW CORPORATION	JAPAN	
16	A025	AIR CONTROL & CHEMICAL ENGG.CO.LTD.	INDIA	
17	B175	BATLIBOI ENVIRONMENTAL ENGG.LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04MH		Description : MECH.SEAL FOR PUMPS/AGITATORS		
Approved Suppliers				
1	3754	EAGLEBURGMANN INDIA PRIVATE LIMITED	INDIA	
2	J078	JOHN CRANE SEALING SYSTEMS INDIA PVT. LTD.	INDIA	
3	A750	AESSEAL PLC	UNITED KINGDOM	
4	L060	LEAK PROOF ENGG (I) PVT. LTD	INDIA	
5	F149	FLOWSERVE SANMAR LTD	INDIA	
6	E153	EAGLEBURGMANN INDIA PRIVATE LIMITED	INDIA	
7	3858	SEALMATIC INDIA PVT. LTD.	INDIA	
8	C753	CETRA DICHUNGSTECHNIK AG	GERMANY	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04NB		Description : DOSING PACKAGE (SKID MOUNTED)		
Approved Suppliers				
1	3965	POSITIVE METERING PUMPS (I) PVT LTD	INDIA	
2	3776	SWELORE ENGG. (P) LTD	INDIA	
3	E183	ENPRO INDUSTRIES PVT LTD	INDIA	
4	I117	INDCON PROJECTS & EQUIPMENTS LTD	INDIA	
5	P701	PETRONASH FZE	UNITED ARAB EMIRATES	
6	S024	SWELORE ENGG. (P) LTD	INDIA	
7	V005	V K PUMP INDUSTRIES PVT. LTD.	INDIA	
8	O632	OFFICINE MECCANICHE GALLARATESI SPA	ITALY	
9	M242	ACCUDYNE INDUSTRIES INDIA PVT. LTD.	INDIA	



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