

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G00-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेपाल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 1 of 70

<p>tkIS India / Vendor</p> <p>Category Codes (Submission Purpose)</p> <table style="width: 100%;"> <tr><td><input type="checkbox"/></td><td>1</td><td>For Approval</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>For Review / Comments</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>For Information</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>For Engineering</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>For Enquiry</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>For Order Placement</td></tr> <tr><td><input type="checkbox"/></td><td>7</td><td>Final & Approved</td></tr> <tr><td><input type="checkbox"/></td><td>8</td><td>Released for Construction</td></tr> </table> <hr/> <p>Acceptance Codes (Approval Codes)</p> <table style="width: 100%;"> <tr><td><input type="checkbox"/></td><td>1</td><td>Approved</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>Approved for Manufacturing / Fabrication with Comments as marked</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>Not Approved / Resubmit</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>Retained for Information / Records</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>Reviewed</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>Reviewed as Noted / Resubmit</td></tr> </table> <p>Remarks for AC2 : This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-submitted after revision. This drawing should be revised only to the extent of tkIS India / Owner / Client comments. Any other changes made by you will not be considered unless clearly highlighted in covering letter asking for approval.</p> <p>This approval / review does not absolve the supplier from the full responsibility for design and fabrication.</p> <p>Date : ___/___/___ Name : _____</p>	<input type="checkbox"/>	1	For Approval	<input type="checkbox"/>	2	For Review / Comments	<input type="checkbox"/>	3	For Information	<input type="checkbox"/>	4	For Engineering	<input type="checkbox"/>	5	For Enquiry	<input type="checkbox"/>	6	For Order Placement	<input type="checkbox"/>	7	Final & Approved	<input type="checkbox"/>	8	Released for Construction	<input type="checkbox"/>	1	Approved	<input type="checkbox"/>	2	Approved for Manufacturing / Fabrication with Comments as marked	<input type="checkbox"/>	3	Not Approved / Resubmit	<input type="checkbox"/>	4	Retained for Information / Records	<input type="checkbox"/>	5	Reviewed	<input type="checkbox"/>	6	Reviewed as Noted / Resubmit	<p>tkIS India / Owner / Client</p> <p>Category Codes (Submission Purpose)</p> <table style="width: 100%;"> <tr><td><input type="checkbox"/></td><td>1</td><td>For Approval</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>For Review / Comments</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>For Information</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>For Engineering</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>For Enquiry</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>For Order Placement</td></tr> <tr><td><input type="checkbox"/></td><td>7</td><td>Final & Approved</td></tr> <tr><td><input type="checkbox"/></td><td>8</td><td>Released for Construction</td></tr> </table> <hr/> <p>Acceptance Codes (Approval Codes)</p> <table style="width: 100%;"> <tr><td><input type="checkbox"/></td><td>1</td><td>Approved</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>Approved for Manufacturing / Fabrication with Comments as marked</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>Not Approved / Resubmit</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>Retained for Information / Records</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>Reviewed</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>Reviewed as Noted / Resubmit</td></tr> </table> <p>Date : ___/___/___ Name : _____</p>	<input type="checkbox"/>	1	For Approval	<input type="checkbox"/>	2	For Review / Comments	<input type="checkbox"/>	3	For Information	<input type="checkbox"/>	4	For Engineering	<input type="checkbox"/>	5	For Enquiry	<input type="checkbox"/>	6	For Order Placement	<input type="checkbox"/>	7	Final & Approved	<input type="checkbox"/>	8	Released for Construction	<input type="checkbox"/>	1	Approved	<input type="checkbox"/>	2	Approved for Manufacturing / Fabrication with Comments as marked	<input type="checkbox"/>	3	Not Approved / Resubmit	<input type="checkbox"/>	4	Retained for Information / Records	<input type="checkbox"/>	5	Reviewed	<input type="checkbox"/>	6	Reviewed as Noted / Resubmit
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Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 2 of 70

CONTENTS: -

NO	DESCRIPTION	PAGE NOS.
1.	CONTENTS	1
2.	GENERAL ENGINEERING SPECIFICATION - INSTRUMENTATION (FOR DETAIL ENGINEERING)	5
3.	ANNEXURE-I LIST OF CODES & STANDARDS	57
4.	ANNEXURE-II CONTROL SYSTEM IMPLEMENTATION PHILOSOPHY	59
5.	ANNEXURE-III INSTRUMENT DOCUMENT NUMBER PHILOSOPHY	61
6.	ANNEXURE-IV UPSTREAM / DOWNSTREAM STRAIGHT LENGTHS	61
7.	ANNEXURE-V DESIGN VELOCITIES FOR IN-LINE FLOW DEVICES	64

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REV.	DATE	PREP.	CHKD.	APPR.	DOCUMENTS/ PAGES REVISED	DESCRIPTION
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01	12-10-2017	SHD	RDL	RDL / SJP	-	NALCO's comments incorporated and issued for engineering
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DOCUMENTS ATTACHED: -

SNO.	DOCUMENT NO.	DESCRIPTION	PAGES	LATEST REV.
1	6695-INS-G00-EB-0008 to 0017	STANDARD SKETCHES & INSTALLATION FORMATS	8	00
2	6695-INS-G00-EB-0018 / 0019	STANDARD SKETCHES FOR ORIFICE ASSEMBLY	2	00
3	6695-INS-G00-EB-0020 / 0022	STANDARD SKETCHES FOR THERMOWELL ASSEMBLY	3	00
4	6695-INS-G00-FA-0001	OVERALL CONTROL SYSTEM ARCHITECTURE DRAWING	2	02
5	6695-INS-G00-EB-0023	INSTRUMENT INDEX LEGEND FORMAT	38	00

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

6	6695-INS-G00-EB-0001	CONTROL SYSTEM I/O LIST FORMAT	1	00
7	6695-INS-G00-EB-0002	CABLE SCHEDULE FORMAT	4	00
8	6695-INS-G00-EB-0003	CABLE DRUM SCHEDULE FORMAT	2	00
9	6695-INS-G00-EB-0004	JB SCHEDULE FORMAT	1	00
10	6695-INS-G00-EB-0005	LOGIC DIAGRAM FORMAT	1	00
11	6695-INS-G00-EB-0006	INSTRUMENT PLOT PLAN FORMAT	1	00
12	6695-INS-G00-EB-0007	INSTRUMENT LOOP DIAGRAM FORMAT	1	00

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

CONTENTS

<u>S.NO.</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
1.0	<u>GENERAL</u>	
1.1	PROJECT INFORMATION	7
1.2	REGULATIONS, CODES AND STANDARDS	8
1.3	DEFINITION OF INSTRUMENTATION	8
1.4	CONCEPT OF INSTRUMENTATION	9
2.0	<u>GENERAL REQUIREMENTS FOR</u>	
	<u>INSTRUMENTATION ENGINEERING</u>	
2.1	GENERAL DESIGN CRITERIA	12
2.2	HAZARDOUS AREA INSTRUMENTATION	13
2.3	ALARM PHILOSOPHY	14
2.4	UNITS OF MEASUREMENT	14
2.5	MEASURING RANGES AND SCALES	15
2.6	INSTRUMENT REFERENCE ACCURACIES	16
2.7	SIGNAL TRANSMISSION	17
2.8	AUXILIARY ENERGY	17
2.9	END CONNECTIONS	18
2.10	EARTHING & LIGHTNING PROTECTION	18
2.11	PROFIBUS DP VI	19
2.12	NAME PLATES	19
3.0	<u>PROCESS CONTROL SYSTEMS</u>	
3.1	DIGITAL DISTRIBUTED CONTROL SYSTEM (DCS)	20
3.2	COMMUNICATION BETWEEN DCS, PLC & MCC	22
3.3	AUXILIARY CONSOLE	22
3.4	PROGRAMMABLE LOGIC CONTROLLER	22

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेपाल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

<u>S.NO.</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
4.0	<u>ENGINEERING AND SELECTION OF FIELD INSTRUMENTS (MEASURING/SWITCHING DEVICES)</u>	
4.1	PRESSURE MEASUREMENT	24
4.2	LEVEL MEASUREMENT	26
4.3	TEMPERATURE MEASUREMENT	29
4.4	FLOW MEASUREMENT	33
4.5	CONDUCTIVITY MEASUREMENT	39
4.6	DENSITY MEASUREMENT	39
4.7	BELT WEIGHING SYSTEM	40
4.8	WAGON LOADING SYSTEM	40
4.9	GAS ANALYSERS	40
5.0	<u>CONTROL VALVES</u>	
5.1	SELECTION OF VALVE TYPE	42
5.2	DESIGN CONSIDERATION	45
5.3	ACTUATORS	48
5.4	ACTUATED VALVE ACCESSORIES	49
5.5	SELF ACTING CONTROL VALVES	50
5.6	PAINTING AND PROTECTIVE COATINGS	50
5.7	VALVE ASSEMBLIES – NAME PLATE	51
6.0	<u>ERECTION HARDWARE</u>	
6.1	PROCESS IMPULSE LINES	51
6.2	PNEUMATIC TUBING	52
6.3	SIGNAL CABLES	52
6.4	CABLE TRAYS	53
6.5	JUNCTION BOXES & CABLE GLANDS	54
6.6	AIR HEADERS	54
6.7	TAPPING POINT DETAILS	54

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

<u>S.NO.</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
7.0	<u>SPARES PHILOSOPHY</u>	
7.1	MANDATORY SPARES	56
7.2	CONSUMABLE SPARES	57
7.3	COMMISSIONING SPARES	57
7.4	NORMAL OPERATION SPARES	57
8.0	<u>INSTALLATION</u>	57
9.0	<u>SITE SERVICES</u>	60
10.0	<u>INSPECTION AND EXPEDITING</u>	60
	<u>ANNEXURES</u>	
I	LIST OF CODES & STANDARDS	61
II	CONTROL SYSTEM IMPLEMENTATION PHILOSOPHY	63
III	INSTRUMENT DOCUMENT NUMBER PHILOSOPHY	65
IV	UPSTREAM/DOWNSTREAM STRAIGHT LENGTHS	65
V	DESIGN VELOCITIES FOR IN-LINE FLOW DEVICES	68

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

1.0 GENERAL

This general engineering specification contains the basic requirements for the engineering, supply and installation of the instrumentation. It is supplemented by individual job-related specifications lists and loop diagrams.

The suppliers of package units and of machinery and equipment including instrumentation shall observe this specification with its attachments unless otherwise agreed.

Any deviation from this general specification requires approval from tkIS / NALCO.

The instrumentation engineering and installation shall conform to the state-of-the-art and the rules for good workmanship. The equipment shall be selected and installed so as to ensure easy and safe operation, the primary aim being the safety of the personnel.

Further during order execution stage, in case of any conflict between the statutory requirements, codes and standards to be followed and various specifications, data sheets etc. of the tender documents, same shall be brought to the notice of the Owner/Consultant. In case of clearly defined requirement, the stringent one shall prevail. In case of ambiguity, Owner/Consultant's decision shall be binding on the Contractor. Any deviation / extra price claim on account of such contradictions shall not be accepted.

1.1 PROJECT INFORMATION

This general specification applies to the instrumentation for:

Plant	: Alumina Refinery (Stream – 5)
Client	: National Aluminium Company Ltd, (NALCO)
Capacity	: 1.0 MTPA of smelter grade alumina.
Location/Country	: Damanjodi, Odisha & Port Facilities at Vizag
Feedstock	: Bauxite

1.1.1 Geographical And Climatic Conditions

The instrumentation selected shall be suitable for the local conditions indicated below:

Plant location	: Damanjodi, Odisha & Port Facilities at Vizag
Altitude above mean sea level	: 900 m
Atmospheric pressure	: 890 mbar (max.), 970 mbar (design)
Ambient temperature, outdoor	: (dry bulb)
	Max. : 47 deg. C
	Min. : 3 deg. C
Rainfall	:
	Daily max. : 354 mm in 24 hours
	Design hourly rainfall : 80 mm/ hr

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

Transport and storage temperature
for instrumentation:

Max. : 47 deg. C

Min. : 3 deg. C

Max. relative air humidity : 89%

Tropicalized : Yes

Seismic zone : Zone 2

1.2 Regulations, Codes And Standards

Annexure-I gives the list of codes and standards to be followed for instrumentation.

1.3 Definition of Instrumentation

The following equipments are part of the instrumentation:

Instruments for measuring, monitoring and controlling flow, pressure, temperature, level, position, speed, density, thermo physical parameters and other physical variables, including analyzers and related equipment.

- Process-related interlock, controls including sequential control, shutdown systems and signaling devices for the process state.
- Weighing devices.
- Remote-operated final control elements including actuators.
- Instruments and equipment for rack room / control rooms and analyzer rooms (if reqd.).
- Data logging and processing systems for operating, balancing and monitoring of the plant.
- Recorders, multipoint indicators, single loop controllers, manual loaders etc.
- Local indicators for level, pressure, temperature and flow.
- Thermowells.
- Signal cables – 24V DC and 230 VAC supply to instrumentation.
- Instrument impulse lines generally of ½"OD or ½"NB with isolation valves installed next to the instrument.
- All signal and sampling lines in analyzer rooms.
- Main and branch cable trays.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेपाल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

- Field mounted instrument junction boxes and instrument power distribution boards.
- Safety valves of ½" size for analyzers only.

Not Included In Instrumentation:

- Taps for pipelines, vessels and machines including related first shut-off valves (these shall be accounted for, by piping / machinery group).
- Instrument impulse lines of NB ¾" and bigger. (These are considered in piping scope of work). Heavy duty GI piping to be used for air service with drain points as and where required.
- Feed lines of NB ½" and bigger for instrument air supply and purge water supply lines (These are included in piping scope of work)
- Safety valves, rupture disc & restriction orifices. (These are engineered by process group)
- Manual valves including limit switches, if any. (These are considered in piping scope of work). Limit switches shall be specified by Instrumentation.
- Power consumers (motors, process heating, plant lighting etc.), electrical power supply systems (auxiliary energy) and Plant earthing system. (These are considered in electrical scope of work)
- Laboratory equipment including Lab analyser.
- Thermal insulation of instrument impulse lines and heating systems. (this shall be engineered by piping group).
- Mechanical equipment for weighing systems.

1.4 Concept of Instrumentation

MAIN PLANT

- Control room : Common Central Control room for RED area and WHITE area.
- Satellite rack rooms close to plants or group of plants with engineering stations for PLC & DCS.
- All process parameters can be set or varied within the admissible range from such a control room or satellite rack rooms..

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

- Control system :
- Control and monitoring of process parameters including monitoring, control and interlocking shall be executed in DCS. However any interlock involves tripping of any motor / drive shall be executed in main plant PLC via hardware signal from DCS to PLC. For detail Refer Overall Control System Architecture Drawing.
- DCS and PLC systems of different control stations are separate and standalone type with respective redundant controllers and other related I/O sub systems. Single Vendor will supply both PLC & DCS systems for the complete 5th stream including that required for LSTK packages. However, any specific local dedicated PLCs required for the process of system, supplied by the LSTK vendor then the same has to be interfaced with the main PLC. Responsibility for interface of these PLCs with Main PLC is with LSTK package vendor.
- LSTK package vendor to coordinate with DCS-PLC vendor / tkIS / NALCO, before supply of any local PLCs and incorporate required logic at the Main PLC.
- All digital Input / Output related to electrical drives / interlocking : PLC (Programmable Logic Controllers). For detail Refer Overall Control System Architecture Drawing.
- Sequence control : DCS

UTILITIES

- Control room : Central control room / Utility control room.
- Control system :
 - The main process parameters shall be shown in DCS at central control room.

OFFSITES

- Control room : Central control room
- Control system :
 - Through main plant control system

PACKAGE UNITS

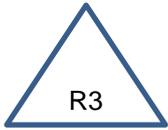
- Refer Overall Control System Architecture Drawing

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 11 of 70

NOTES

- Digital input and output for interlocking and annunciation system shall be used in fail-safe manner i.e., in normal operating conditions contact shall be closed and solenoid valve and relays shall be energized. Provision of isolation for electrical input / output signal to DCS shall be provided. Relays with LED indication to be used. (Green for Digital input and RED for Digital output.)
- Contacts from position feedback switch (limit switches of valves, etc.) will be closed when position is reached.
- In order to avoid undesired position of control valve with interlocks when interlock returns to healthy condition, controller shall go to "Manual" and output of controller shall go to a value corresponding to interlock position of the valve when interlock occurs.
- Local control shall be restricted to minor items only. Local control panels shall be used only for special items such as compressors and blow down valves which require local operation for safety reasons. It is likely that the local panel will require a permission signal from the central control room.
- For utilities and offsite separate control rooms shall be considered for housing panels, including package vendor's items, if required single loop controllers and PLC/relay based logic shall be used as per requirements. Their main process parameters shall be shown in DCS.
- Discrete instruments (like speed, pressure, temperature and flow switches etc) should not be used if they have interlocks for equipment or process safety . Instead of switches, continuous measuring instruments with trip amplifiers for interlocking purpose shall be used for continuous indication of that parameter in PLC/DCS.
- Various parameters of individual compressors (including diagnostic parameters if any) and drier units to be made available at DCS either through serial communication or through hardware.
- Each compressor to be provided with individual air flow measurement system (including compensating parameters) to assess and monitor their performance throughout its life cycle.
- All applicable multi-function calibrators, portable measuring instruments are to be included in the scope of supply of LSTK package.
- Control valves shall be provided with pneumatic actuator. Electric / Hydraulic actuators are used if required for certain applications.
- All belt conveyors shall be supplied with required quantities belt sway, pull chord, zero speed switch. Belt scale with required no. of load cells shall be provided for the conveyors as required. Minimum 4 nos. of loadcells to be used for belt weighers.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
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				Rev	03



- Plugged Chute detection by noncontact type microwave barrier switch shall be provided.
- Magnetic separator and metal detector for conveyors as may be required.
- All silos shall be fitted with radar type level transmitter for level measurement and signaling.
- All sumps tanks shall be fitted with ultrasonic type level transmitter. Use of radar / conductivity switches to be considered where presence of foam is expected.
- Vibration monitoring system shall be considered for HT motors, critical LT motor applications and fans.
- All thickeners shall be fitted with ultrasonic type level transmitter, bed mass / pressure transmitter.
- Weighing system shall be used for weigh hopper, weigh feeders, belt scales, crane weighing as well as road / rail weigh bridges. Suitable provision shall be included for calibrating the weighing system as well as for changing the load cells. Strain gauge type load cell shall be used and load cell capacities shall be considered taking into account the impact loading. Weigh feeder panel to be separate from electrical controls (DCS will receive TPH current input signal directly from weigh feeder electronics and a controlled mA output signal from PID control of DCS will be given to electrical system for control of weigh feeder belt speed. Complicated gravimetric / volumetric PLC controls to be avoided).
- Supply of any additional instruments (if required) is to be in the scope of respective vendor to carry out performance gurantee tests.

2.0 GENERAL REQUIREMENTS FOR INSTRUMENTATION ENGINEERING

2.1 General Design Criteria

If possible, all instrument equipment to be supplied shall be of the manufacturer's standard type. The instrument equipment shall be purchased only from manufacturers with long-standing experience. It is imperative that the items be of proven and state-of-the-art design.

The performance of the instruments/devices shall correspond to the specified criteria under the climatic conditions in 1.1.1 or at least to the local conditions (e.g. control room).

The admissible temperatures for transport and storage shall conform to conditions indicated in Project specific requirements.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 13 of 70

The material components which come into contact with the fluids to be measured shall be resistant to corrosion caused by said fluids. It shall also be compatible with the piping material when being clamped, welded or connected by other methods.

The selected field instrument types shall be rationalized to achieve maximum standardization and minimum spares inventory. Field instrument shall only be selected with a proven record of reliability and expected spare parts availability in excel of ten years. Instruments shall not be selected which are nearing the end of their design or market life, or a type that has been superseded by other proven designs from the same manufacturer.

All field instruments shall be damp-proof and dust-proof, minimum protection class as per IEC 529 shall be as follows:

Electronic transmitters	:	IP 65
Local indicators	:	IP 55
Pneumatic instruments	:	IP 54

All instruments/devices shall be immune to interference due to normal walkie-talkies and mobile phones.

All instruments and equipments shall be suitable for use in a hot, humid, dusty and highly caustic atmosphere in which caustic gases, dust and/or chemicals may be present. As a minimum, all instruments and enclosures in field shall be dust proof and weatherproof to IP-65 as per IEC-529/IS-2147 and secure against the ingress of dust, fumes, dampness, insects and vermin. All external surfaces shall be suitably treated to provide protection against corrosive plant atmosphere.

Instrument cases for all field instruments (like PG, TG and Transmitters etc), shall be of SS. All instrument tubing shall also be of SS316.

Instrument Field Junction Boxes, Local Panel & Power Distribution boards shall be fabricated from SS.

Preferred materials of construction for parts exposed to the atmosphere are polyester or epoxy, fiberglass, plastic, stainless steel.

The use of zinc & zinc alloy, Low copper & copper alloy and aluminium & aluminium alloy is permitted only when coated with suitable and approved paint or coating, as the atmosphere is highly caustic.

Unprotected glass faces of instruments quickly become etched and unreadable when subject to caustic attack. Suitable alternative to glass or some form of protection shall therefore be used.

2.2 Hazardous Area Instrumentation

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

Plant hazardous area shall be classified in accordance with API/NFPA/IS 5572. In such a hazardous area, instrument input/output signals to / from control room / field shall be as follows.

- Transmitters (2 wire) – Intrinsically safe
- Transmitters (4 wire) – Flameproof-explosion proof with signal output intrinsically safe.
- Field switches (Inductive & mechanical) – Intrinsically safe.
- RTD & Thermocouple – Flameproof-explosion proof / intrinsically safe.
- Solenoid valves – Flameproof-explosion proof / intrinsically safe.

Note:-

- Safety barriers with galvanic isolation (active barriers) shall be used instead of passive safety barriers to achieve intrinsically safe signals.
 - Following concepts shall be applied for protection if intrinsically safe or flameproof concept cannot be applied.
 - Increased safety method.
 - Pressurization method.
 - Certification and approval for intrinsic safe/explosion proof equipment shall be by any one of the following agencies as per ATEX / FM / IEC / IS:
 - Physikalisch-technische Bundesanstalt (PTB-Germany)
 - British Approval Services for Electrical Equipment in Flammable Atmosphere (BASEEFA).
- OR**
- Any other authority licensed in the European Community
 - Central Mining Research Institute (CMRI).
 - Factory Mutual (FM) / Underwriter’s Laboratories (UL)

Additionally, approval from Chief Controller of Explosives (CCOE), Petroleum and Explosives Safety Organization (PESO) shall be obtained for all electrical equipment to be installed in hazardous areas for installations in India.

Installations in Europe shall have ‘CE’ marking on the equipment meant for installation in hazardous areas.

Installation in other countries shall be as per requirements in respective country.

All electrical analog signals to / from DCS will be provided with Galvanic isolations. Separate transducer panel with signal isolation shall be located in electrical switch gear room.

2.3 Alarm Philosophy

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेपाल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

- kg/m³ for density
- cP for viscosity
- m/s for velocity
- dB for sound pressure
- m³/kg for specific volume
- Nm for torque
- h-s for time

2.5 Measuring Ranges And Scales

Ranges for instruments shall be selected in general, such that in normal process operation the indication is between 40% to 60% of span for linear and 60% to 80% of span for square root inputs.

Ranges for process switches shall be selected, in general, such that the set point falls preferably in the middle 30% of full adjustable range i.e. the set point shall fall between 35 % and 65 % of adjustable range.

In general calibration ranges for pressure, level and temperature transmitters shall be as per the table given below:

Design Level	Calibration Ranges
0 to 0.75	0 to 0.8
0.76 to 0.9	0 to 1
0.91 to 1.3	0 to 1.5
1.31 to 1.75	0 to 2
1.76 to 2.3	0 to 2.5
2.31 to 3.6	0 to 4
3.61 to 4.5	0 to 5
4.51 to 7.5	0 to 8
7.51 to 9	0 to 10
9.1 to 13	0 to 15

Flow:

Scales shall be graduated in engineering units; number of decimal places according to the selected span but restricted to two maximum.

The scale graduation for rotameters shall correspond to the manufacturer's standard.

Level:

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेपाल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

0-100% of the respective measuring range, mm for precision tank level measurements. No decimal places necessary.

Pressure:

Measuring ranges according to DIN EN-837-1 recommended. (Number of decimal places according to the selected span, but restricted to two maximum).

Temperature gauge:

Measuring ranges preferably according to manufacturer's standard scales in °C. No of decimal places restricted to one maximum.

Analysis

Ranges as per process requirement.

2.6 Instrument Reference Accuracies

Following accuracy or better shall be adhered to by the contractor in selection of various instruments / sensors. Any deviation from the above shall be only after explicit concurrence from NALCO / tkIS.

- | | |
|--|--|
| a) Gas Monitors all types: | 5% FS |
| b) Conductivity, pH meters: | 0.5 % value |
| c) Belt weighers: | 0.5% range |
| d) Pr., DP XRS ref accuracy: | 0.1 % of span (for 10:1 turndown) |
| e) Pr., DP XRS rangeability: | 100:1 |
| f) Pr. Gauges: | 1 % of span for bourdon type,
1.5% of span for diaphragm type |
| g) Tank Gauging (Custody transfer): | ± 1 mm with ± 1 mm resolution |
| h) Other Tank Gauging: | ± 5 mm |
| i) Displacer transmitter: | ± 10 mm |
| j) Temp Gauge bimetallic: | ± 1 % |
| k) TT for T/C , RTD: | ± 0.12 ° C |
| l) Orifice plate: normal application: | ± 2 % of flow rate |
| m) Orifice plate special application: | ± 1.5 % of flow rate |
| n) Annubar, lines < 10 “: | ± 1 % of flow rate |
| o) Rotameters: | ± 2 % of flow rate |
| p) Vortex meter: | ± 0.7 % of flow rate |
| q) Magnetic flowmeter: | ± 0.5 % of flow rate |
| r) PD meter: | ± 0.25 % of flow rate |
| s) Ultrasonic flowmeter: | ± 0.5 % of rate |
| t) Mass flowmeter: | ± 0.25 % of rate |
| u) All utility flows for guarantee runs: | ± 1% or better |

2.7 Signal Transmission

The standard signals for transmitting measuring and control signals shall be as follows.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

- 4-20 mA - Transmitters shall be of the two-wire type HART compatible with auxiliary power supply via the signal line. Wherever 2-wire transmitters are not available (e.g., magnetic flowmeters), 4-wire transmitters shall be used.
- The field instruments such as pressure, temperature, level gauges shall be used for local monitoring. All the transmitters shall have provision for remote calibration facility.
- Binary signals - Proximity switches as per NAMUR design or potential free contacts with 24V DC interrogating voltage.

The standard range for pneumatic control equipment shall be 0.2 - 1.0 Kg/cm²g. Every package vendor using HART instruments should also supply latest HART communicator.

2.8 Auxiliary Energy

2.8.1 Electric Power

Primary source of power shall be 230 V AC \pm 1%, 50 Hz. \pm 0.5%, DCS, PLC, solenoid valves and analyzers shall necessarily operate on above voltage level. Uninterrupted power source will be considered, wherever required, based on safety, process requirement or requirements of hardware. Such UPS system shall have sufficient capacity of battery ampere hours with charger to achieve the goal of bringing the plant to a safe shut down.

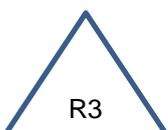
Hardwired alarm system, if provided, and for field instruments, interrogation voltage level from PLC and DCS shall be limited to only 24 V DC. Any coupling relays for alarm/interlock purposes shall also work on 24 V DC.

Normal AC power of 230 V, 50 Hz is generally recommended for the purpose of illumination in various panels. Electric actuators of valves/dampers will be preferred to operate on 3 ph, 415 V, 50 Hz, power source. Voltage / frequency variation shall be as per General Engineering Specification – Electrical.

Instrumentation loops shall be grounded if necessary at one terminal only. The negative pole shall be grounded in the case of DC power.

All control panels, electronic cabinets and control consoles shall be connected to safety grounding system. This grounding system shall be same as the electrical ring earthing system. A separate grounding system shall be considered for earthing of safety barriers and shields of cables. This shall be independent of the electrical ring earthing system.

2.8.2 Pneumatic Power Supply



Instrument dry air at a pressure of 690 kPa(g), design temperature of 70 °C and dew point of (-) 40 °C at atmospheric pressure shall be the source of power for all pneumatic instruments, wherever envisaged. Selection and design basis of such pneumatic instruments shall be such that even if system air pressure falls down to minimum level of 4.0 bar (g) instruments, proper operation of instruments shall be ensured.

2.8.3 Purge Water Supply

Purge water supply for differential pressure cell impulse lines shall be clean non-scaling water distributed at a pressure in the order of 1300 kPag and temperature of

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

80°C.

The purge water lines shall form part of the differential pressure cell hookup installation. These lines shall supply the impulse lines through a rotameter, regulator and check valve.

2.9 End Connections

End connections shall meet the following, unless, otherwise specified;

- a) Threaded end connection shall be NPT as per ANSI/ASME B1.20.1.
- b) Flanged end connection shall be as per ASME B16.5.
- c) Flange face finish shall be per paragraphs 6.4.4.1, 6.4.4.2 and 6.4.4.3 of ASME B 16.5.
- d) Grooves of ring type joint flanges shall be octagonal as per ANSI/ASME B 16.20

2.10 Earthing & Lightning Protection

The earthing of control and instrumentation systems shall be separate from any other electrical earthing systems. Cable screening shall be earthed at the DCS (or source) end only. At the transmitter end, the screen cable shall be insulated and not grounded.

2.11 Profibus DP V1 (If applicable)

This communications protocol is used for communications between the DCS and 'intelligent' MCC related devices subject to the following:

- Segments that include devices for control, no more than sixteen (16) devices per segment allowed.
- Segment that include monitor only devices, no more than thirty-two (32) devices per segment allowed.
- No more than two (2) variable speed devices per segment allowed.
- Separate segments required for separate MCC buses.
- Normal segmentation and partitioning rules should be applied, for example, redundant equipment shall be located on separate I/O modules.
- Any device that connects onto a Profibus DP segment must be certified for use by 'Profibus International'.

2.12 Nameplates

Nameplates for measurement elements and transmitters shall have the following minimum requirements:

- Manufactured from stainless steel
- Must clearly identify the following minimum information;

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 20 of 70

1. Manufacturer's name, model and serial number
2. Any electrical rating and volt / ampere requirement
3. Body pressure rating and material
4. Specified instrument tag number
5. Specified calibrated range (DP range, flow range, pipe size data to be engraved on the plate along with other common details for orifice plate)
6. Hazardous Area Classification / Approval (if required)
 - Must utilize lettering and characters that are no less than 3 millimeters in height.
 - Must be attached to all elements and transmitters
 - Should be mechanically affixed to the device. If it is not practical to mechanically affix the nameplate, then the nameplate must be attached using a stainless steel wire.

3.0 PROCESS CONTROL SYSTEMS

3.1 Digital Distributed Control System (DCS)

3.1.1 General

The process plants shall be controlled by Digital Distributed Control System. The basic system architecture shall be as per attached annexure. Refer 1.4 for the concept.

The Distributed Control System (DCS) shall include equipment panels housing, processing hardware, and operator consoles with visual display units and other peripheral equipment. The processing equipment shall be located in substations or equipment rooms in different areas of the plant. The operator consoles and visual display units shall be located in centralized control rooms. Analogue and digital measurements and control signals shall be connected from different plant areas to the DCS. The signals may be connected directly into the DCS input/output, or indirectly through local Programmable Logic Controllers (PLC's) which in turn communicate with the DCS via Data Highway links. Any interlock from DCS shall be hard wired and not through soft communication.

PLC shall be used for all digital input / output signals related to Electrical motor / drives / Motor Operated Valves / Emergency stop / shutdown / interlock with respect to drives only.

All data from package PLC to be made available in DCS.

Digital input signals shall be in the form of potential free contacts or proximity switches.

Sequence control operation of batch processes will be controlled by DCS.

The DCS shall be capable of providing the following general facilities and functions:

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 21 of 70

- Motor Start and Stop functions
- Modulating and sequential control
- Complete electrical isolation between processor and Input / Output signals
- Data collection
- Historical and real time trending
- Diagnostic and process information
- System report generation.
- Advance Alarm Management system
- Plantwide communication network
- User-friendly operator interface
- Gateways or other interface devices which enable communication with other proprietary, intelligent equipment.
- Efficient plant operation by way of complex programming capability.
- Advanced control facilities
- Automatic Anti-virus updation system
- Network Management system
- Large video screen to view complete operation in a single page
- Standard office applications including regression analysis package
- Application for HART signal processing

Communication Network: All DCS equipment shall be interconnected by communication cables, commonly known as data highways. The data highway shall allow high speed, efficient, information transfer within the DCS.

These data highways shall preferably be fibre optic cables, but in areas of the plant susceptible to damage, coaxial cable may be specified for ease of repair

3.1.2 Scan Time

Scanning interval for system internal processing of signal shall be as follows (maximum):

- Binary signals : 250 ms.
- Analog signal for close loops
Flow & Pressure : 500 ms. / 250 ms. and better for critical application
Level & Temperature : 500 ms.
- Analog signal for open loops -
Pressure, flow, level analyzers : 250 ms.
- Level, Analyser & Temperature : 2 sec / 500 ms. and better for critical application
- Vibration : 100 – 500 ms.

3.1.3 Redundancy

Redundancy levels shall be specified as per following guidelines:

- CPU, Hard disc, memory module, power supply, communication cards,
Communication bus – 1:1

The Communication Network shall consist of a fully redundant system including communication controllers, gateways, and data highways. Any failure of a subsystem component shall not cause a general failure of the DCS.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेपाल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 22 of 70

The Communication Network shall have diagnostic alarms to alert the console operator to any component failure in the system. System alarms and process alarms to be in separate consoles.

Changeover from a failed communication path to a backup path shall have a bumpless transfer characteristic. The changeover shall be indicated on the operator's console.

Multiple operator stations (each with its own dedicated electronics) shall be capable of providing access to the same data base for alarm, control and display purpose. Multi windows system shall be considered.

- I/O cards for closed loops (HART compatible and Galvanically isolated) - 1:1
- I/O cards for open loops & digital I/O (HART compatible and Galvanically isolated) – No redundancy

3.1.4 Safety Instrumented System

Non-critical safety functions can be realized in DCS / PLC. Safety critical functions shall be realized in relay based system or TUV approved ESD based on size of plant or number of safety functions.

Necessary information shall be sent to DCS through communication bus.

Sensor inputs shall be preferably transmitters instead of switches and shall be independent of sensors of DCS for closed loops.

First out sequence alarm logic shall be implemented for each logic group.

3.2 Communication between DCS, PLC & MCC

For details refer Overall Control System Architecture Drawing. (6695-INS-G00-FA-0001)

3.3 Auxiliary Console

In addition to DCS operator station (consoles), one or two auxiliary consoles shall be provided to mount following:

- All push buttons, switches and lamps related with emergency trips and reset.
- Hardwired alarm annunciator for important process inputs related with plant safety.
- P.A. system console.

3.4 Programmable Logic Controller

PLC shall be used for all digital input / output signals related to Electrical drives / Motors / Motor operated valves / Emergency Stop / shut down / interlock with respect to drives only. Separate local PLC's for specific applications from LSTK package unit supplier are not preferred, such signals / functions of these PLC shall be integrated with the main plant PLC / DCS based on the signal connection philosophy indicated else where. If use of package supplied PLC is inevitable, then the same need to be hooked up to main PLC / DCS through communication port.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

- PLC shall be microprocessor based system, modular in construction and expandable in future by adding additional modules. The system shall be designed to be fault tolerant through design and by the use of redundant hardware.
- On-line replacement of any module shall be possible in a way that removal and addition of any module shall be possible without de-energizing the system. Further there shall not be any interruption in the system while replacing a faulty module except for the inputs/outputs which are being handled by the module.
- Operation of PLC shall be completely unaffected by a momentary power loss of the order of 20 milli seconds.
- All the controllers/cards located in field or located in rooms having air conditioner without chemical filter shall conform to conformal coating (preferably G3) on controller, I/O cards.
- System hardware & marshalling cabinets shall have cooling fans, lighting facility and two nos (min.) of utility sockets inside it.
- Licensed programming software along with all required hardware accessories, etc. shall be provided for future updation.
- The PLC system shall be capable of withstanding noise errors due to electromagnetic interference (EMI) or radio frequency interference (RFI) including nearby radio stations, hand-held 2-way walkie-talkie sets, mobile phones, electrical storms, solenoids, relays or contractors carrying heavy currents. RFI/EMI noise immunity shall be as per SAMA standard PMC 33.1. The surge withstands capability for input/output modules shall be as per IEEE 472.
- Sequencer logic to be incorporated in PLC for Dedusting system with necessary interlocks.

Processor Sub System:-

The processor shall have capability to implement all the control functions required to execute the logic schemes.

The size of the memory shall be sufficient for the storage of the programmed instructions required by the logic schemes with 40 % extra space for future expansion. Memory shall be non volatile. In case volatile memory is provided, battery backup shall be provided for a minimum of three months to keep the storage intact. A battery drain indication shall be provided at least one week before the battery gets drained.

- Input / Output subsystem

Each I/O shall be galvanically isolated from external control circuit by suitable means. Each I/O shall be protected against the reversal of polarity of the power supply voltage to I/O. Each module shall have a LED for each I/O per channel to indicate the status of each Input/Output.

Each output shall be short circuit proof and protected by using fuse. Visual indication of fuse blown must be provided for each output.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 24 of 70

20 % spare I/O shall be provided for future expansion.

Analog:-

Max. No. of I/P per Module : - 8 (Close Loop)/ 16 (Open Loop)

Max. No. of O/P per Module : - 8

Digital:-

Max no. of I/P per Module : - 32

Max no. of OI/P per Module : - 32

System shall have RS232/RS485, USB each two ports for communication interface.

Redundancy

1:1 redundancy shall be provided for CPU, memory modules, power supply, communication card and communication bus and operator station.

PLC Console (Operator Interface)

Industrial grade, reputed make, Colored, Operator Interface shall be used for View, Control and programming. Vendor shall recommend the number of operator interfaces based on his package system.

The monitor size shall be 22" minimum. Keyboard shall be provided with lock and key to prevent any unintentional programs modification.

A printer (LaserJet) shall be provided along with the system.

Local Panel:-

It shall be fabricated from SS sheets. It shall be designed to meet IP 55 requirements. Panel supplied shall be in pre-wired / pre-tubed condition & completely tested prior to Despatch. Cutouts for mounting of instruments, lamps, push buttons etc. shall be made by machine saw/hack saw/drilling.

4.0 ENGINEERING AND SELECTION OF FIELD INSTRUMENTS (MEASURING/SWITCHING DEVICES)

General

Field mounted direct actuated Flow and Temperature switches shall not be used. Instead, receiver switch/trip amplifier shall be used along with flow transmitter / temperature transmitter.

4.1 Pressure Measurement

4.1.1 Local Pressure Gauges

Local pressure gauges may be used where a temporary local pressure indication is required, for example, on a pump discharge during commissioning. Where a more permanent pressure indication is required, pressure transmitters with local indicators are preferred over local pressure gauges. Transmitters shall be remote mounted.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 25 of 70

Measuring range selected shall be such that normal indication is between 60% and 80% of range. However, maximum operating value shall not be more than 90% of range.

All local pressure gauges shall be diaphragm type (except for clean air application where bourdon tube type can be used) of material SS 316. Dial size for local gauges will be 100 mm. Material of movement shall be SS 304. Superior materials will be considered only if process condition demands. Pulsation dampener (floating pin type) or glycerin filled case shall be used wherever pulsating pressure occurs in process. The gauges should be weather proof to IP55 as per IS-2147.

All pressure gauges (above 100 Kg/cm²g) shall be solid front type.

For temperature greater than 70^oC, necessary precautions will be considered like use of Condensate pots in steam service.

Diaphragm seals type will be considered for viscous slurry services including fluids tending to crystallize.

All pressure gauges shall be equipped with safety vent consisting of rubber grommet at the back of housing. Diaphragm seal type pressure gauges with flushing ring shall be used where plugging of the element may occur.

Range of pressure gauges shall be as per DIN EN-837-1.

Draft gauges or manometers may be used for very low pressure measurements.

4.1.2 Pressure / Differential Pressure Transmitters

Material selection and selection of diaphragm/remote seal transmitters shall be on the same guidelines mentioned under local gauges. In capillary type transmitters, capillary length shall normally be 3 meters. Also capillary shall be armoured and material of both capillary and armour shall be SS 316.

Rangeability shall be generally 100:1.

Pressure and differential pressure transmitters used in slurry, scaling or corrosive applications shall have purged sensing lines or be equipped with diaphragm seals with capillary. Differential pressure transmitters without seals shall be used in conjunction with a close coupled manifold. Transmitters shall have provision for mounting on a DN50 pipe stand.

Transmitters shall be selected with integral output meter to read process value directly in engineering units. In case of differential pressure type transmitters capillary tubes to be avoided, rather inter connecting cable to be used..

3-valve / 2-valve manifold shall be provided with all differential pressure (DP transmitters for flow measurement system) and pressure transmitter for isolation and zero checking purpose.

Refer to section for details of auto-rodding device to be used with these transmitters.

Remote seals should be from the transmitter manufacturer make only, all remote seals shall be provided with a spacer ring / flushing ring with ½" NPT flushing connections. This spacer ring shall also function as an adaptor fitting and have the process connection of remote seal as mentioned above on one side, while the other side will have the process connection as dictated by the process.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

DP transmitters to be provided for air slides and de-dusting systems and provision of indication at DCS.

4.1.3 Pressure Switches

The use of pressure switches is discouraged. Pressure transmitters with alarm set point in the DCS are preferred. Pressure switch may be used for pump seal application. Pressure switches or transmitters are to be mounted away from main equipment.

Set value of Pressure switches to be between 30% and 80% of range.

Pressure switches shall be blind type with 1/2 NPTF process connection and shall be operative in full specified range. The switch differential shall be selected as per operating conditions.

Snap acting micro-switches shall be normally used.

Miniature type electronic type pressure switches are to be used rather than using spring loaded pressure switches.

Material and sensor selection shall be on the same guidelines mentioned under local pressure gauges.

4.2 Level Measurement

The following instruments are recommended for level detection:

Service	Selection		Comments
	Preferred	Alternative	
Atmospheric tank - slurry or liquor	Radar,Ultra sonic	DP	DP to have purge water and auto-rodders
Digesters, flash tanks, other pressure vessels	DP, Nucleonic		DP to have purge water and auto-rodders
Atmospheric tanks - acids or other non-scaling fluid	Radar, Ultrasonic	DP	
Bins & chutes	Nucleonic		

4.2.1 Local Level Indicators

Local level indication with all metallic construction with magnetic coupling and follower magnets shall be generally preferred for local level indication. When level indicators with all metallic construction and metallic coupling are not considered to be suitable, transparent or reflex type gauge glass may be used.

Where a level transmitter is required in conjunction with a magnetically coupled local level gauge, a magnetostrictive level transmitter should be used.

Reflex type will be used for clean and colourless liquids, except for level interface. For low temperature, low boiling point service, large chamber type will be used. 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. Tubular gauge glasses shall, in general, not be used. Transparent type of gauges shall be provided with integral illuminators

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 27 of 70

operating at 230 V 50 Hz non-UPS supply and suitable for electrical area classification specified.

Large chamber gauges with frost shields shall be provided for cold services below 0°C. Heating jacket shall be provided for viscous liquids.

Gauge glasses shall be provided where process requirements ask for accurate local level indication independent of density fluctuations. They may be provided in addition to level transmitters which do not cover the full range of level change in a vessel.

Maximum length of each gauge instrument shall be limited to about 1500 mm. If greater distance is to be covered, several instruments shall be considered with minimum overlapping (on visible part) of about 50 mm. Visible length shall be nearly equal to centre to centre distance of level gauge. Following centre to centre distance shall be used as a standard:

350 mm, 500 mm, 750 mm, 1000 mm, 1500 mm.

Level gauge instruments shall generally be flanged to the equipment. Flanges and body rating shall be selected as per rating of the vessel. Necessary vents and drains shall be provided.

Gauge glasses mounted externally have to be provided with:

- Excess flow check valves.
- Mica sheet to be provided for high temperature services. Gauge glasses mounted on IBR approved equipment shall have IBR certification.

4.2.2 Level Transmitters

Level transmitters shall be generally electronic type with local digital indication. Displacer Type shall be used only **when other types of Level measurement are not suitable**. Displacer may be used for interface level measurement. Displacer material shall be minimum SS316; torque tube material shall be of inconel. Superior materials shall be selected if process demands the same. Internal displacer shall be considered with stilling well normally for buried/underground vessel level measurements. Otherwise, all displacers shall be external chamber type. Chamber material shall be according to fluids or vessel specification.

Normally, standard displacer length as listed below shall only be selected:
356 mm, 512 mm, 813 mm, 1219 mm, 1524 mm, 1829 mm, 2134 mm, 2438 mm, 3048 mm.

Centre to centre distance of connecting float chamber shall be same as displacer length or guided wave rod length. Vents/drains shall be considered wherever required. Cooling fins/isolators shall be considered, wherever required, based on manufacturer's recommendation.

Differential Pressure (DP) Level Transmitters

For large measuring span, DP transmitters may be used. When remote seal transmitters are selected, capillary will be generally armoured and material for both capillary and armour shall be SS 316. Flushing ring should also be provided

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

at both legs of the transmitter. Flanged transmitters flush or extended diaphragm shall be considered in case of slurry services or fluids tending to crystallize.

Purge type level measurement may be used for applications where normal differential pressure transmitter cannot be used, but air purging is permitted. The DP cells shall be water purged and installed with auto-rodding devices on scaling fluids. With non-scaling fluids, DP cells shall be installed with remote diaphragm seals. Capillary type differential pressure type transmitters to be avoided, rather interconnecting cable type DP transmitter are to be used.

Density compensation of head based level measurements is required when the maximum density effect can cause a measurement error that is equal to or greater than 5% of the normal reading.

Purge Meter Assemblies (For Pressure & Differential Pressure Instruments)

Pressure and differential pressure transmitters used in slurry or mud service that is likely to plug the impulse line and cause erroneous readings from the transmitter shall be fitted with purge flow meter assemblies.

The purge medium shall be water.

The purge flow meter assemblies shall be installed adjacent to the transmitter to ensure purging of the maximum length of the impulse line.

Each purge flow meter assemblies shall consist of an armoured rotameter, differential pressure regulator, non-return valve, isolation and bypass valves, tubing and fittings.

An upstream pressure regulator shall be specified if purge water pressure fluctuations exceed the specification of the differential pressure regulator.

Differential pressure transmitters shall be fitted with a purge flow meter assembly on each impulse line.

The purge flowmeter assembly shall be supplied in a stainless steel hinged enclosure.

Auto-rodding device (For Pressure & Differential Pressure Instruments)

Pressure and differential pressure transmitters in critical services should also be fitted with an auto rodding device in addition to the purge meter assembly.

Auto rodding devices shall consist of a pneumatically operated cylinder with extending rod to penetrate the full length of the transmitter nozzle on the vessel.

The auto rodding device shall be solenoid operated from a local control panel and the DCS. The frequency of operation shall be programmed in the DCS to suit the service conditions.

Limit switches mounted on the air cylinder shall signal the position of the auto rodding device to the DCS.

Operation of the auto rodding device shall not restrict the purge water flow or affect the transmitter output reading.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 29 of 70

Non Contact type level Instruments

Radar type transmitters shall be selected for condensation, evaporation services. Radar level instrument can also be used as necessitated by application requirements. For all tank gauging system Radar type level transmitter with +/- 3mm accuracy shall be used.

Non-contact type like ultrasonic or radioactive method shall be considered where no other suitable measurement mentioned above is possible or feasible Ultrasonic Level measurement with remote transmitter shall be used for sumps and other applications where normal differential pressure transmitter cannot be used.

However ultrasonic level transmitters for sump tank applications to be avoided where presence of foam is expected. Conductivity type level switches may be used in such applications.

When flush bottom type level measuring system is used, suitable drain and flushing arrangements to be provided.

Capacitance Type

Capacitance type level measurements can also be selected as an alternative method wherever required for highly viscous fluids or bulk materials.

4.2.3 Level Switches

Generally use of level switches is discouraged. Level transmitters with the alarm set point in the DCS are preferred.

External float type level switches may be selected where choking of the liquid cannot occur. Standard nozzle to nozzle distance shall be 350 mm.

Capacitive level sensors may be considered for pits or corrosive services where float type cannot be used. These instruments shall be mounted directly on the vessel.

Tanks containing liquids which may pollute the environment in case of overflow shall be provided with separate level switch against overfilling. It has to be checked with the authorities where a special certified measuring system or instrument has to be used. On polluting services turn dish (funnel) & pipe drain shall be provided.

Radio active/ultrasonic/vibration/capacitance type level switches shall be used for solids, powder, pellets etc.

4.2.4 3D - level system to be considered for bauxite and alumina silos along with normal level indication system. Non-contact type level transmitter to be provided (4 nos- each alumina silo) with air purging provision. For alumina silos, radar type level transmitter with high range upto 70 meter may be considered. Vendor to furnish PTR for such applications. The model shall be VEGAPULS 69 or equivalent due to narrow focussing optimised for high and narrow silo. Similar is the case with critical applications like seed tanks and digestion tanks where there is presence of high temperature and fumes.

4.2.3 Hydrate bin level measurement should be with four load-cell system.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

4.3 Temperature Measurement

General requirements are as follows:

- For temperatures within the range 0 to 300°C RTD sensors (mineral insulated) should be used.
- For temperature ranges above 300 °C, thermocouples (with 2 or 4 hole impervious ceramic beads only, No mineral insulated t/c to be used) beyond 300 Deg C .
- RTDs may be used for temperature up to 300 Deg C, J-type thermocouple up to 500 Deg C, K-type up to 900 Deg C and R-type up to 1300 Deg C.
- Head mounted transmitters not to be used, Remote mounted transmitters with local display to be used.
- Precipitation tank RTD thermowell to be mounted on top of precipitation tank with SS thermowell and use of 100 mm RTD with 10 meters Teflon coated extension cable to be used.

4.3.1 Thermowells

Thermowell shall be used for all temperature measurement except tube surface (skin) temperature measurement and motor winding temperature. Thermowell shall be fabricated out of barstock upto a length of 500 mm. Beyond 500 mm, fabricated construction may be used. Basically tkIS norms shall be followed for deciding thermowell length. Please refer to tkIS sketch no:- 6695-INS-G00-EB-0020/0021/0022 for thermowell dimension details.

For thermowell installation in pipelines minimum pipe diameter shall be 3". Smaller pipelines have to be expanded to 3" with eccentric expander (to avoid any pocket in the line) for thermowell installation.

- Unless otherwise specified, all thermowells shall have a DN50 ANSI raised-face flanged process connection, rated to the same flange rating as the adjoining process piping,
- Thermowells in steam or gas service where the process fluid velocity exceeds 10m per second shall be subjected to a wake frequency calculation. Standard thermowells which fail the wake frequency calculation may be designed shorter and/or have the outer diameter increased.
- Standard thermowells that fail the wake frequency calculation when designed shorter and with increased diameter may be fabricated with a collar. This is the least preferred method as close tolerance is required between the collar and the pipeline nozzle. Material lists on pipeline isometric drawings must be strictly adhered to.
- In high-pressure steam lines, the thermowells may be welded in the pipeline. The standard shorter weld-in type thermowell will generally pass the wake frequency calculation.
- Sensors used in conjunction with thermowells shall be spring loaded to ensure good surface contact with the thermowell.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

- Thermowell material in the process area of the plant will be dictated by the application specific requirements and their suitability for the task.
 - For general service on air and water Thermowell material shall be SS 316.
 - 316 stainless steel should not be considered a suitable thermowell construction material for use on temperatures greater than 870°C or in most areas of the process plant.
 - Stainless steel to ASTM A789 should be considered for thermowells in the process plant & liquor service.
 - Hastelloy C should be considered for thermowells in severe service in the process plant.
 - Inconel 600 shall be used for temperatures in excess of 800°C to 1200°C.
 - Ceramic covered thermowells are acceptable for extreme high temperature.
 - Thermowell construction material for destructive service applications shall be a combination of Sandvick SAF 2205 duplex stainless steel for the thermowell bodies and carbon steel for the thermowell flanges. As an alternative to Sandvick SAF 2205, Hastelloy-C can be used for the thermowell bodies.
 - All R-type thermocouples (**Wire size 18 AWG**) will be provided with “Ceramic Protection Sheath” along with Inconel-600 barstock Thermowell. The thermowells for Calcination plant (high temperature or high abrasion zones) should be fabricated from a Inconel-600 bar stock of required length with dimensions OD : 45 to 48 mm, ID 15 to 20 mm. The flange connection size shall be 4” flange.

4.3.2 Local Gauges

Local gauges shall be ‘all angle’ bimetallic or expansion thermometer with liquid/gas. Dial size of 100 mm shall be considered for local gauges. Capillary shall be armoured type with minimum length of 5 meters where required. Selected range shall be such that normal indication is within 60-80% of FS.

4.3.3 RTD

For remote temperature indication/control at less than 300°C, RTD element (PT-100, 3 wire system) shall be used.

Normally mineral insulated type of RTD with SS 316 sheath material shall be used. RTD construction shall be designed to protect against vibrations. RTD calibration shall be as per IEC 751.

RTD/s shall be contained in a stainless steel sheath with mineral oxide insulation. The preferred sheath diameter is 6.4 mm. The sensitive length should not extend more than 25 mm from the tip of the element and the element should have an integral terminal block.

RTDs should be supplied as an assembly comprising the following items:

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

- A terminal block large enough to accept 2 mm² (14 AWH, 16 SWG) cable (if a remote transmitter is to be used).
- A spring-loaded nipple union nipple connection.
- A element head complete with fixed terminals for outgoing cable termination.

RTD head shall have an M20 electrical connection.

RTD elements are to be isolated and not grounded to the sheath.

4.3.4 Temperature Transmitters

Remote mounted Temperature transmitters shall be used for all temperature elements (RTD/Thermocouple) where the environmental temperature is likely to exceed the rating of the temperature transmitter.

For motor bearing and winding temperatures, individual temperature transmitter to be provided for each measurement instead of a common temperature scanner.

Temperature transmitters with integral indicator shall be field mounting type not head mounted. Burn out protection shall be provided with transmitter. Element heads shall include a screw on cover complete with chain and weatherproof gasket.

Transmitter shall accept different types of RTD, thermocouple, ohm, and milli-volt inputs.

4.3.5 Thermocouple

For temperature measurements above 300⁰ C thermocouple shall be used. Thermocouples shall be J-type up to 500 Deg C, K-type up to 900 Deg C and R-type up to 1300 Deg C with stainless steel sheathed type construction. The preferred sheath diameter is 6.4mm. In applications below 800°C, the preferred sheath material is 316 stainless steel. In applications above 800°C, the preferred sheath material is either Inconel or Hastelloy. Mineral insulated thermocouple not to be used, rather thermocouple with 2 or 4 hole impervious only ceramic beads to be used.

Thermocouple shall be duplex type with two cable entry of M20.

Thermocouples should be supplied as an assembly comprising the following items:

- A terminal block large enough to accept 2 mm² (14 AWG, 16 SWG) compensating cable (if a remote transmitter is to be used).
- A spring-loaded nipple-union-nipple connection
- An element head complete with fixed terminals for outgoing cable termination.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

Hot junction shall be welded and insulated ungrounded. Grounded junction thermocouples should be used only in applications where high speed and an accurate response are required. Installation of these devices should be accompanied by the use of a temperature transmitter that provides galvanic isolation.

4.3.6 Compensating Cables etc.

Generally, thermocouple extension wire shall be used for interconnection. Wire size AWG 16 shall be used for extension wire. Colour coding and EMF error limitations of extension wires shall be generally as per IEC recommendations.

4.3.7 Temperature switches

Field mounted direct actuated Temperature switches shall not be used. Instead, receiver switch/trip amplifier shall be used along with temperature transmitter or alarm set point in the DCS.

Temperature switched or transmitters are to be away from main equipment.

Miniature type electronic type temp switches are to be used rather than using bi-metallic thermal switches.

4.4 Flow Measurement

In general, all flow meters shall be installed in pipelines running full and two phase shall be avoided.

The table below recommends selection of flow measurements devices. The first choice shall be selected unless there are specific reasons for using alternatives.

Fluid Service	Selection		Comments
	Preferred	Alternative	
Bauxite slurry, digester slurry, sand tails slurry	Magnetic		All magnetic flowmeters should be with PFA liner irrespective of application with SS flow tube and body.
High Temperature Slurries High Pressure Steam	Venturi Tube		
Spent liquor, pregnant liquor, weak liquor, supernatant liquor, hosing water, caustic cleaning liquor	Magnetic	Orifice Plate (D. P. Range / Flow range to engrave on the name plate along with other details)	
Lime slurry, hydrate slurry, mud slurry, red mud tailings	Magnetic		

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

Sulphuric acid, hydrochloric acid	Magnetic	Vortex	D. P. Range / Flow range to engrave on the name plate along with other details
Compressed and instrument air	Orifice Plate	Averaging Pitot Tube Vortex	
Cooling water, instrument purge water, pump gland water	Orifice Plate	Magnetic	
Steam	Orifice Plate	Averaging Pitot Tube Vortex	
Fuel Gas	Coriolis	Orifice Plate Vortex	
Fuel Oil	Coriolis	Turbine Vortex	Turbine meter (c/w pressure & temperature compensation) to be used for custody transfer
High Temperature Slurry	Magnetic	Venturi Tube	

4.4.1 Differential Pressure Flowmeter

Differential pressure primary elements such as orifice plates, venture tubes and averaging pitot tubes shall only be used on clean process fluids such as steam, process air, natural gas and clean water for flow measurement except for following services:

- Services where high accuracy is required.
- Slurry services.
- High velocity service.

The orifice plate should only be used on a clean service where a maximum turndown ratio of 1:4 is acceptable.

Orifice plates shall be with flange taps only for line sizes between 2" and 12". For lower size, integral orifice meters shall be used. For line size of 14" and above, D and D/2 taps shall be used. For less than 2" line sizes, meter run assembly/integral orifice assembly with corner tapping shall be used.

Orifice plate sizing shall be done as per ISO 5167-1:1991. Orifice flanges shall be tapped flanges to ANSI B16.36. The orifice plate shall be sized for a nominal differential pressure of 2500 mm WC at maximum flow and preferred beta ratio (d/D) of 0.55. Sizing shall be done at maximum expected flow rate plus 10% flow rate as margin. d/D ratio shall be between 0.25 and 0.75.

Orifice plate shall be generally square edge type, concentric style with flange taps. Conditioning orifice plates should be considered where short upstream straight lengths are available. For high viscosity services quadrant edge type shall be preferred. Orifice plate material shall be SS 316 unless process condition calls for special material.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 35 of 70

Orifice plate dimensions shall be as per TKIS - INDIA Standard Drawings.

Upstream/Downstream straight length shall generally be as per ISO 5167.

DP transmitter shall generally be used with orifice plate. Every effort shall be made in design, so that the differential pressure does not exceed 2500 mm (100") WC. Only in exceptional cases, a deviation is allowed.

Transmitter shall be furnished with local indication. Transmitter impulse lines shall have a minimum slope of 10%.

Flowmeters to be provided at return condensate lines.

Where the process line size is less than DN50, integral orifice plate assemblies that include the differential pressure transmitter should be considered. The differential pressure transmitter to be used with the orifice plate shall be equipped with a 5-valve manifold.

If a flowmeter is required for both air or steam, then separate individual flowmeters to be provided. For air application, the transmitter to be mounted above the main tapping and for steam below tapping with suitable steam condensers.

For steam flow measuring systems (as far as possible) combined unit having temp, pressure and dP type transmitter may be considered (multivariable transmitter) rather than having individual transmitters for each parameter for necessary flow calculations at DCS side.

Where mass flow measurement is required, compensation for pressure & temperature shall be achieved within the supplied multivariable transmitter.

4.4.2 Rotameters

Rotameter shall be normally selected for line size less than 3". Wherever transmitter is required, same shall be with local indicator.

Rotameter shall be normally metal type for process fluids, material shall be selected according to process requirements and fluids. In such cases magnetic transmission shall be used.

No Glass tube type rotameters are to be used for sizes 1 inch and above rather magnetically coupled metallic rotameters are to be used. Below 1" size PVC type rotameter to be used.

Normal flow rate shall be between 60% and 80% of flow capacity selected.

Rotameter shall have flange connections. Ratings shall be as per piping specifications.

4.4.3 Magnetic Flowmeter

Magnetic flowmeter shall be used for liquids with sufficient electrical conductivity, especially for slurry services, corrosive liquids, liquids with high impurities and liquid prone to crystallization. DC-version with pulse controlled magnetic field

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 36 of 70

shall be preferred to AC version. Installation and sizing shall be generally based on manufacturer's recommendation.

Meter shall only have PFA Liners with SS flow tube and SS housing irrespective of type of application.

Magnetic flow meters shall be flanged.

Magnetic flow meters for slurry service shall be selected as suitable for the heavy service. This requirement will apply to those services that are defined on the relevant P&ID with the following slurry line prefixes:

DS	Digestion Slurry
HDRM	High Density Red Mud Caustic Slurry
HS	Hydration Slurry
RM	Red Mud Slurry
SS	Sand Slurry
MS	Mill Slurry
LS	Lime Slurry

Magnetic flowmeters are preferred for use on water, liquor and dirty or slurry process flow measurements.

Magnetic flowmeters in all services shall include two (2) liner protectors to be installed one at each end of the flow tube. These also serve as earthing rings. Electrode shall be manufactured from Hastelloy C. Liner protectors shall be manufactured from stainless steel.

Transmitters on slurry service with high solids content typically above forty percent shall be the high excitation type to ensure high signal to noise ratio with a quality output signal. Installation and sizing shall be generally based on manufacturer's recommendation. Magnetic flow meters shall not be located on pump suction. They shall not be lagged with thermal insulation.

It is not recommended to locate magnetic flow meters on pump suction. Also it is not recommended to lag magnetic flowmeters with thermal insulation. Locations of flow meter to be decided with due consent from NALCO.

Where possible, install magnetic flow meters in the vertical position with the flow in the upward direction. If this is not possible, install the magnetic flow meter in a horizontal position ensuring that the electrodes are in the horizontal plane. Ensure that the meters have a full pipe at all times, typically by installing them near the low point in the system.

Earthing electrodes shall not be acceptable in place of earthing ring, unless specified.

Electrode cleaning equipment integral with each flow meter shall be supplied as required.

4.4.4 Vortex Meter

Vortex flow meters are preferred for use on clean non-conductive and non-corrosive liquids or gases where vibration is low and built up minimal.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

Vortex meters with remote mounted head shall be preferred for non conductive, non corrosive liquid or gases where vibration is low & build is minimal and high accuracy is required. Vortex meters shall be flanged as per piping specifications. In totalizing applications in steam and gas services Vortex meters shall be preferred. For high temperature service transmitter shall be remotely mounted.

Where mass flow measurement is required, compensation for pressure & temperature shall be achieved within the supplied vortex transmitter.

4.4.5 Turbine Meter

For high accuracy flow measurements turbine flow meter with remote mounted head shall be used. Necessary straight length requirement and installation shall be considered as per manufacturer's recommendation along with other accessories like strainer, air eliminator, flow straightener etc. Bearings shall preferably be of tungsten carbide. Other wetted parts shall be as per process fluid requirement. Meters shall be flanged.

4.4.6 Positive Displacement Meter

This type of meter shall be chosen normally for material balance measurement services and high viscous clean fluid services.

Gear-type positive displacement flow meters are preferred for use on warm heavy fuel oil and polymer

Volumetric measurements using positive displacement flow meters shall be temperature and density compensated if mass flow measurement is required.

Necessary straight length requirements shall be considered as per manufacturer's recommendations, along with accessories like strainer, etc. Meters shall be flanged.

4.4.7 Mass Flow Meters

For very accurate flow measurement of liquids mass flow meters with remote mounted head working on Coriolis force principle may be used.

Coriolis flow meters shall be of the 'Straight-through' or 'U' flow tube design.

Coriolis flow meters are preferred for use on non-abrasive liquids and gases in relatively small pipes particularly where mass flow measurement is required. Typical applications include measurements of oil, flocculants, milk of lime, surfactants, natural gas and polymer process fluids.

Thermal conductivity type mass flow meters shall be used for gas services. Proper support on both ends should be provided to reduce line vibration. Meters shall be flanged and either straight tube or U-tube design.

Steam jacket to be provided where ever necessary with remote mounted transmitter.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

4.4.8 Venturi Tubes (Clean Service Applications)

Venturi tubes are the preferred flow meter primary element on clean liquids, gases and steam where minimal pressure loss is required. For high pressure steam applications, butt welded venturi tubes shall be used. Flanged mounted venturi tubes are suitable for all other applications.

The differential pressure transmitter to be used with the venturi tube shall be equipped with a 5-valve manifold.

Venturi Tubes (High Temperature Slurry & Liquor Applications)

- In applications where the temperature of the process medium exceeds the temperature rating for magnetic flow meters, venturi tubes in conjunction with differential pressure transmitters shall be used.
- In high temperature slurry applications a ceramic lined venturi tube shall be used. The ceramic lining for these applications shall be Partially Stabilized Zirconia (PSZ). In these applications the venturi tube Beta ratio should be kept as high as possible in an attempt to minimize wear of the internal orifice bore.
- On high temperature liquor applications, the venturi tube material of construction should resemble the connecting upstream and downstream process piping as much as possible.
- Venturi tube differential pressure transmitter tapping points shall be DN50 sized flanges to facilitate the mounting of ClearGuard® auto-rodding devices if required.

Where mass flow measurement is required, compensation for pressure & temperature shall be achieved within the supplied multivariable transmitter.

4.4.9 Averaging Pitot tube

The averaging Pitot tube is the preferred instrument for measuring flow of clean non-conducting fluids like steam, air, water and natural gas. It is a good alternative to an orifice plate on air and steam lines where pressure drop is a concern. In very large diameter pipe (above 8") or duct for clear gas service and in low pressure application the Averaging Pitot tube can be selected as primary flow element.

The sensor should have a facility to incorporate a temperature element in the APT, this can be on line replaceable. Ideal for Gas & steam applications to enable temperature sensing without an additional thermo well and with minimum intrusion on the piping.

The differential pressure transmitter to be used with the averaging pitot tube shall be equipped with a 5-valve manifold.

An Air vent kit should be supplied with the annubar on all application where the annubar is top mounted on a liquid application and there is a high probability of air entrapment

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

Where mass flow measurement is required, compensation for pressure & temperature shall be achieved within the supplied multivariable transmitter

4.4.10 Flow switches

Field mounted direct actuated flow switches shall not be used. Instead, receiver switch/trip amplifier shall be used along with flow transmitter.

4.4.11 Ultrasonic Flowmeters:-

Ultrasonic flow meter may be considered for special applications such as large diameter pipes, highly corrosive fluids, high temperature flow measurement or high pressure fluids with due regard for the accuracy required.

4.5 **Conductivity Measurement:-**

Conductivity measurement devices for condensate shall consist of an insertion type probe, and a remote transmitter. Insertion probes shall be arranged to permit removal of probes from live process lines. This will usually be facilitated by having a stand-by probe located in a by-pass line that can be safely depressurized.

Conductivity of plant liquors (for bauxite charge control, or other purposes) shall utilise an electrode less toroidal conductivity measurement tube. The tube shall be rated for high pressure and temperature, and sized to match the piping installation.

Transmitters shall include temperature compensation, linearization and a local display. Conductivity measurement devices shall be interchangeable regardless of process medium, with re-ranging achieved in the transmitter.

For conductivity systems requiring a sample conditioning system:

- The conductivity meters should be of line mounted type; not sampling type. Online conductivity transmitters with sample check facility to be provided.
- The sampling system shall be designed to deliver a reliable and representative sample.
- The sample shall be pressure regulated, cooled, cleaned or conditioned and measured to suit the specific application.
- Location shall enable access for maintenance and return of the sample to the process stream if possible.
- The sensor and transmitter shall be of the same manufacture.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 40 of 70

4.6 Density Measurement:-

Sensors for nuclear density transmitters shall be placed in vertical sections of a flanged pipeline spool where possible to ensure homogeneous conditions. A spool is the preferred method to facilitate pipe change-out in erosive conditions.

Where this is not possible, the sensor for the nuclear density transmitter can be installed near the low point in a horizontal section of pipeline, thereby ensuring a full pipe at all times.

Sensors for nuclear density transmitters shall be located to enable easy access for maintenance.

Sample isolation valves installed either side of the transmitter shall be provided to facilitate calibration and on-line checks.

4.7 Belt Weighing System:-

The general requirements for belt weighing systems are as follows:

A suitable method of calibration (generally test chains) shall be provided. A system for load testing with actual product shall be possible.

The belt weighing systems shall be continuous in operation and be of the mechanical lever/load cell type. The belt weighing system shall be robust and easily serviceable. 4-loadcell type belt-weighers are to be used and where ever possible test chain system to be provided to facilitate calibrations.

The belt weighing system shall incorporate a hermetically sealed precision load sensor, load reactor and a belt speed sensor to correct for variations in the conveyor belt speed. The speed sensor shall be designed such that regardless of the belt loading, there is no possibility that a slip will affect the results.

The load sensor and reactor shall incorporate overload protection of not less than 150% of the design capacity to maintain structural integrity and will include temperature compensation over the temperature range specified.

If there is any requirement to provide belt weighing system for shuttle conveyors (bi-directional), then conveyor of required length with zero inclination to be provided.

4.8 Wagon loading system:

a) Forward & backward motion type wagon position system to be considered. Weighing system with RFID facility with jumbo display and serial communication with remote PC for wagon loading data, to be provided. Alumina Wagon filling system to ensure optimum filling of wagons.

b) Capacitance type of probes with external tripping circuits (high level sensing) to be considered for the spouts of wagon loading system.

c) Loading spout design should meet the requirement of disbursing incoming alumina to all sides inside the wagon tank to accommodate more material into the wagon.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

4.9 Gas Analyzers:-

Stack and Flue Gas oxygen (Residual O₂) measurement:-

Measurements of stack and flue gas oxygen concentrations shall be made by an analyser that uses an in-situ Zirconium oxide probe. These analysers have the advantage of offering a long service life, stable operation and easy sensor replacement if required.

For O₂ analyser of Calcination Inconel 600 protection tube to be provided alongwith probe.

Stack and Flue Gas carbon Monoxide (CO) measurement:-

Measurements of stack and flue gas carbon monoxide (CO) concentrations shall be made by an analyser that uses extractive sampling and non-dispersion infrared (NDIR) techniques. These analysers have the advantage of being able to measure concentrations of several types of gas simultaneously. Typically CO₂, CO, CH₄ and SO₂ tend to be measured by the NDIR method, while O₂ is measured by paramagnetic or Zirconia probe methods.

Use of in-situ carbon monoxide analyser probes is only possible in process streams having low dust concentrations (typically less than 200 mg/m³). These in-situ type of carbon monoxide analysers typically utilise infrared absorption spectroscopy and consist of an infrared source mounted directly on the flue gas duct (or stack) on the side opposite from a receiver unit. Infrared energy is radiated by the source, through the flue gas, to the receiver. The receiver typically employs gas filter correlation and narrow band-pass optical filtration with a solid-state detector to determine the absorption of radiation by carbon monoxide in the gas stream.

The in-situ type of analyser has the advantage over the NDIR type of analyser when it comes to maintainability. The extractive sampling and conditioning system required by the NDIR type of instrument makes it both more expensive initially and also to maintain. The disadvantage of the in-situ type of analyser is that it requires a process stream with relatively low particulate concentrations.

Sox, NO_x, CO Analyzers based on sampling to be avoided rather online in-situ type of instruments to be provided. Respective vendor should meet the guidelines laid by CPCB/OSPCB and should also able to provide comprehensive AMC for the supplied system.

Online in-situ type SO_x, NO_x, CO analysers should have facility of auto zero and span calibrations. Opacity metersto be supplied along with span check cells and alignment instrument (if applicable: required if separate source and detectors are used.)

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 42 of 70

Stack and Flue Gas particulate concentration (opacity) measurement:-

Measurement of stack and flue gas dust concentrations, otherwise known as opacity, shall be made by the use of a device that relies on optical measurement. There are many such types of device and each uses its own proprietary techniques. The two most common methods of particulate detection are 'optical absorption' and 'optical scintillation'.

Optical absorption techniques rely on the fact that particles present in flue or stack gas will scatter and absorb a certain amount of light as it passes through a beam of light. As the particulate content of the stack gas increases, the percentage of the light that is blocked increases. By measuring the signal produced by the Light before and after it is transmitted across the stack (or flue), the percentage of opacity in the stack can be calculated.

Optical scintillation techniques use dynamic sensing to measure the rate of change of light (Dynamic Opacity) as particulates pass through an infrared light beam. This technique offers significant reliability and resolution advantages over 'optical absorption' opacity monitors since the measurement is unaffected by the lens.

All types of opacity monitors shall be regularly calibrated against an iso-kinetic sample. Iso-kinetic sampling involves taking a precise volumetric sample of the stack (or flue) gas whilst under a set of standard conditions such as temperature and pressure. The dust content of this sample is then accurately measured to determine the exact dust concentration. This concentration value can then be used as a reference against which the output from optical type dust opacity detectors can be compared and calibrated.

4.10 Portable Dew-point meter based on chilled mirror technique to be supplied by respective Package vendor of drier systems.

5.0 CONTROL VALVES

General

Actuated valves shall be resistant to any mechanical vibration that is transmitted longitudinally or laterally from pipes or other equipment installed in the line.

Actuated valves should minimize the requirement for strategic spares, with a particular emphasis on

- Minimising the number of spare parts
- Minimising the capital cost of spare parts

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

- Maximizing the modularity and component inter-changeability (with preference given to instruments with parts common across a number of models)
- Using spare parts that are readily available (viz. ex stock with short delivery times)
- Where the application demands are such that the smaller valve size is required, reduced port sizes will be selected.
- Actuated valve face-to-face dimensions shall be in accordance with relevant ISA S75-01 standards.
- Bolting and fasteners shall be protected with high quality corrosion protection without sacrificing bolt strength.
- Control Valves shall be designed to be "fail safe" on air and signal failure and where possible design shall be such that the valve action may be reversed in the field without the need for additional parts.
- Valves with flanged bodies are preferred. Butterfly and ball valves may have a wafer style body if a flanged body is not available in the valve of choice.
- Valves and actuators weighing over 30 Kg shall be supplied with lifting lugs.

All control valves on steam services shall be with IBR approval for pressures greater than 3.0 bar (g).

Steam jacket heating shall be considered on body of control valves handling fluids, which tend to crystallize.

Block and bypass valves shall be considered wherever required as per process requirement. Hand wheel may be considered where no bypasses are used and as per process requirement.

If, for any reasons, single port valve is selected for high differential pressure service, it shall be top and bottom guided type only. Generally seat rings shall be of replaceable type.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 44 of 70

5.1 Selection of valve type:-

Fluid Service	Selection		Comments
	Preferred	Alternative	
Bauxite Slurry, Digester Slurry, Sand tails Slurry	Butterfly , V-Ball	Diaphragm	Heavy duty Butterfly valve, abrasion resistant materials
Spent Liquor, Pregnant Liquor, Weak Liquor, Supernatant Liquor, Hosing Water, Caustic Cleaning Liquor	Butterfly		
Lime Slurry, Hydrate Slurry, Mud Slurry, Red mud tailings	Butterfly , V-Ball	Diaphragm	Heavy duty Butterfly valve, abrasion resistant materials. Ceramic lined valves for lime application.
Sulphuric Acid, Hydrochloric Acid	S/S Butterfly		Rubber-lined for HCL
Compressed and Instrument air	Butterfly		
Cooling Water, Instrument purge water, pump gland water	Butterfly		
Steam / Boiler Feed Water	Globe		
Fuel Oil, Fuel Gas	Globe		

Where flow control valves are required they shall be selected in accordance with the table below:-

Globe Valves

Globe valves shall be selected for standard application. Sizing calculation should be carried out as per ISA S75-01.

Globe valves shall be top entry type with drop-in trim. Screwed in seat ring constructions are unacceptable.

Globe valves shall have interchangeable valve trim that is designed for a quick replacement to facilitate change of port size and for flow characteristics.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

Globe valves shall have guide bushings, where applicable, of hardened material and with anti-galling properties.

Angle Valves

Angle control valves mounted in pipes shall be selected for high differential pressure, for viscous liquids and fluids which may tend to deposit or crystallize.

Angle valves used for slurry service shall be capable of being reground while in-line.

On/Off actuation and automation of the regrinding capability shall be available electrically, hydraulically or pneumatically.

All components of the valve trim material shall comprise hard wearing materials.

Ball Valves

Ball valves and Plug valves shall be considered if required by process (quick closing or opening services).

For piston rotary actuators, the valve actuator action should be field reversible between 'Air to Open' or 'Air to Close'.

The valve shaft connection to the actuator shall be such that it will minimize play, lost motion and promote superior control.

Butterfly Valves

Butterfly valves shall be selected for large size process lines, for reasons of economy and low pressure drop. For size 6" and above butterfly type shall be preferred.

The actuator valve action should be field reversible between 'Air to Open' and 'Air to Close'.

The body liner and disc shall be fully replaceable.

The valve shaft shall be designed in such a manner to prevent the valve shaft from blow-out in the unlikely event that the internal connections between the shaft and the disc are broken.

Valves with extended body style construction are preferred for slurry applications.

Rotary Plug Valves

Rotary plug valves are recommended for viscous liquids and fluids which may tend to deposit or crystallize. They are also recommended for hazardous fluids as sealing of a rotating shaft is better than of an ordinary globe valve stem.

Special valves may be considered for high noise services, high corrosion and erosion services, etc. For instance, chlorine control valves require inside cladding with PTFE (upto 200 C).

Flat disk type valves

Flat disk type valves are to be used for all tank-bottom type valves (normally used at precipitation area) and all respective air buffer tanks along with solenoid valve system to be mounted away from valve area. Suitable common canopy, valve dismantling & transportation arrangement to be provided for these valves with soft seat with double acting actuator.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

5.2 Design Considerations

5.2.1 Valve Sizing

Valve sizing shall be in accordance with ISA S75.01; however, sizing based on valve manufacturer's proprietary methods may be accepted when approved.

Control valve design pressure drop shall be at least one third of total system dynamic pressure drop to the extent possible.

Body Sizing

Minimum control valve body size shall be 1" in general. Reduced trims can also be considered. Body size shall be limited to 1", 1-1/2", 2", 3", 4", 6", 8", 10", and 12". Higher sizes may be used wherever necessary. Body sizes larger than 4" shall be multiples of 2". Sizes such as 1 1/4", 2 1/2", 3 1/2", 4 1/2", 5", and 7" shall not be used. Notwithstanding the above, body sizes smaller than 1" may be used for special applications and for pressure regulator services.

Valve size of 1/2" can be used on in 1/2" dia pipes only.

Reduced ports shall be used as required.

On-Off Valves (Actuated)

- Body size shall be line size.

Control valve (modulating)

- Body size shall not be more than two pipe sizes smaller than the line unless approved.
- Globe control valve sizing shall be done to pass the design flow rate of normal operation condition with the valve opening of 60% to 80% open with an equal % characteristic and 50% to 70% open with a linear characteristic. But at the same time, valve shall be capable of handling 10% more flow rate than the maximum flow rate expected. It shall be checked whether maximum and minimum flow rate are within the limits of 90% and 5% of Cv value or not. If the process requires a Cv value of more than 90% and/or less than 5% of the Cvs value, two valves shall be considered in parallel. For flashing service or two phase service existing at the inlet, Cv values of both phases shall be calculated separately and added.
- Butterfly control valves shall be sized to operate over the range 25° to 70° open. Normal operating flow shall lie between 30 deg to 55 deg open, however for slurries normal flow shall lie between 40 deg to 60 deg open except for characterized vane valves (such as the fish tail) which may be sized at 90° opening.
- Diaphragm type control valves shall be sized for 100% of flow at 50% lift and sized to operate between 25% and 35% lift at normal flow.

5.2.3 Pressure Rating

All valve bodies should be designed to comply with the corresponding ANSI rating as indicated on the application specific datasheet. Butterfly valves with ANSI drilling patterns may not meet this requirement in body rating or allowable pressure drop across a closed butterfly.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

5.2.4 Temperature Rating

Material of construction for all soft parts of the valves (e.g. seat rings, seals, packing, shaft bearings, liners, etc.) shall be rated to the maximum design process temperatures as indicated on the application specific datasheet.

Valves used for fluids of temperature below 0°C shall be provided with extension bonnet. For fluid service temperature greater than 200°C extension bonnet/radiating fins shall be provided. Special requirement like bellow seals for hazardous fluids shall be considered as per process requirement.

5.2.2 Material Compatibility

The valve body and trim material will be selected based on issues such as corrosion by process fluid, erosion by abrasive material, flashing, cavitations and the process temperature & pressure requirements. Material used for trim shall be minimum 316 SS, with guide bushing of hardened stainless steel like 440 C, 17-4 PH, all upto a pressure drop of 10 kg/cm².

For higher pressure drops (greater than 10kg/cm²g), flashing, cavitating, erosive and slurry services and, in general, all steam services, trim shall be stellited. (Wetted parts like seat ring, valve plug, plug guide, plug stem, guide bushing and cage are being termed as trim)

Special cases may require 17-4 PH seat ring and 440 C solid plugs or other materials like Hastelloy, Durimet and Monel.

For temperature above 300°C stellite facing shall be used for guide posts. Guide bushing shall always be harder by a minimum of 125 Brinell than the guide post.

Stem, plug and seat material shall be minimum SS 316 for any pressure drop upto 8.0 kg/cm². For higher pressure drops, hardened chromium steel or stainless steel shall be preferred. Superior materials shall be used where erosive or corrosive conditions are expected

External parts that are in direct contact with the environment shall be resistant to contact with air borne salts, caustic fumes (i.e. NaOH) and sulphur dioxide (i.e. SO₂)

In general, the use of copper, aluminium, or an alloy of these metals is unacceptable. However, if no alternative to these materials is available, then these parts shall be coated in a manner that is acceptable to the Principal. Adequate coating with epoxy type paint may be acceptable.

5.2.6 Cavitation and Flashing

Hard wearing surfaces or special purpose trims shall be included where cavitations or flashing has been identified as a problem due to the application requirement.

5.2.7 Noise

Aerodynamic noise calculations shall be in accordance with IEC 60534 Noise Prediction Method.

The valve selection shall ensure that each item of equipment does not exceed the maximum allowable noise level of 85dB (A) at a distance of 1m for an

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

exposure of 8 hours. Noise abatement techniques shall be used where required to minimize noise levels generated by valves. (NT Occupational Health and Safety Regulations: Section 56 Noise)

If the noise level exceeds 85 db (A), anyone of the following methods shall be adopted, to limit the noise level:

- Special noise reducing trims.
- Down stream silencers.
- Use of special valves.
- Acoustic insulation.

5.2.8 Shut-off capability

ANSI-FCI 70.2 control valve leakage standard shall be generally followed in specification of control valves. Leakage Class II to Class VI will be used as per process requirement. All single seated globe valves shall have minimum leakage Class IV for utility services. For all special valves, if any used, leakage class shall be generally as per manufacturer's standard. The valves shall be designed in accordance with the leakage classification specified in the data sheet. Where the leakage classification is not specified, the valve shall be supplied with the following minimum leakage classification:

- Regulating/modulating type control valves: Class II as defined by FCI 70-2-1991.
- On/off type valves: Class IV as defined by FCI 70-2-1991.

Proprietary valve leakage classification or leak testing and/or compliance with other established standards would be acceptable with a prior approval.

Valves to be used in hydrocarbon and some other applications may also require additional compliance with API 598 for leakage testing.

5.2.9 Packing

Teflon shall be used as stuffing box packing material minimum requirement. Other types of packing materials shall be generally as per process requirement and recommendation of manufacturer. Whenever required by packing material, lubricator and isolating valve shall be provided for the packing.

5.3 Actuators

Actuators shall be designed to provide maximum shutoff differential pressure existing across the valve during operation, as well as to overcome frictional forces.

Valve actuator selection shall be based on the required valve type, torque (or force) and the required valve fails action. Spring loaded power cylinder type actuator to be avoided rather double acting actuator with self lubricating (PTFE sealing) type to be used..

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 49 of 70

Pneumatic Actuators

The application and selection of pneumatic actuators shall be based on:

- Globe valves, actuators shall be normally single action (spring opposed) pneumatic diaphragm operated type.
- Diaphragm actuators shall be sized for 0.2 to 1 kg/cm² (g) or 0.4 to 2 kg/cm² (g) operation.
- Actuators shall be also designed to operate with 4.0 bar (g) instrument air pressure available in plant. Double action piston actuators shall be also considered wherever required based on process guidelines
- Applications requiring high torque shall be piston actuators. Piston actuators shall be sized to operate between the minimum and maximum air pressure. Self lubricating type piston actuators with PTFE sealing shall be used.
- Plug valve with double action piston actuators are recommended where quick closing and opening action is required. For these actuators buffer vessels shall be provided for achieving the “shutdown” position.
- Where 'Fail Safe' action for either signal or air supply failure is required and the application demands the use of a diaphragm or piston actuator, the actuator shall be fitted with a spring return or the assembly shall be supplied with an air accumulator/pneumatic trip system complete with all accessories to move the valve to the required fail condition.
- Actuators shall be scheduled maintenance free (lifetime lubricated).

Hydraulic Actuators

Hydraulic power packs may be specified to be supplied with the valve and actuator or may be specified and supplied by others.

When specified, the actuator shall

- Include a hydraulic power pack suitable for the operation of the hydraulic cylinder
- Include the hydraulic pump, a suitable electric motor, solenoid valves
- Include monitoring equipment such as oil level, oil temperature, oil pressure and adequately sized relief valve etc.
- Be equipped with an oil accumulator adequately sized to store enough energy to operate the cylinder for three complete operating cycles when the electric power supply fails.

Electric actuators

Selection of electric actuator shall be according to the Specified Equipment List. Electric actuators may be employed in instances where the following conditions prevail:

- Modulating requirement is fairly low
- Driving forces are high
- Fail shut or fail open is not required
- Air supply is not available

Where required, actuator shall be supplied with local hand wheel in event of power failure. Each actuator shall provide remote indication of valve position.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

5.4 Actuated Valve Accessories

5.4.1 Selection of the discrete valve controller and valve accessories shall be in accordance with the Specified Equipment List.

- All valve accessories should be integrally mounted on the valve. Pneumatic accessories shall be piped up with seamless 316 stainless steel tubing conforming to ASTM A269.
- All air filter regulator should have mesh size of 5 micron minimum. The filter/regulator shall be sized so that less than 10% variation of nominal output pressure occurs over 0 to 125% of the total air consumption of all instruments supplied from that particular regulator/filter set.

5.4.2 E/P Positioner

Field mounted I/P converters shall not be used. Electro-pneumatic positioner shall be used. All control valves shall be considered with positioner with gauges for supply and output indications and one air filter regulator without output gauge mounted and tubed. For special cases, volume boosters shall be considered for control valve positioner to get fast operation as per process requirement.

E/P type valve positioners shall be fitted to all modulating valves. They should be designed to ensure minimum air consumption. Smart positioners are not acceptable, rather conventional E/P converters to be used,

E/P type valve positioners should be supplied complete with a filter regulator set suitably sized.

5.4.3 Limit Switches/Solenoid Valves

All pneumatic ON-OFF valves connected to DCS (not to safety system) shall be provided with solenoid valves and limit switches as required.

Whenever limit switches are specified as inductive proximity type, these shall meet NAMUR (DIN-19234) requirements. Only two wire proximity switches only to be used. (as far as possible 24 V DC type may be used)

For limit switches proximity types are recommended instead of electromechanical types because of their insensitivity against chemical atmosphere and dust. Use of mechanical type limit switches to be avoided rather proximity switches to be used.

3-way solenoid valves shall be generally selected for single action pneumatic actuators. Solenoid valves shall be of direct acting type with minimum electrical power consumption. If necessary air flow for quick closing/opening cannot be achieved by the solenoid valve, additional pneumatic pilot valves shall be used.

5-way solenoid valves or 3-way solenoid valves with 5-way pneumatic relay shall be considered for double acting piston actuators. Requirement of solenoid valves and limit switches for other control valves shall be based on process requirement. 3-way & 5-way solenoid valves based on air bearing principle to be used.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 51 of 70

Solenoid valves, wherever used, shall be universal type and shall be continuous rated type with class F coil insulation as per IEC 85/IS 1271. These shall be of SS316 body and trim, as a minimum. Solenoid valves shall be powered using 230 V AC +/- 1%, 50 Hz, +/- 0.5% UPS supply.

5.4.4 Position Transmitters

Position transmitter shall be considered based on process requirements. Such transmitter shall be generally electronic 2 wire type.

Position feedback with 4-20mA for discharge lance of Calcination plant and any such important equipment to be provided.

5.5 Self Acting Control Valves

Self acting control valves shall be selected in secondary local control circuits, preferably in utility services. Valves material, connection, pressure and temperature ratings shall be generally as per piping specifications.

5.6 Painting and Protective Coatings

The valve body and all accessories should be suitably painted and/or supplied with protective coating to withstand the environmental conditions.

5.7 Valve Assembly Name Plate

Each control valve assembly shall have an engraved stainless steel nameplate affixed to the body or at an appropriate position indicating the following information. The Vendor shall submit a sample nameplate for approval.

Valve Body

- Valve Tag Number
- Manufacturer
- Valve Serial Number
- Model Number
- Purchase Order Number
- ANSI Rating of the Valve Body
- Valve Body Size
- Port Size
- Valve Body Material
- Valve Failure Mode
- Flow direction

Actuator

- Manufacturer
- Model Number
- Size

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

- Units and operating range of Motive Force

Other Accessories

- Manufacturer
- Model Number
- Size
- Units and operating range of motive force

6.0 ERECTION HARDWARE

6.1 Process Impulse Lines

Impulse lines for instruments shall be SS 316 material, 12 mm OD x 1.0 mm wall thickness tubing according to ASTM A269. All fittings to be used for tubing shall be also SS 316 double compression type of standard make.

6.2 Pneumatic Tubing

For pneumatic signal transmission, 6 mm OD x 1.0 mm wall thickness SS 316 tubes shall be used. Stainless steel double compression type fittings shall be used for connections.

6.3 Signal Cables

- a) For 4-20 mA current signal, 1-5 V DC voltage signals, RTD signals and 24 V DC interrogation alarm and interlock signals etc., twisted screened single or double pair/triad cables of 1.0 mm² (multi strand) shall be used from sensor to junction box. Multi pair cables with individual & overall screen shall be considered from control room up to junction boxes. Required parameters for intrinsic safe signal handling shall be considered, wherever applicable, according to Indian Standards or British Standards.
- b) For thermocouple signals, thermocouple extension wire shall be used as mentioned in temperature measurement. Wire size AWG 16 gauge shall be used for extension wire.
Normally twisted screened single pair shall be used from the sensing element to junction box. Multi pair cable with individual & overall screened shall be used from control room to junction box. Colour coding and EMF error limitations of extension wires shall be generally as per ISA recommendations.
- c) For solenoid valves and relay based safety interlock system 1.5 / 2.5 sq.mm. bare copper conductor control cables as per Indian Standards shall be used. Conductor size shall be decided based on cable length and voltage drop considerations.

If requested by manufacturers, special control cables shall be used (for instance, radioactive level transmitters).

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेपाल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 53 of 70

The following cables in general shall be used for Instrumentation:

- a. Signal & Control cables
 1. Single pair
 2. 2 pair
 3. 6 pair
 4. 12 pair
 5. 1 triad, 8 triad
 6. T/C extension cable, 1 pair
- b. Power cable
 1. 2 Core
 2. 3 Core
 3. 12 Core
 4. 24 Core

All cable shall be flame retardant, oil & sunlight resistant. Considering mechanical protection armoring shall be considered for above cables.

Redundant data highway cables for DCS and PLC system shall be run by separate routes to ensure that one accident will not disrupt DCS communication.

Instrument and electrical cables shall be run in a separate cable ladders where ever possible. When instrument and electrical cables utilize the same cable ladder minimum separation criteria must be met.

Ferruling

The ferrules used should be PVC, white coloured, tubular, machine printed of appropriate sizes.

6.4 Cable Trays

Instrument cabling shall be in general overhead.

Mainly GI trays should be used in plant. Wherever there is possibility of huge spillage of caustic, MS painted cable tray shall be used.

Pre-fabricated cable trays shall be hot dip galvanized. The fasteners shall be electroplated. Cutting of trays at site shall be minimized. As far as possible pre-fabricated bends shall be used.

Ladder trays shall be made from angles and flats.

The width of the cable trays shall in general be 150mm, 300 mm, 600 mm and 750 mm.

Perforated G.I. trays shall be used from junction boxes to individual instruments. They shall be hot dip galvanized, made of at least 2.5 mm thick sheet. In general, the desired sizes are:

- 50 mm W x 20 mm H
- 75 mm W x 20 mm H
- 100 mm W x 20 mm H

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 54 of 70

- 150 mm W x 25 mm H
(Length of each tray section shall be minimum 2.5 meters.)

Minimum 20% spare space shall be left in each tray for future use.

Cable segregation between instrument and electrical cables shall be as per IEEE 518 as given below:

- HV (up to 1 KV) or other electrical power cabling on pipe rack (where cable density is more) - 900 mm minimum.
- 230 VAC - 300 mm minimum.

For runs at right angles and inside plant section (where cable density is less), 300 mm is permissible.

Intrinsic safe cables and non-intrinsic safe cables shall be segregated. 230 V, 50 Hz power cables for instruments shall preferably run in separate tray. If running in same tray, minimum 150 mm space shall be left between signal cables and these power cables.

6.5 Junction Boxes & Cable Glands

Junction boxes and cable glands shall be suitable for area classification. Junction boxes shall be made of SS 316 in general and shall be weatherproof to IP65. Locking arrangement with allen screw or bolt shall be provided. SS tag plate shall be provided on junction box.

Explosion proof junction box can be Die cast Aluminum with Anti-corrosive paint.

All electrical connections shall be with metric threads only.
Double compression SS 316 glands with PVC hood shall be used.
In general, all cable entries shall be at bottom.

Signal grouping of Junction Boxes will be as followed:

1. 4~20 mA signals
2. Digital input signals.
3. Intrinsically safe signals should be in separate junction box.
4. 230 V AC power for solenoid valves.
5. Any special signals like vibration etc.
6. In case PLC is used then DCS and PLC signals should not be combined. Even for PLC signals, the grouping of signals to be followed as followed in DCS.

6.6 Air Headers

Air headers shall generally not be used. A system of headers and sub-headers with a ½" sub-header run to each valve shall be used. Large valves may require ¾" or 1" lines.

Auto drain trapping to be used for air lines wherever necessary.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

6.7 Tapping Point Installation Details

Tapping point details as given below to be followed. In case there are any deviations from these, the same shall be intimated by tkIS otherwise, these requirements shall be strictly adhered to.

Following general points may be noted:

- a. The pressure rating and material of all flanges, blind/reducing flanges, valves, etc. shall be as per piping class applicable.
- b. Unless otherwise indicated specifically, all nuts, bolts, gaskets, etc. and the materials will be as per piping class.
- c. As regards straight piping requirements for various flow instruments, the same are based on 90% of class commonly encountered. These are dependent on various factors such as number of elbows, valves, upstream of the instrument etc.
- d. Straight length requirement Magnetic flowmeter, Vortex flowmeter and Coriolis meter manufacturer's recommendation should be followed.
- e. For all rotameters and rotameter transmitters direction of flow shall be from bottom to top only and line should be vertical within a deviation of $\pm 1\%$.

Instrument type	Instrument connection	Piping connection	Equipment connection
Pressure			
Pressure gauge (screwed)	½" NPT (M)	½" NPT (F)	1" nozzle
Pressure switch/ transmitter (screwed)	½" NPT (M)	½" NPT (F)	1" nozzle
Pressure transmitter (flanged transmitter, As per P&ID & Autorodding)	2" flanged	2" nozzle	2" nozzle
Pressure gauge (Diaphragm seal type)	2" flanged	2" nozzle	2" nozzle
Pressure/DP transmitter (Remote seal type)	3" flanged	3" nozzle	3" nozzle
Temperature			
Thermowell	2" flanged	2" nozzle	2" nozzle
Level			
Level gauges	2" flanged	NA	2" nozzle
Level switch (side mounted external chamber type)	2" flanged	NA	2" nozzle
DP Level transmitter	½" NPT (F)	NA	2" nozzle
Flanged Level Transmitter	3" flanged	NA	3" nozzle
Remote seal Level Transmitter	3" flanged	NA	3" nozzle
Extended diaphragm seal level transmitter	4" flanged	NA	4" nozzle

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

Displacer Level Transmitter (side mounted external chamber type)	2" flanged	NA	2" nozzle
Displacer Level Transmitter (Top mounted internal displacer)	4" flanged	NA	4" nozzle
Purge Level transmitter	½" NPT (F)	NA	2" nozzle
Capacitive Level transmitter	2" flanged	NA	2" nozzle
Radar type Level transmitter (horn type antenna) Note 1	4"/6" flanged	NA	4"/6" flanged
Radar type Level transmitter (disk type antenna) Note 1	6"/8" flanged	NA	6"/8" flanged
Radar type Level transmitter (guided wave with external chamber) Note 1	2" flanged	NA	2" flanged
Radar type Level transmitter (top mounted) Note 1	6" flanged	NA	6" flanged
Tuning Fork type instrument Note 1	2" flanged	NA	2" flanged
Ultrasonic Level transmitter Note 1	6" flanged	NA	6" flanged
Ball float level instrument (side mounted)	4" flanged	NA	4" flanged
Float and tape level indicator	1 ½" flanged (3 Nos)	NA	1 ½" flanged (3 Nos)
Servo level indicator	6" flanged	NA	6" flanged
Standpipe	NA	NA	2" flanged
Flow			
Orifice flowmeter	½" NPT (F)	½" NPT (F)	NA
Annubar – Vendor standard	2" flanged	2" flanged	NA

Conductivity – Instrument Connection (2" flanged), Piping Connection (2" flanged), Equipment Connection (2" nozzle).

Note: When possible the minimum nozzle size on a vessel is 2". For flexibility the thermowell nozzle size to be 2".

General Note: This table should be read in conjunction with Standard Drawings showing nozzle size and vessel/pipe stand-off distances.

Note 1:

Level Transmitter nozzles sizes depend on the material being measured, the measuring distance and the vendor and model. The nozzle sizes shown are not specific but could be regarded as common or usual.

Following general points may be noted:

The pressure rating and material of all flanges, blind/reducing flanges, valves, etc. shall be as per piping class applicable.

Type of first isolation valve shall be as per the piping specification applicable for the service.

Unless otherwise indicated specifically, all nuts, bolts, gaskets, etc. shall be as per piping class.

As regards straight piping requirements for various flow instruments, the same are based on 90% of class commonly encountered. These are dependent on various factors such as number of elbows, valves, upstream of the instrument etc. Case by case study shall be made and the piping shall be routed accordingly in order to get the highest accuracy in measurement.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 57 of 70

For all rotameters and rotameter transmitters direction of flow shall be from bottom to top and pipeline should be vertical within a deviation of $\pm 1\%$.

For Magnetic Flow Meters, piping shall be designed taking into consideration the provision of filled leg for the flow meter all the times.

7.0 SPARES PHILOSOPHY

The following spare philosophy should be followed:

7.1 Mandatory Spare:

Higher of 10% or minimum one of each type (Range/Type/Material of construction) of complete instruments, unless otherwise indicated elsewhere in this specification. This shall include all instruments except detectors for Fire & Gas System. The detectors shall be supplied with 5% spare or minimum one of each type.

All soft material required for opening and boxing-up of control / on-off valves & trim (like gland packings, gaskets, seal rings, O-rings etc.) shall be supplied with 20% subject to minimum 1 no. of each type.

10% or one of each type of modules used in the system including all processors memory, communication, disc drive modules and power supply modules but shall not include CRTs, keyboards, disc drives etc. This shall be applicable for distributed control system and programmable logic controllers, analyser systems etc.

Installed spare modules of higher of 10% or minimum one of each type of Input/Output modules (including termination panels, if applicable) to enhance the system functional requirements of Distributed Control System and Programmable Logic Controller.

A minimum of 20% spare windows with alarm modules shall be provided in alarm annunciator.

A minimum of 20% spare status lamps/switches/push buttons/terminals or one of each type, which ever is higher, shall be provided.

For pneumatic panels, 10% spare instrument air header branch lines and 15% spare bulk heads and tapping points shall be provided in each panel (if applicable).

7.2 Consumable Spares:

Consumable spares for a minimum of six months duration after acceptance and shall include chart paper, printer paper, ink, cartridges, floppies etc required for recorders, printers and hard copier units.

7.3 Commissioning Spares :

All spares required for commissioning of the package/system in the vendor's scope of instruments.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

7.4 Normal Operational Spares :

Vendor shall supply a list of spare parts for each instrument and system required for 1 year of continuous operation. These spares shall be quoted separately.

8.0 INSTALLATION

Instrument Installation

Vendor shall be completely responsible for installation of all instruments within their battery limit, in line with the installation standards (typical) furnished along with this specification. (tkIS Doc. no. 6695-INS-G000-EB-0008 TO 0017).

Installation of various instruments to be done only after prior approval from NALCO for fixing the location.

Vendor shall submit tag-wise detailed hook-ups and installation sketches.

All direct mounted instruments like thermocouples thermowells, temperature gauges, pressure gauges; pressure switches etc. shall be installed in such a way that they have good readability and accessibility. Following points shall be adhered:-

- a) Installation of instruments should be done with the knowledge of NALCO official only for finalizing location & orientation to avoid any re-work.
- b) Standard installation guidelines to be strictly followed for all type of instruments.
- c) Proper approach and maintenance platforms with lighting arrangement to be provided to all field instruments.
- d) Canopies to be provided to field instruments where ever necessary. Necessity of canopies will be decided by Nalco.
- e) Mounting of RTD on Vertical lines to be done with 45 deg inclination. For small sizes of pipes inclination to be in the direction of flow path.
- f) For all air pressure / flow measurements, trx to be mounted above the tapping points and for steam /water applications below the main tapping.
- g) Only heavy-duty GI piping to be done for air applications where pipe sizes are from 3 inch to 1 inch (to avoid rusting) With proper support and clamping.
- h) Dual Mono rail , Chain-pulley system to be provided for all heavy / bulky valves, flow elements or other instruments such a way that the equipment can be brought to the nearest approach roads / floor from where equipment can be taken to service area.
- i) Sufficient height of inter connecting channels of precipitators to be maintained to avoid spillage of slurry on valves / instruments.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

- j) Air/ water tapping to be provided for cleaning purpose wherever necessary.
- k) Height of monkey ladders to be limited to 1.5 meters only otherwise stair case approach to be considered.
- l) Separate earth pits to be made for electrical and instrumentation systems also separate earth pits for body earth and signal earth. All weigh bridge should be provided with two earth pit and lighting arrester.
- m) Scoop controllers of various pumps may be provided away from the main equipment by constructing suitable civil foundation and linking arrangements.
- n) All cable should be lay on duct/tray, with metal clamping and should be covered to avoid cable damage. Signal cable and power cable to be laid in separate duct/tray to avoid induction.
- o) SS Cable gland to be used for all field instrument with gland sealing.
- p) All main airline isolation valve to be provided at approachable place and individual isolation to be provide near to instrument with SS ball valve. Provision of proper support and clamping arrangement to be provided.
- q) Provision of SS housing for all field transmitter ,RTD & T/C to be considered.
- r) All impulse line should be provided with SS tube.
- s) All taping point should be provided with isolation valve.
- t) All analyzer mounted on stack should be provided with proper walkway / staircase approach.
- u) All field instrument identification tag should be provided. Instrument to be mounted at vibration free zone.
- v) All entry cables to various control stations should be provided with Water tight Cable-Bus system. The entry shall be sealed properly with a provision for keeping spare cable entry for future use.

The capillary of all capillary type instruments shall be supported properly and shall be protected against mechanical damage.

All pressure/differential pressure instruments shall be provided with block and bleed/by pass, drain/vent valves etc as per the installation standards, and shall have accessibility.

All primary piping/tubing (impulse lines) shall have a slope of 1 in 12 on the horizontal run.

For toxic/ corrosive services drain and vent shall be routed to safe location.

All welding shall be carried out as per the relevant codes with proper electrodes. Any testing (non destructive) like D.P. test and radiography on root weld and final weld shall be carried out as applicable. All consumables shall be part of vendor's scope of supply. Any pre/post weld treatment as

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 60 of 70

required
by the relevant codes shall be carried out.

All threaded joints shall be joined by PTFE tapes only. All impulse lines shall be supported at regular intervals.

All instruments mounted outdoors shall be provided with FRP weather protection hood.

All Bolts, Nuts, Washers, Fasteners, etc for instrumentation interconnection should be Stainless Steel.

Cabling

Cables shall be run in continuous unbroken lengths, and shall only be jointed if the route length exceeds the maximum manufactured drum length. All cable joints shall be installed in accordance with the jointing kit manufacturer.

When cables are installed, care should be taken to ensure that the cables are not damaged.

Redundant data highway cables for the DCS and PLC system shall be run by separate routes (e.g. underground / pipe rack), to ensure that one accident will not disrupt DCS communication.

All special cables (pulse, vibration etc) and power supply cables shall be laid to the field instrument without any junction boxes, unless otherwise specified.

9.0 SITE SERVICES :

Vendor shall depute the following services engineers to site as required to install and commission items as well as impart training to owner's personnel:

1. Analyser systems (except pH, conductivity analysers)
2. Vibration Monitoring System(if any)
3. Nucleonic Instruments
4. Vendor's supplied Control System

10.0 INSPECTION & EXPEDITING:

For items like control valves, shutdown valves, de-superheaters (if applicable) etc. radiography procedure and area of casting to be radiographed shall be as per ANSI B16.34 and acceptance criteria shall be as per ANSI B16.34 Annexure B, in general. 100 % radiography shall be done on the following areas of each item requiring radiography:-

- inlet flange neck
- outlet flange neck
- all weld joints

Following tests shall be carried out by contractor at his vendor's works and test certificate shall be furnished.

- i) Material test certificate for all instruments.
- ii) *Calibration / test certificates for all instruments including control valves.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

iii)* Seat leakage test for control valves.

iv)* Hydro test certificate for all inline instruments, pipes, tubes, fittings etc.

v)* Radiography of control valve of rating ANSI 600# or above.

vi) Conformity certificate from sub-vendor.

All tests prefixed by (*) shall be witnessed by owner/owner representative / third party. The above is minimum requirement. Inspection agency engaged for the job shall detail out inspection and detailed testing procedure for individual items after contract is awarded. Functional and simulation tests for all instruments supplied by the contractor shall be carried out at sub-vendor's works and witnessed by Purchaser/purchaser's representative.

Each component and the Analyzer systems shall be tested separately at the vendor's works and the test certificates like material test certificate for all wetted parts and certificates from statutory bodies for use in area classification indicated in data sheet to be provided to tkIS / owner. After installation of the Analyzer system at site, demonstration of the tests carried out at vendor's works shall be explained to tkIS / owner.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

ANNEXURE-I

LIST OF CODES AND STANDARDS

IEC 60584	:	Temperature Measurement, Thermocouples
API RP-551	:	Process Instrumentation & Control
API RP-500	:	Classification of locations for Electrical Installation at Petroleum Facilities
ASTM B-75 /75M	:	Standard Specification for Seamless Copper Tubes, Bright Annealed
ASTM A-269	:	Stainless Steel Tubes
DIN 43712	:	Measurement & Control, Electrical Temperature Sensors, Wires for Thermocouples
IEC 751	:	Industrial platinum resistance thermometer sensors.
IS 694	:	PVC Insulated Cables for working voltage upto & including 1100V (Third Revision)
IS 1554, Part-I	:	PVC Insulated (heavy duty) Electric Cables Part-I for working voltage upto & including 1100V
DIN EN-837-1	:	Pressure & Vacuum Gauges (Second Revision)
IS 13947, Part-I	:	Low Voltage Control Gear & Switch Gear Part-I General Rules
IS 2148	:	Flameproof Enclosures for Electrical Apparatus (Second Revision - Amendment-2)
IS 5572, Part-I	:	Hazardous Area Classification for Electrical Installations
IS 5780	:	Intrinsically Safe Electrical Apparatus and Circuits
NFPA 493	:	Intrinsically Safe Apparatus in Div.I Hazardous Location
IS 5831	:	PVC Insulation and Sheath of Electrical Cables
EN 50288-7	:	Instrumentation Signal Cables
ASME/PTC-19.3	:	Thermowells
ISO 5167, Part-I	:	Orifice Plates
ANSI/ISA S75.01	:	Control Valve Sizing
ANSI B16.5	:	Pipe Flanges and Flanged Fitting, Errata-October : 1988
ANSI B16.20	:	Metallic Gasket for Pipe flanges, Ring-joint, Spiral wound and Socketed.
ANSI B1.20.1	:	Pipe threads, General purpose (Inch)

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 64 of 70

ANNEXURE-II

CONTROL SYSTEM IMPLEMENTATION PHILOSOPHY (Proposed)

Unit	Description	Unit Scope LSTK / EPCM	Sub-station No./ Sub- Station Scope	Basic Engineering Scope
51	Open Storage Yard	LSTK 1	US-501 / LSTK 1	tkIS India
52	Bauxite Storage and Handling	LSTK 1	US-501 / LSTK 1	tkIS India
01	Secondary Crushing	LSTK 1	US-501 / LSTK 1	RTAIL
02	Bauxite Grinding	LSTK 2	US-502 / LSTK 2	RTAIL
02	Indirect Bauxite Slurry Heating (IBSH) & Pre-Desilication	EPCM	US-503 / EPCM	RTAIL
03	Digestion	EPCM	US-503 / EPCM	RTAIL
08	Acid cleaning System	EPCM	US-503 / EPCM	RTAIL
04	Mud Settling	LSTK 3	US-504 / LSTK 3	RTAIL
04	Mud Washing	LSTK 3	US-504 / LSTK 3	RTAIL
05	Tri Calcium Aluminate (TCA) preparation	LSTK 3	US-504 / LSTK 3	RTAIL
04	Flocculent Preparation	LSTK 3	US-504 / LSTK 3	RTAIL
05	Security Filtration	EPCM	US-505 / LSTK 3	RTAIL
04	Causticization	LSTK 3	US-504 / LSTK 3	RTAIL
06	Heat Interchange	EPCM	US-505 / LSTK 3	RTAIL
06	Hydrate Filtration	EPCM	US-505 / EPCM	RTAIL
07	Precipitation	EPCM	US-505 / EPCM	RTAIL
07	Seed grinding	EPCM	US-505 / EPCM	RTAIL
07	Caustic Cleaning Preparation (included in Precipitation)	EPCM	US-505 / EPCM	RTAIL
07	Hydrate Classification	EPCM	US-505 / EPCM	RTAIL
09	Product Hydrate Filtration Stage 1	EPCM	US-505 / EPCM	RTAIL
09	Product Hydrate Filtration Stage 2	LSTK 4	US-507 / LSTK 4	RTAIL
53	Hydrate transfer & storage	LSTK 4	US-507 / LSTK 4	TkIS India
10	Calcination unit	LSTK 4	US-507 / LSTK 4	RTAIL
08	Evaporation	LSTK 5	US-506 / LSTK 5	RTAIL
08	Condensate tank farm	EPCM	US-503 / LSTK 3	RTAIL
56	Lime Preparation (Slaking)	LSTK 6	US-501 / EPCM	RTAIL
11	Residue Pumping / Redmud filtration	LSTK 7	US-504 / LSTK 3	RTAIL
08	Tank Farm for Evaporation unit	EPCM	US-506 / LSTK 5	tkIS India
55	Alumina Storage and Handling	LSTK 8	US-508 / LSTK 8	tkIS India

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

57	Caustic Soda receipt & Storage	EPCM	US-508 / LSTK 8	tkIS India
36	Effluent Treatment Plant	EPCM	US-505 / EPCM	tkIS India
36	Sewage Treatment Plant	LSTK 10	US-505 / EPCM	tkIS India
30	Fuel Oil Storage (HFO) and Distribution	EPCM	US-508 / LSTK 8	tkIS India
35	Raw Water Storage	LSTK 11	US-508 / LSTK 8	tkIS India
35	Drinking water Unit	LSTK 11	US-508 / LSTK 8	tkIS India
38	Cooling towers & Cooling Water Distribution – Evaporation	LSTK 13	US-506 / LSTK 5	tkIS India
38	Cooling towers & Cooling Water Distribution – Precipitation	LSTK 13	US-505 / EPCM	tkIS India
38	Cooling towers & Cooling Water Distribution – Calcination	LSTK 13	US-507 / LSTK 4	tkIS India
28	Plant air & Instrument air system	EPCM	US-505 / EPCM	tkIS India
25	Steam	EPCM	To be finalised	tkIS India
37	Fire Water Storage	LSTK 9	US-503 / LSTK 8	tkIS India
R501	Main Pipe Rack for main plant	EPCM	To be finalised	tkIS India
99	Port Facilities-Alumina Storage and Handling	LSTK	To be finalised	tkIS India
98	Port Facilities-Caustic Storage and Handling	EPCM	To be finalised	tkIS India
26	Substation	-	-	-
00	CCR	-	500	-

Note: The above philosophy shall be read in conjunction with Electrical power distribution philosophy.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

ANNEXURE III

INSTRUMENT DOCUMENT NUMBER PHILOSOPHY

Please refer tkIS document number 6695-PMG-G00-BD-0001 for document numbering philosophy.

ANNEXURE-IV

UPSTREAM / DOWNSTREAM STRAIGHT LENGTHS

The minimum up/down stream straight length clearance for in-line devices, will in general, be dictated by each application's specific requirements. In any case, the clearance lengths shall meet or exceed those as defined in the following tables.

Magnetic Flow Meters:-

Description of Discontinuity		Minimum Clearance	
Upstream	Downstream	Upstream	Downstream
Reducer	Expander	5D	2D
Expander	Reducer	10D	2D
Single Plain Bend	Single Plain Bend	5D	2D
Double Plain Bend	Double Plain Bend	10D	2D
Reducer	Valve	5D	2D
Expander	Valve	10D	2D
Single Plain Bend	Valve	5D	2D
Double Plain Bend	Valve	10D	2D
Valve (Gate type)		5D	2D
Valve (Modulating)		10D	2D
Pump/Blower/Compresso		10D	2D

Distance above given are guideline, however vendor recommendation shall be followed for Upstream/ Downstream requirement.

Averaging Pitot Tubes (Liquids):

Description of Discontinuity		Minimum Clearance	
Upstream	Downstream	Upstream*	Downstream*
Reducer	Expander	15D	5D
Expander	Reducer	20D	5D
Single Plain Bend	Single Plain Bend	10D	5D
Double Plain Bend	Double Plain Bend	25D	5D
Reducer	Valve	15D	5D
Expander	Valve	20D	5D
Single Plain Bend	Valve	10D	5D
Double Plain Bend	Valve	30D	5D
Valve (Gate type)		10D	5D

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695
	General Engineering Specification for Instrumentation & Control			 नेपाल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
				Rev 03 Page 67 of 70

Valve (Modulating)		30D	5D
Pump/Blower/Compresso		30D	5D

* - These are general guideline values, subject to change with vendor specific data & may vary for Elbow mounted Annubar.

Averaging Pitot Tubes (Gases):

Description of Discontinuity		Minimum Clearance	
Upstream	Downstream	Upstream*	Downstream*
Reducer	Expander	25D	7.5D
Expander	Reducer	30D	7.5D
Single Plain Bend	Single Plain Bend	15D	7.5D
Double Plain Bend	Double Plain Bend	35D	7.5D
Reducer	Valve	25D	7.5D
Expander	Valve	30D	7.5D
Single Plain Bend	Valve	15D	7.5D
Double Plain Bend	Valve	45D	7.5D
Valve (Gate type)		15D	7.5D
Valve (Modulating)		45D	7.5D
Pump/Blower/Compresso		45D	7.5D

* - These are general guideline values, subject to change with vendor specific data & may vary for Elbow mounted Annubar.

Vortex Flow Meters:

Description of Discontinuity		Minimum Clearance	
Upstream	Downstream	Upstream	Downstream
Reducer	Expander	5D	5D
Expander	Reducer	10D	5D
Single Plain Bend		10D	5D
Double Plain Bend		20D	5D
Reducer	Valve	5D	5D
Expander	Valve	10D	5D
Single Plain Bend	Valve	10D	5D
Double Plain Bend	Valve	20D	5D
Valve (Gate type)		10D	5D
Valve (Modulating)		20D	5D
Pump/Blower/Compressor		20D	5D

Distance above given are guideline, however vendor recommendation shall be followed for Upstream/ Downstream requirement.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

Radiation Density Gauges:

Description of Discontinuity		Minimum Clearance	
Upstream	Downstream	Upstream	Downstream
Reducer	Expander	3D	3D
Expander	Reducer	3D	3D
Single Plain Bend		3D	3D
Double Plain Bend		3D	3D
Reducer	Valve	3D	3D
Expander	Valve	3D	3D
Single Plain Bend	Valve	3D	3D
Double Plain Bend	Valve	3D	3D
Valve (Gate type)		10D	3D
Valve (Modulating)		10D	3D
Pump/Blower/Compresso		10D	3D

Distance above given are guideline, however vendor recommendation shall be followed.

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

ANNEXURE-V

DESIGN VELOCITIES FOR IN-LINE FLOW DEVICES

Design Velocities for In-Line Flow Devices

The flow velocity range for in-line devices, will in general, be dictated by each application's specific requirements. In any case, the flow device

- Shall be sized to ensure that none of the following flow conditions exceed the 'maximum' velocity specification as defined below:
 - 'Maximum' flow value as defined on the corresponding PFD
 - 133% of the 'Normal' flow value as defined on the corresponding PFD
 - Rated maximum flow for pump

- Shall be sized to ensure that none of the following flow conditions drop below the 'minimum' velocity specification as defined below:
 - 'Minimum' flow value as defined on the corresponding PFD
 - 30% of the 'Normal' flow value as defined on the corresponding PFD

- Shall be sized for the following velocities at the 'normal' flow rate as defined on the corresponding PFD:
 - Magnetic Flow Meter (slurries) - 2.5 to 3.5 meters/sec
 - Magnetic Flow Meter (non-slurries) - 4.0 to 5.0 meters/sec
 - Vortex Flow Meter - 50 to 66% of maximum velocity.

Magnetic Flow Meters (Slurries):

Service Description		Velocity	
Medium	Line Size	Minimum	Maximum
All	All	1 m/sec	4 m/sec

Magnetic Flow Meters (non-Slurries):

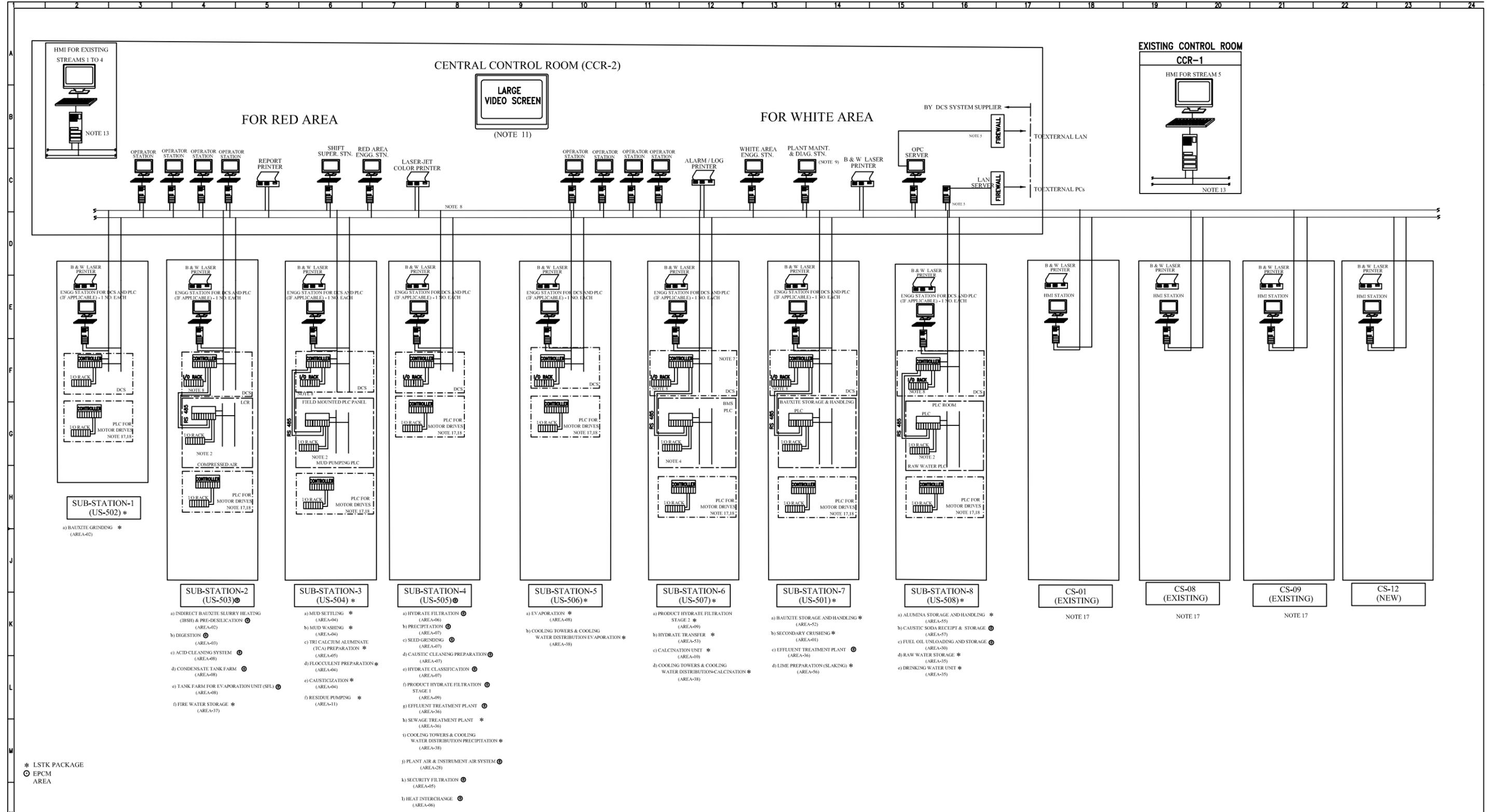
Service Description		Velocity	
Medium	Line Size	Minimum	Maximum
Process Liquor	All	2 m/sec	8 m/sec
Other	All	2 m/sec	8m/sec

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-INS-G000-EC-0001	Contract No. 66-6695	
	General Engineering Specification for Instrumentation & Control			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
				Rev	03

Vortex Flow Meters:-

Service Description		Velocity	
Medium	Line Size	Minimum	Maximum
Process Liquor	15 to 300 mm	0.5 m/sec	10 m/sec
Water	15 to 300 mm	0.5 m/sec	10 m/sec
Liquid (General)	15 to 300 mm	SQRT(250/ρ)	10 m/sec
Air	15 to 300 mm	8 m/sec	80 m/sec
Natural Gas	15 to 300 mm	12 m/sec	80 m/sec
Gas (General)	15 to 300 mm	SQRT(80/ρ)	80 m/sec

Note: 'ρ' is density of media in kg/m³ at operating conditions.



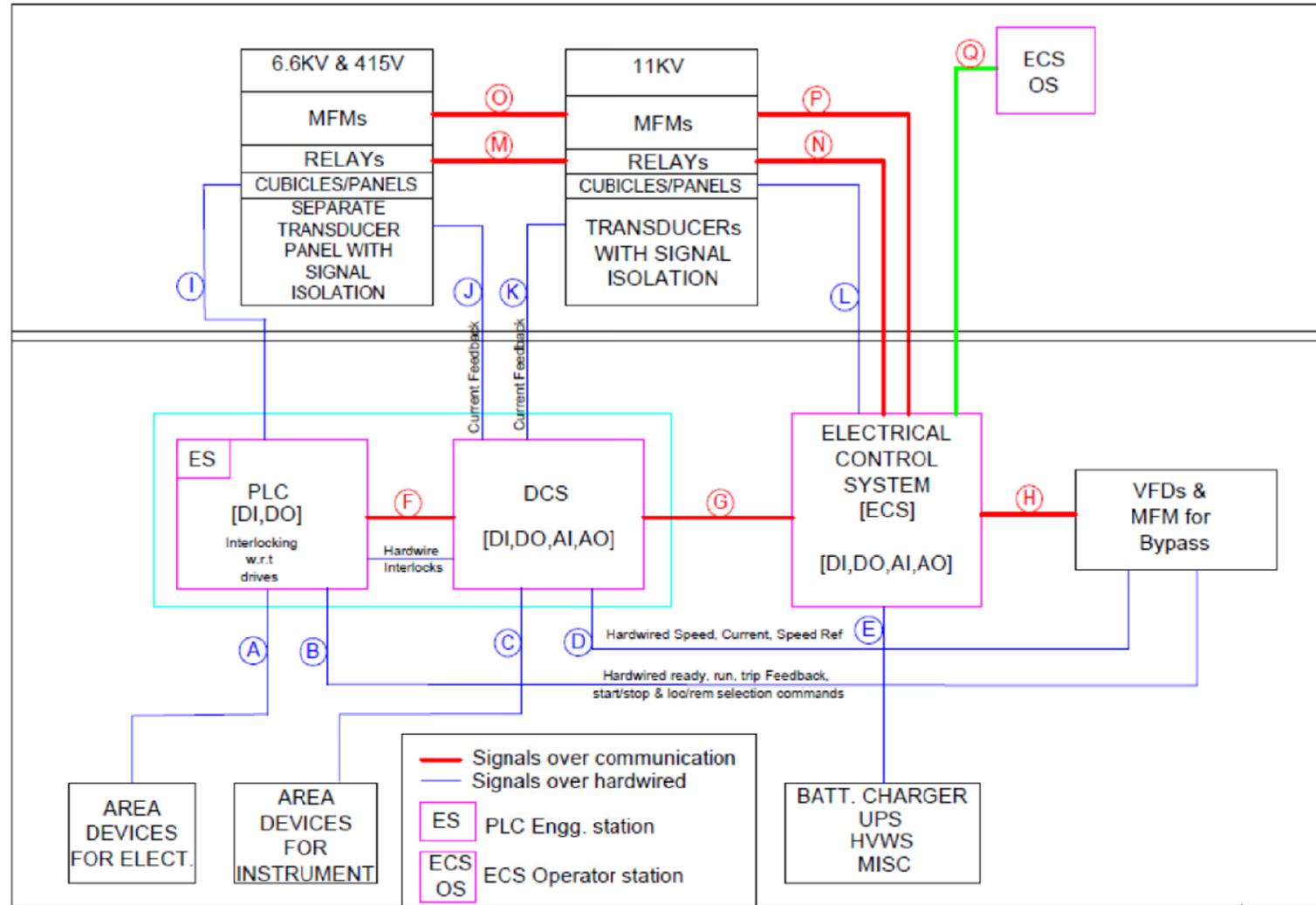
* LSTK PACKAGE
 ○ EPCM AREA

- NOTES**
- THIS DRAWING IS ONLY AN OVERALL CONTROL SCHEME FOR THE PLANT. DETAIL ARCHITECTURE SHALL BE SUBMITTED BY CONTROL SYSTEM SUPPLIER.
 - PACKAGE PLC IF SUPPLIED WILL BE LOCATED IN THE LOCAL CONTROL ROOM (LCR) AND CONNECTED TO DCS/PLC THROUGH SERIAL COMMUNICATION.
 - UNIT ALLOCATED IN ARCHITECTURE IS BASED ON GEOGRAPHICAL LOCATION.
 - CALCINER BURNER MANAGEMENT SYSTEM'S PLC PANEL.
 - NECESSARY FIREWALL (BOTH HARDWARE AND SOFTWARE) SHALL BE IN THE SCOPE OF DCS VENDOR.
 - SERIAL COMMUNICATION CARD FOR VFD SHALL BE PROVIDED AS REQUIRED SEPARATE ARCHITECTURE TO BE PREPARED FOR THE SAME.
 - IF MORE THAN 1 CONTROLLER REQUIRED THEN SEPERATE CONTROLLER TO BE CONSIDERED FOR CALCINATION.
 - CABLE WILL BE SUPPLIED BY CONTROL SYSTEM VENDOR.
 - PLANT MAINTENANCE & DIAGNOSTIC STATION IS INTENDED FOR MAINTENANCE OF HART FIELD INSTRUMENTS.
 - HARDWARE SHALL BE PROVIDED AS PER BILL OF MATERIAL.
 - A LARGE VIDEO WALL TO BE MOUNTED IN FRONT OF OPERATOR STATIONS TO DISPLAY DYNAMICALLY COMPLETE PLANT OPERATION IN ADDITION TO OTHER SELECTED PLANT RUNNING SCREENS.
 - ANTIVIRUS SYSTEM WITH ONLINE PATCH UPDATION FOR ALL PCs CONNECTED TO DCS SYSTEM TO BE PROVIDED.
 - HMI STATION OF 5TH STREAM SHALL BE PROVIDED AT EXISTING CCR OF STREAM 1 TO 4 AND HMI STATION OF EXISTING STREAM 1 TO 4 SHALL BE PROVIDED AT NEW CCR FOR MONITORING PURPOSE ONLY.
 - NETWORK MANAGEMENT SYSTEM TO BE PROVIDED.
 - ALARM MANAGEMENT WITH AUTOMATIC SMS/EMAIL FACILITY TO BE PROVIDED.
 - FIBRE OPTIC LINK WILL BE USED FOR CONNECTIONS BETWEEN CONTROL ROOMS/SUBSTATIONS.
 - PLC IS TO BE USED FOR ALL DIGITAL INPUTS/OUTPUTS RELATED TO ELECTRICAL DRIVES/MOTORS/MOV&EMERGENCY STOP/SHUT DOWN/INTERLOCK WRT DRIVES ONLY.
 - DCS SHALL BE USED FOR ALL INPUTS/OUTPUTS RELATED TO PROCESS PARAMETERS, INCLUDING MONITORING/CONTROL/INTERLOCKS. ANY INTERLOCKS INVOLVING TRIPPING OF MOTORS TO BE EXECUTED IN PLC VIA HARDWIRED SIGNAL FROM DCS TO PLC.

- INDIRECT BAUXITE SLURRY HEATING (AREA-40)
 - BHSH & PRE-DESILICATION (AREA-40)
 - DIGESTION (AREA-40)
 - TRI CALCIUM ALUMINATE (TCA) PREPARATION (AREA-40)
 - ACID CLEANING SYSTEM (AREA-40)
 - CONDENSATE TANK FARM (AREA-40)
 - TANK FARM FOR EVAPORATION UNIT (SFL) (AREA-40)
 - FIRE WATER STORAGE (AREA-37)
- MUD SETTLING (AREA-46)
 - MUD WASHING (AREA-46)
 - TRI CALCIUM ALUMINATE (TCA) PREPARATION (AREA-46)
 - FLOCCULENT PREPARATION (AREA-46)
 - CAUSTICIZATION (AREA-46)
 - RESIDUE PUMPING (AREA-46)
- HYDRATE FILTRATION (AREA-46)
 - PRECIPITATION (AREA-46)
 - SEED GRINDING (AREA-46)
 - CAUSTIC CLEANING PREPARATION (AREA-46)
 - HYDRATE CLASSIFICATION (AREA-46)
 - PRODUCT HYDRATE FILTRATION STAGE 1 (AREA-46)
 - EFFLUENT TREATMENT PLANT (AREA-36)
 - SEWAGE TREATMENT PLANT (AREA-36)
 - COOLING TOWERS & COOLING WATER DISTRIBUTION PRECIPITATION (AREA-38)
 - PLANT AIR & INSTRUMENT AIR SYSTEM (AREA-28)
 - SECURITY FILTRATION (AREA-45)
 - HEAT INTERCHANGE (AREA-46)
- EVAPORATION (AREA-48)
 - COOLING TOWERS & COOLING WATER DISTRIBUTION EVAPORATION (AREA-38)
- PRODUCT HYDRATE FILTRATION STAGE 2 (AREA-49)
 - HYDRATE TRANSFER (AREA-53)
 - CALCINATION UNIT (AREA-40)
 - COOLING TOWERS & COOLING WATER DISTRIBUTION-CALCINATION (AREA-38)
- BAUXITE STORAGE AND HANDLING (AREA-52)
 - SECONDARY CRUSHING (AREA-41)
 - EFFLUENT TREATMENT PLANT (AREA-47)
 - LIME PREPARATION (SLAKING) (AREA-56)
- ALUMINA STORAGE AND HANDLING (AREA-55)
 - CAUSTIC SODA RECEIPT & STORAGE (AREA-57)
 - FUEL OIL UNLOADING AND STORAGE (AREA-30)
 - RAW WATER STORAGE (AREA-35)
 - DRINKING WATER UNIT (AREA-35)

Rev.	Date	Drawn/Prepared	Checked	Approved	Name	Date	Home	Checked	Approved	Description
2	08.01.18	YH	YH	SHD	08.01.18	SHD	08.01.17	SHD	NALCO'S COMMENT INCORPORATED	
1	27.10.17	YH	YH	SHD	27.10.17	SHD	27.10.17	SHD	NALCO'S COMMENT INCORPORATED	
0	11.08.17	PPV	PPV	SHD	11.08.17	SHD	11.08.17	SHD	ISSUED FOR NALCO'S COMMENT	

NALCO India / Owner/Client <input type="checkbox"/> 1 For Approved <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction		NALCO India / Owner/Client <input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing/ Fabrication With Comments as Noted <input type="checkbox"/> 3 Not Approved/Resubmit <input type="checkbox"/> 4 Retained for Information/Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted/Resubmit	
Contract No.	Document ID	Date	Rev.
	6695-INS-G00-FA-0001		02
Store Location: Server/Share	BWR-Code		
Store Location: Folder			
Store Name			
Proc. Unit	Con. Unit	Group	Order No.
NALCO National Aluminium Company Ltd. 1.0 MTPA ALUMINA REFINERY STREAM-5 DAMANJODI, ODISHA		thyssenkrupp thyssenkrupp Industrial Solutions (India) Private Limited	
OVERALL CONTROL SYSTEM ARCHITECTURE DRAWING			
Drawn	08.01.17	YH	
Prepared	08.01.17	YH	
Checked	08.01.17	SHD	
Approved	08.01.17	SHD	
Scale			
Doc. Code	Acc. Code	Acc. Code	Status
N.T.S.			



SUMMARY	
A) AREA DEVICES TO PLC	
B) PLC TO VFDs & VICE VERSA	
HARDWIRED DIGITAL SIGNALS:	
READY	
RUN FB	
FAULT	
START/STOP	
LOC/REM	
C) AREA DEVICES TO DCS	
D) VFD TO DCS & VICE VERSA	
HARDWIRED ANALOG SIGNALS:	
SPEED FEEDBACK (AI)	
CURRENT FEEDBACK (AI)	
SPEED REFERENCE TO VFD (AO)	
E) BATT. CHARGER/UPS/HVWS/MISC TO ECS	
HARDWIRED DIGITAL SIGNALS:	
STATUS	
FAULT	
F) 1) PLC TO DCS OVER COMMUNICATION	
READY F/B	
RUN F/B	
TRIP F/B	
INTERLOCK F/B	
2) DCS TO PLC OVER COMMUNICATION	
LOCAL/REMOTE SELECTION COMMAND	
START/STOP COMMAND	
INTERLOCKS	
G) 1) DCS TO ECS OVER COMMUNICATION	
STATUS OF PROCESS EQUIPMENTS MAY BE DIGITAL OR ANALOG SIGNALS	
2) ECS TO DCS OVER COMMUNICATION	
GRID DATA	
GENERATOR DATA	
H) ECS TO VFD & VICE VERSA OVER COMMUNICATION	
SOFT SIGNALS:	
VFD-SPEED	
VFD-CURRENT	
VFD-DC VOLTAGE	
VFD-POWER	
VFD-FAULT CODE	
ALL-RUN F/B	
ALL-READY F/B	
ALL-TRIP F/B	
LOC /REM STATUS-AS PER P&ID	
VFD TEMPERATURE	
I) 6.6KV AND 415V CUBICLES/PANELS TO PLC	
HARDWIRED DIGITAL SIGNALS:	
REMOTE START/STOP- DCS DO(SOFT)- PLC DO(HARDWIRED)	
REMOTE LOCAL/REM- DCS DO(SOFT)- PLC DO(HARDWIRED)	
READY F/B- PLC DI(HARDWIRED)	
RUN F/B- PLC DI(HARDWIRED)	
TRIP F/B- PLC DI(HARDWIRED)	
TRIP 86 F/B- PLC DI(HARDWIRED)	
95 TCS STATUS- PLC DI(HARDWIRED)	
J) 6.6KV AND 415V SWITCHBOARD TRANSDUCCERS TO DCS	
HARDWIRED ANALOG SIGNALS:	
CURRENT FEEDBACK (AI)	
K) 11KV SWITCHBOARD TRANSDUCCERS TO DCS	
HARDWIRED ANALOG SIGNALS:	
CURRENT FEEDBACK (AI)	
L) 11KV CUBICLES/PANELS TO ECS	
HARDWIRED DIGITAL SIGNALS:	
BREAKER ON / OFF	
RELAY 86 STATUS	
RELAY WATCHDOG	
95 TCS STATUS	
M) 6.6KV, 415V RELAYS COMMUNICATION TO ECS	
SOFT SIGNALS:	
TRIP 86	
TYPE OF FAULT	
READY	
RUN / ON / OFF	
RELAY WATCHDOG	
N) 11KV RELAYS COMMUNICATION TO ECS	
SOFT SIGNALS:	
TRIP 86	
TYPE OF FAULT	
READY	
RUN / ON / OFF	
RELAY WATCHDOG	
O) 6.6KV, 415V MFM COMMUNICATION TO ECS (30 kW and above)	
SOFT SIGNALS:	
CURRENT	
VOLTAGE	
POWER	
ENERGY	
RUN HOJR	
P) 11KV MFM COMMUNICATION TO ECS (30kW and above)	
SOFT SIGNALS:	
CURRENT	
VOLTAGE	
POWER	
ENERGY	
RUN HOJR	
Q) ECS OPERATING STATION COMMUNICATION TO ECS	

<input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction		<input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing/ Fabrication With Comments <input type="checkbox"/> 3 Not Approved/Resubmit <input type="checkbox"/> 4 Retained for Information/Records <input type="checkbox"/> 5 Revisited <input type="checkbox"/> 6 Reviewed as Noted/Resubmit	
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	6695-INS-G00-FA-0001		02
Store Location: Server/Share	BAR-Code		
Store Location: Folder			
Store Name			
Store Path			
Prn. Unit	Con. Unit	Group	Order No.
NALCO National Aluminium Company Ltd.		thyssenkrupp thyssenkrupp Industrial Solutions (India) Private Limited	
1.0 MTPA ALUMINA REFINERY STREAM-5 DAMANJODI, ODISHA			
OVERALL CONTROL SYSTEM ARCHITECTURE DRAWING			
Drawn	08.01.17	YH	
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Approved	08.01.17	SHD	
Scale	N.T.S.		

Rev.	Date	Drawn/Prepared	Checked	Approved	Description
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1	27.10.17	YH	SHD	SHD	NALCO'S COMMENT INCORPORATED
0	11.08.17	PPV	SHD	SHD	ISSUED FOR NALCO'S COMMENT

ISO 9001

CONTROL SYSTEM IO LIST

PROJ.NO.:	66-6695-700
PROJECT:	NALCO AUMINA
DOC.NO.:	6695-INS-G00-EB-0001

Sr	Rev	Loop No	Service	Range	Engg. Unit	Inst Tag no	System	System tag	Loc	IO Type	Signal type	Redun	Alarms	Setpoint	Controller action	Accessories	Remarks
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	

SAMPLE FORMAT



Signal type :

Junction box:

UAN
66-6695-700

PROJECT
NALCO ALUMINA

DOCUMENT NO. :6695-INS-G00-EB-0004

Intrinsic safe circuit: Yes/No

Page : 1

Location :
EL:

Location : Control Room

DCS CABINET

Tm'l strip:

Junction-box

**Branch
 cable**

**Main cable
 NOTE 1)**

NOTE 2)

Tm'l

Tm'l

Tm'l

CABLE NO

SAMPLE FORMAT



BUSBAR IN MARSHALLING CABINET

NOTES: 1)TYPE OF MAIN CABLE : 12 Pair x 0.75/1.0mm² armoured

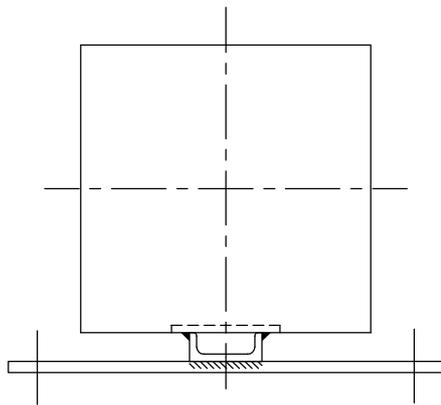
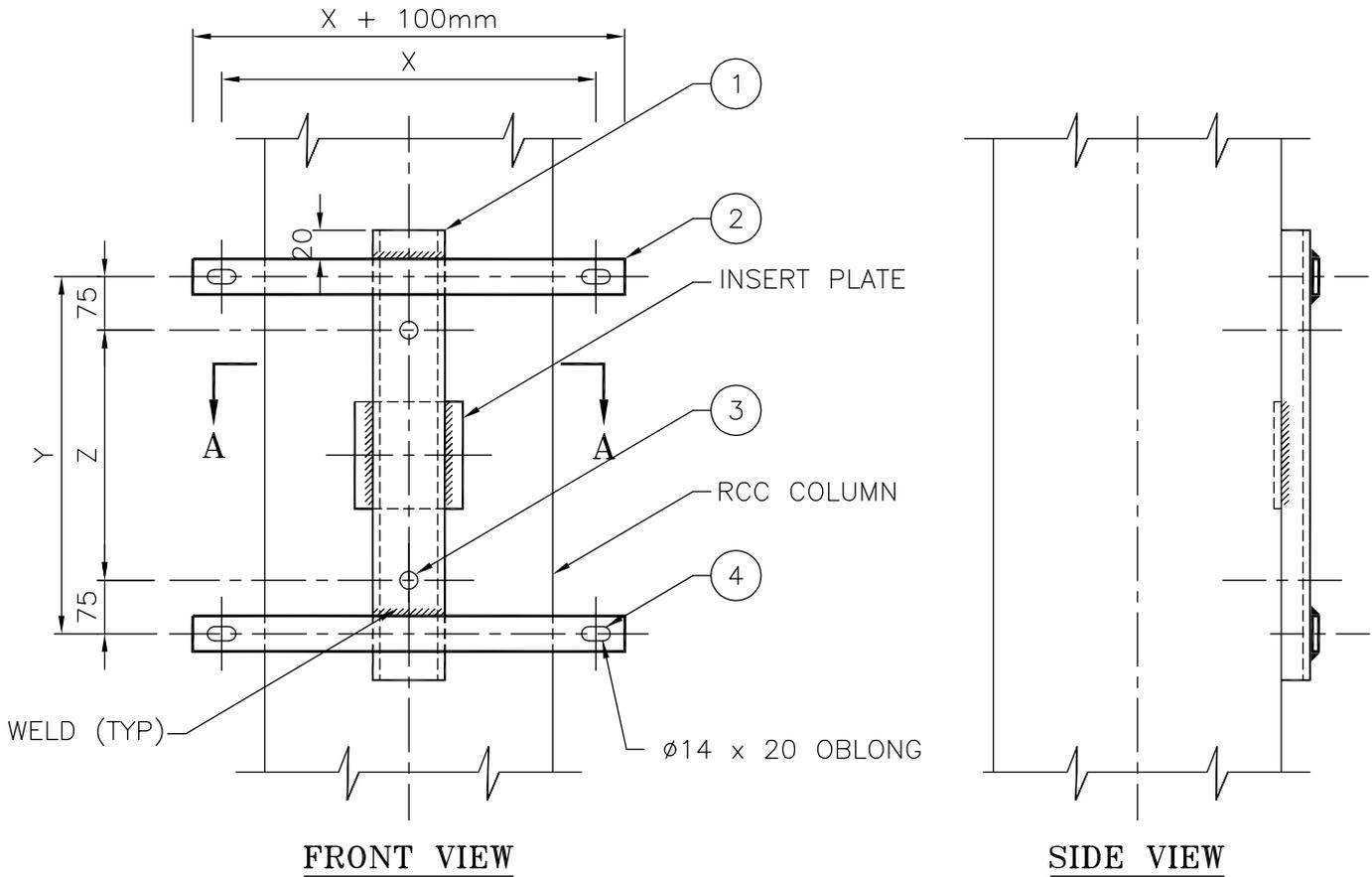
2)TYPE OF BRANCH CABLE : 1 Pair x 0.75/1.0mm² armoured

Rev.	Date	Name	Check	Description	Rev.	Date	Name	Check	Description

INTERLOCK LOGIC DIAGRAM

INPUT								LOGIC	OUTPUT						
Sr NO.	INTERLK. NO.	TAG NO DESCRIPTION	LOCATION	SET POINT	FROM SHEET	SYSTEM	CONTACT CONDITION		CONTACT ACTION	TO SHEET	LOCATION	FAIL POS	TAG NO DESCRIPTION	Sr	
1														1	
2														2	
3														3	
4														4	
5														5	
6														6	
7														7	
8														8	
9														9	
10														10	
11														11	
12														12	
13														13	
14														14	
15														15	
16														16	
Notes:								LOGIC DIAGRAM TITLE	INTERLOCK LOGIC DIAGRAMS						
								DOCUMENT NO.: 6695-INS-G00-EB-0005	PAGE :	 PROJECT NO. 66-6695-700					Rev 0

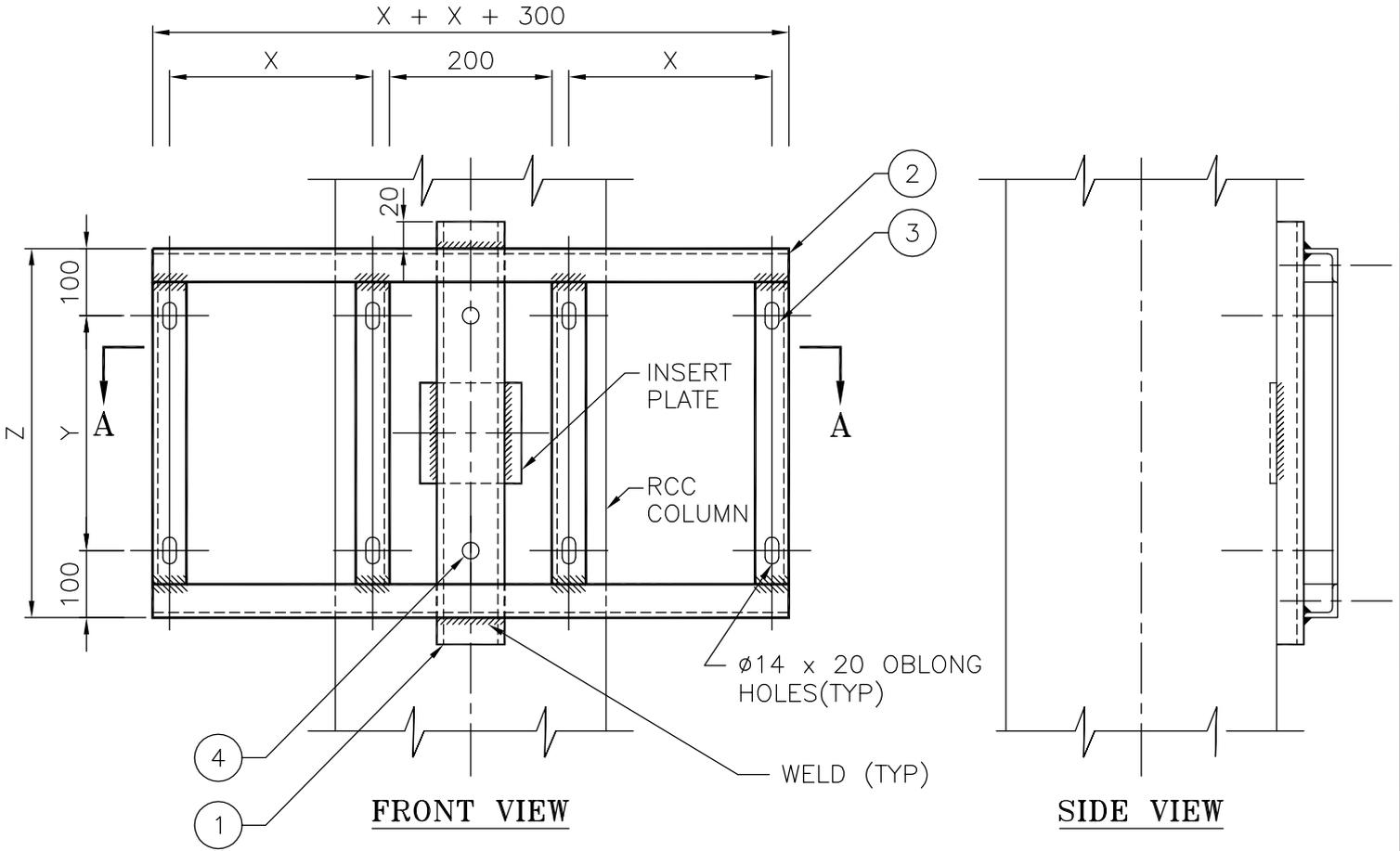
SAMPLE FORMAT



NOTE:—

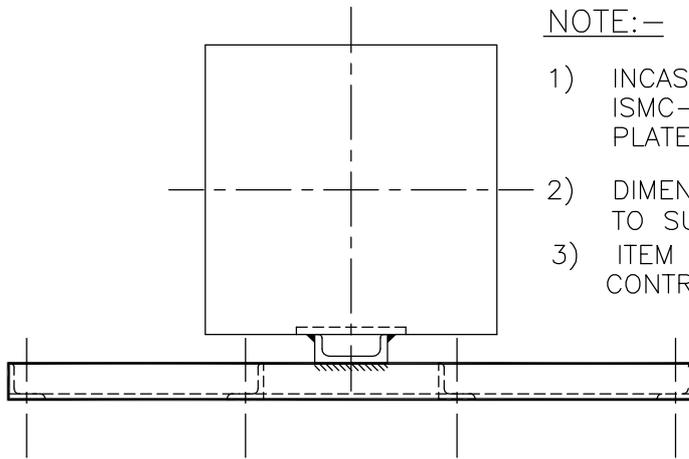
- 1) INCASE INSERT PLATE ARE AVAILABLE IN COLUMN ISMC-100 SHOULD BE WELDED TO THE INSERT PLATE & ANCHOR FASTENERS NOT TO BE USED.
- 2) DIMENSION X,Y & Z TO BE DECIDED AT SITE TO SUIT JUNCTION BOX DIMENSIONS.
- 3) ITEM NO 4 TO BE PROVIDED BY ERECTION CONTRACTOR.

4	NUTS & BOLTS WITH WASHERS	4 Nos	M12 x 40mm	M S GALVANISED
3	ANCHOR FASTENERS WITH BOLTS	2 Nos	M10 x 100mm	M S
2	FLAT	1M LONG	50 x 6 THK.	M S
1	ISMC CHANNEL	750mm LONG	100 x 50	M S
ITEM No	DESCRIPTION	QUANTITY	SIZE	MATERIAL



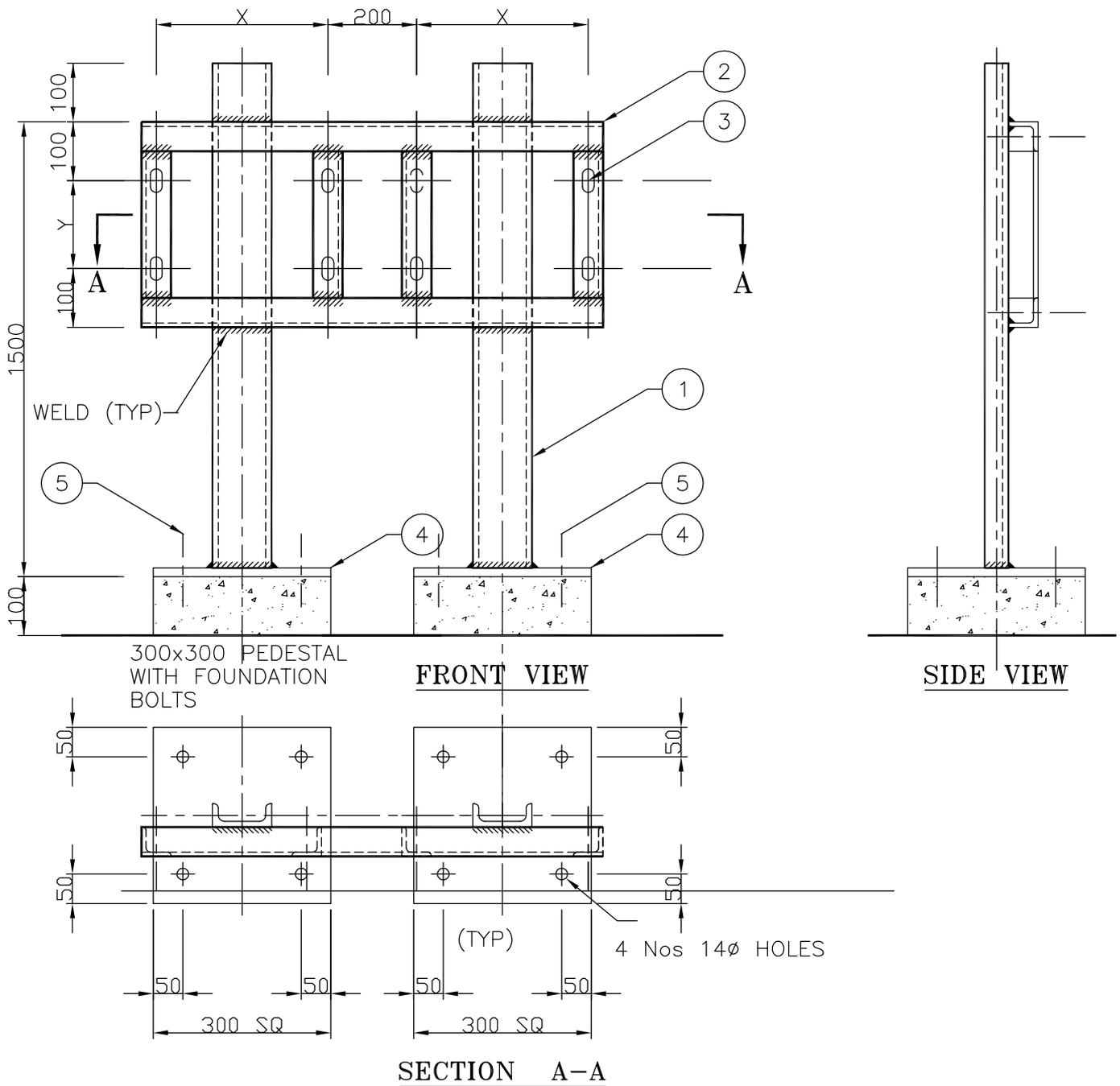
NOTE:-

- 1) INCASE INSERT PLATE ARE AVAILABLE IN COLUMN ISMC-100 SHOULD BE WELDED TO THE INSERT PLATE & ANCHOR FASTENERS NOT TO BE USED.
- 2) DIMENSION X,Y & Z TO BE DECIDED AT SITE TO SUIT JUNCTION BOX DIMENSIONS.
- 3) ITEM NO 4 TO BE PROVIDED BY ERECTION CONTRACTOR.



4	NUTS & BOLTS WITH WASHERS	8 Nos	M12 x 40mm	M S GALVANISED
3	ANCHOR FASTENERS WITH BOLTS	2 Nos	M10 X 100mm	M S
2	ANGLE	5M LONG	50x50x6THK	M S
1	ISMC CHANNEL	750mm LONG	100 x 50	M S
ITEM No	DESCRIPTION	QUANTITY	SIZE	MATERIAL

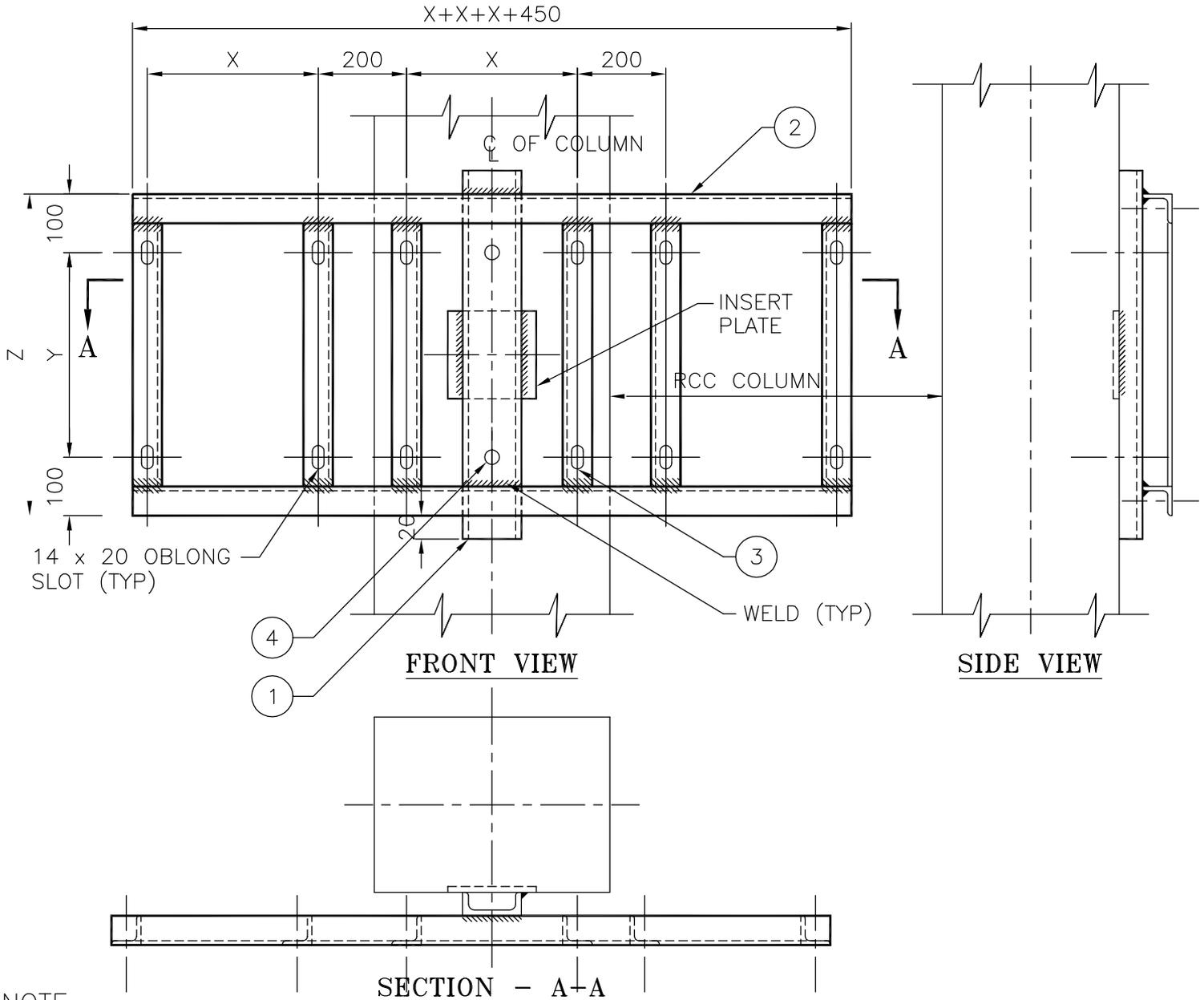
**STANDARD INSTALLATION DETAILS
 TWO JUNCTION BOXES FLOOR MOUNTED**



NOTE:-

- 1) DIMENSION X & Y TO BE DECIDED AT SITE TO SUIT JUNCTION BOX DIMENSIONS
- 2) ITEM NO 3 TO BE PROVIDED BY ERECTION CONTRACTOR.

5	ANCHOR FASTENERS WITH BOLTS	8 Nos	M12 x 125 LONG	M S
4	BASE PLATE	2 Nos	300 SQ x 6 THK	M S
3	NUTS & BOLTS WITH WASHERS	12 Nos	M12 x 40mm	M S GALVANISED
2	ANGLE	6M LONG	50x50x6THK	M S
1	ISM CHANNEL	3.2M LONG	100 x 50	M S
ITEM No	DESCRIPTION	QUANTITY	SIZE	MATERIAL

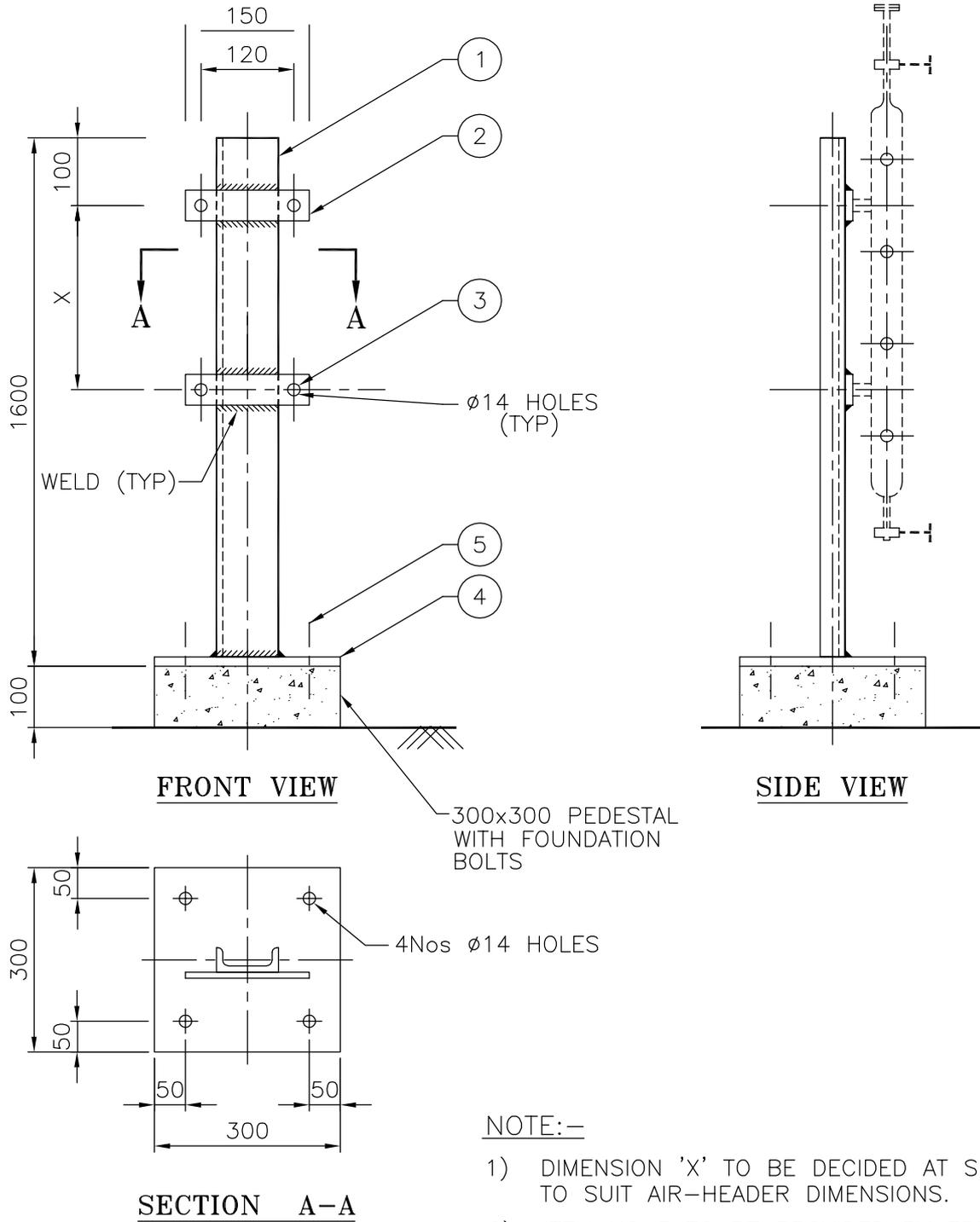


NOTE-

- 1) INCASE INSERT PLATE ARE AVAILABLE IN COLUMN ISMC-100 SHOULD BE WELDED TO INSERT PLATE & ANCHOR FASTENERS NOT TO BE USED.
- 2) DIMENSION X,Y & Z TO BE DECIDED AT SITE TO SUIT JUNCTION BOX DIMENSIONS.
- 3) ITEM NO 4 TO BE PROVIDED BY ERECTION CONTRACTOR.

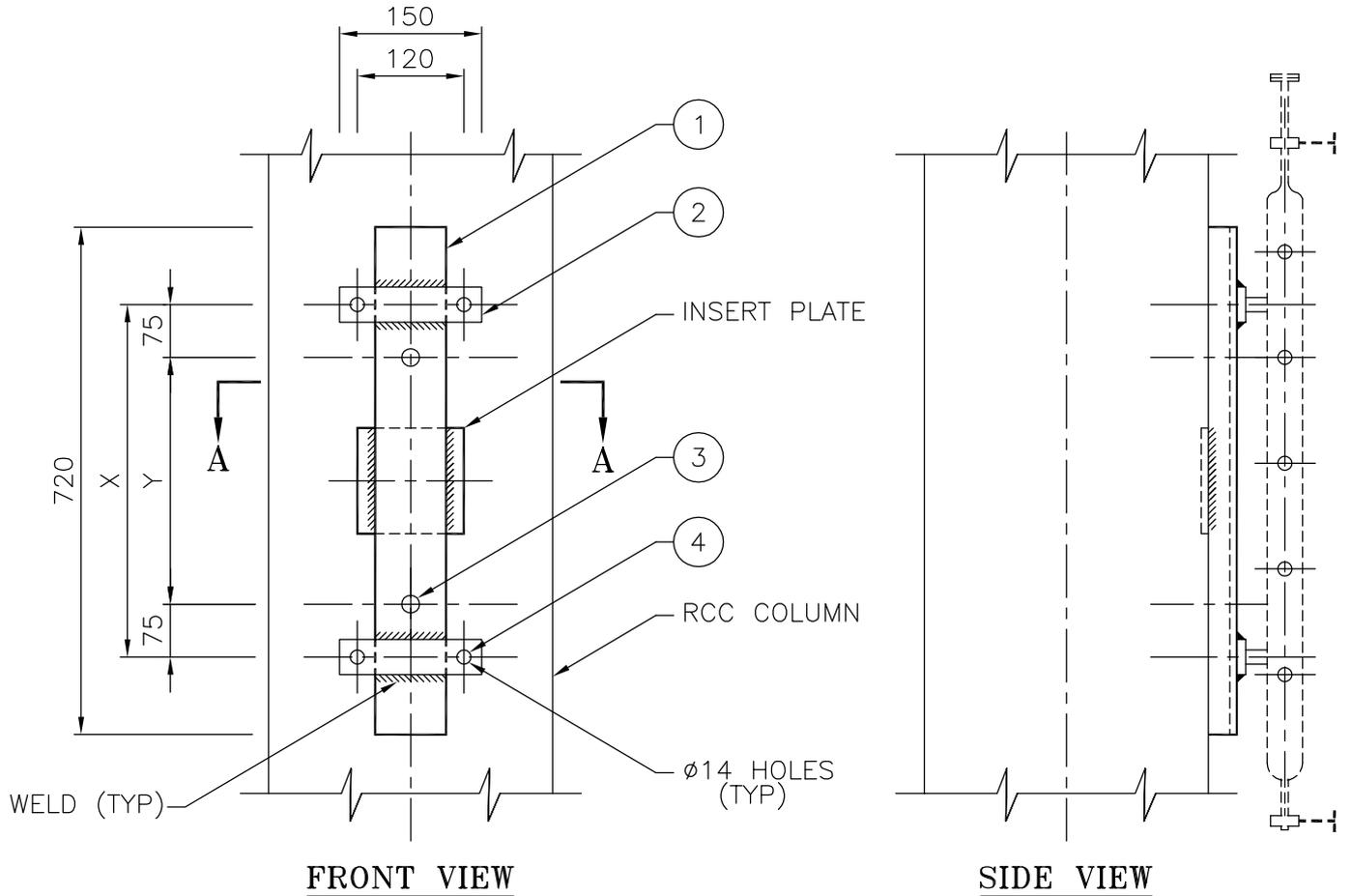
4	NUTS & BOLTS WITH WASHERS	12NOs	M12x40mm	M S GALVANISED
3	ANCHOR FASTENERS WITH BOLTS	2NOs	M10x100mm	M S
2	ANGLE	8M LONG	50x50x6THK	M S
1	ISMC CHANNEL	750mmLONG	100x50	M S
ITEM No	DESCRIPTION	QUANTITY	SIZE	MATERIAL

ONE AIR-HEADER ON FLOOR



5	ANCHOR FASTENERS WITH BOLTS	4 Nos	M12 x 125 LONG	M S
4	BASE PLATE	1 No	300 SQ x 6 THK	M S
3	NUTS & BOLTS WITH WASHERS	4 Nos	M12 x 40mm	M S GALVANISED
2	FLAT	300mm LONG	50 x 6 THK	M S
1	ISMC CHANNEL	1.6M LONG	100 x 50	M S
ITEM No	DESCRIPTION	QUANTITY	SIZE	MATERIAL

ONE AIR-HEADER ON COLUMN

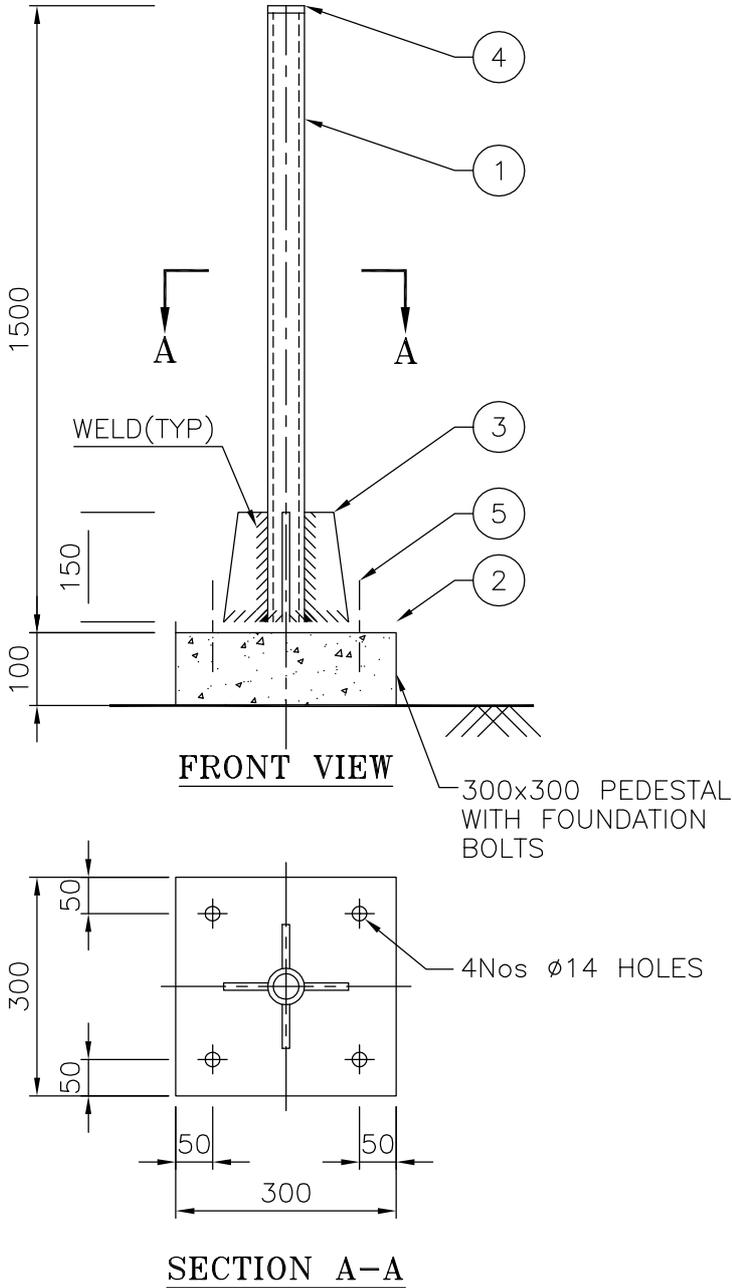


NOTE:-

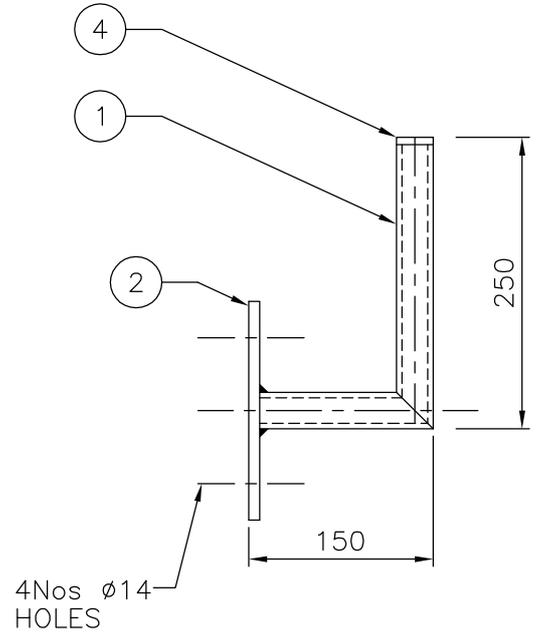
- 1) INCASE INSERT PLATE ARE AVAILABLE IN COLUMN ISMC-100 SHOULD BE WELDED TO THE INSERT PLATE & ANCHOR FASTENERS NOT TO BE USED.
- 2) DIMENSION 'X' & 'Y' TO BE DECIDED AT SITE TO SUIT AIR-HEADER DIMENSIONS.
- 3) ITEM NO 4 TO BE PROVIDED BY ERECTION CONTRACTOR.

ITEM No	DESCRIPTION	QUANTITY	SIZE	MATERIAL
4	NUTS & BOLTS WITH WASHERS	4 Nos	M12 x 40mm	M S GALVANISED
3	ANCHOR FASTENERS WITH BOLTS	2 Nos	M10 x 100mm	M S
2	FLAT	300mm LONG	50 x 6 THK	M S
1	ISMC CHANNEL	1M LONG	100 x 50	M S

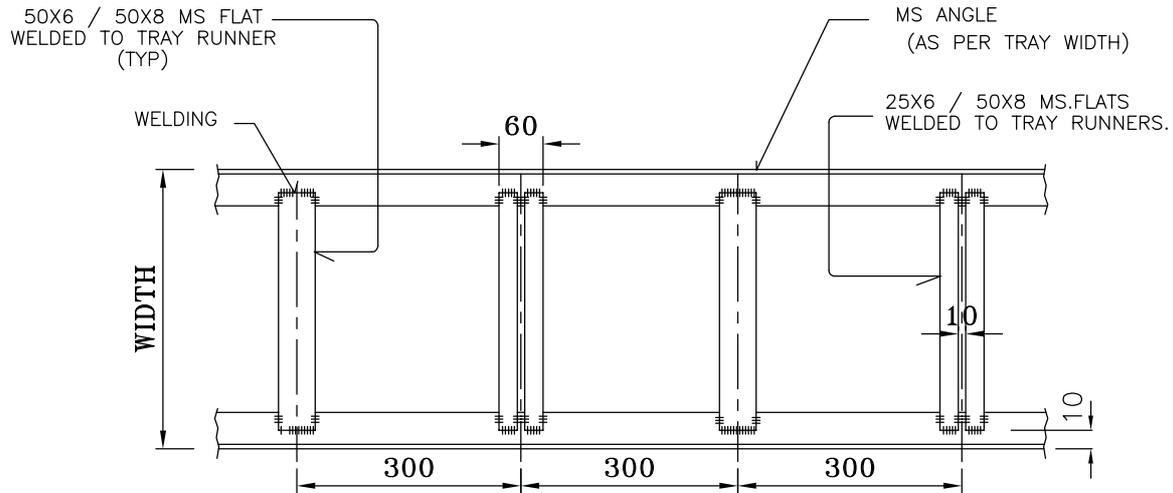
FLOOR MOUNTING
TYPE-A



STRUCTURE MOUNTING
TYPE-B



5	ANCHOR FASTENERS WITH BOLTS	4 Nos		M12 x 125 LONG	M S
4	COVER PLATE FOR PIPE	1 No	1 No	6 THK	M S
3	RIBS (STIFFNERS)	4 Nos	4 Nos	150x60x40 6 THK	M S
2	BASE PLATE	1 No	1 No	300 SQ x 6 THK	M S
1	PIPE HEAVY DUTY TYPE(THK- 4.5 mm)	1.6M LONG	0.5M LONG	2" NB	IS - 1239 PART - 1
ITEM No	DESCRIPTION	QUANTITY TYPE-A	QUANTITY TYPE-B	SIZE	MATERIAL

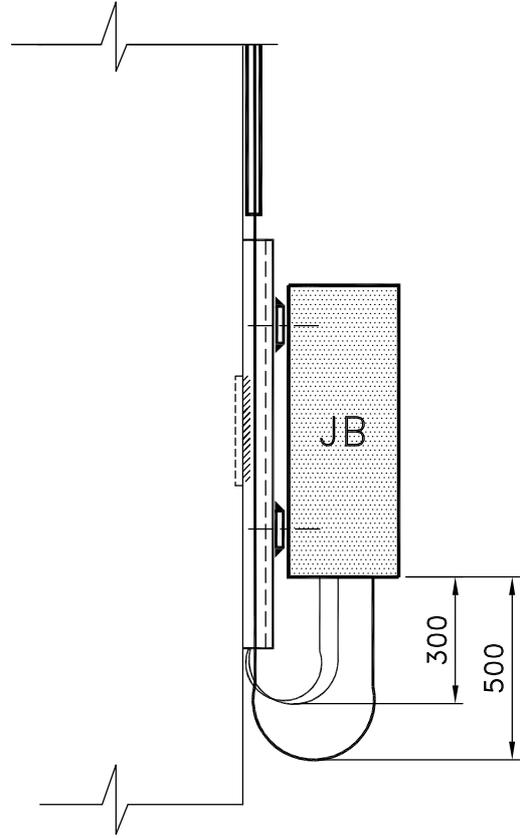
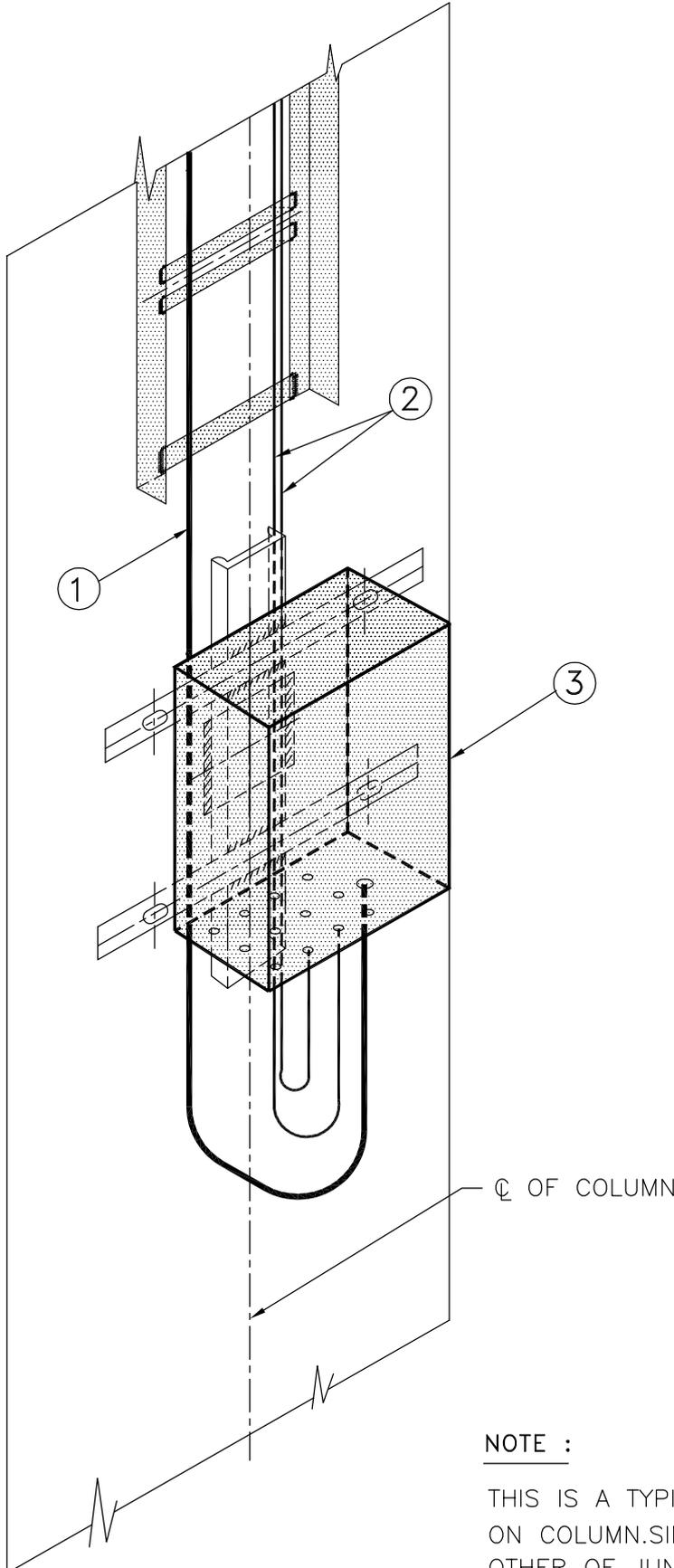
CABLE TRAY

TYPICAL CABLE TRAY PLAN
STRUCTURAL STEEL DETAILS.

CABLE TRAY WIDTH	M.S.ANGLE SIZE FOR STRAIGHT RUN	SECTION SIZE FOR CROSS RUNGS.	WEIGHT OF THE TRAY PER METRE (kg)
100	35X35X3 ANGLE	25X6 & 50X6 FLATS.	4
150	40X40X6 ANGLE	25X6 & 50X6 FLATS.	8.2
200	50X50X6 ANGLE	25X6 & 50X6 FLATS.	10.6
300	50X50X6 ANGLE	25X6 & 50X6 FLATS.	11.4
400	50X50X6 ANGLE	25X6 & 50X6 FLATS.	12.2
500	50X50X6 ANGLE	25X6 & 50X6 FLATS.	13
600	75X75X6X6 ANGLE	25X6 & 50X6 FLATS.	18.4
700	75X75X6 ANGLE	25X6 & 50X6 FLATS.	19.2
800	75X75X6 ANGLE	25X6 & 50X6 FLATS.	20
900	75X75X6 ANGLE	25X8 & 50X8 FLATS.	23.05
1000	75X75X6 ANGLE	25X8 & 50X8 FLATS.	24.1

ISA DESIGNATION	STRUCTURAL STEEL MATERIAL FOR CABLE TRAY,SUPPORTS, ETC.	UNIT WT.IN kg/m (AS PER ISI HANDBOOK)
ISA 7575	75X75X6 M.S.ANGLE	6.8
ISA 5050	50X50X6 M.S.ANGLE	4.5
ISA 4040	40X40X6 M.S.ANGLE	3.5
ISA 3535	35X35X3 M.S.ANGLE	1.6
ISMC 100	100X50 M.S.CHANNEL	9.2
ISMC 75	75X40 M.S.CHANNEL	6.8
	50X6 M.S.FLAT / 50X8 M. S. FLAT	2.4 / 3.1
	25X6 M.S.FLAT / 25X8 M. S. FLAT	1.2 / 1.6

- NOTE :**
- 1) ALL DIMENSIONS ARE IN mm.
 - 2) CABLE TRAYS SHALL BE PAINTED AS PER INSTALLATION SPECIFICATION.

**TYPICAL JUNCTION BOX INSTALLATION
 ON A COLUMN**



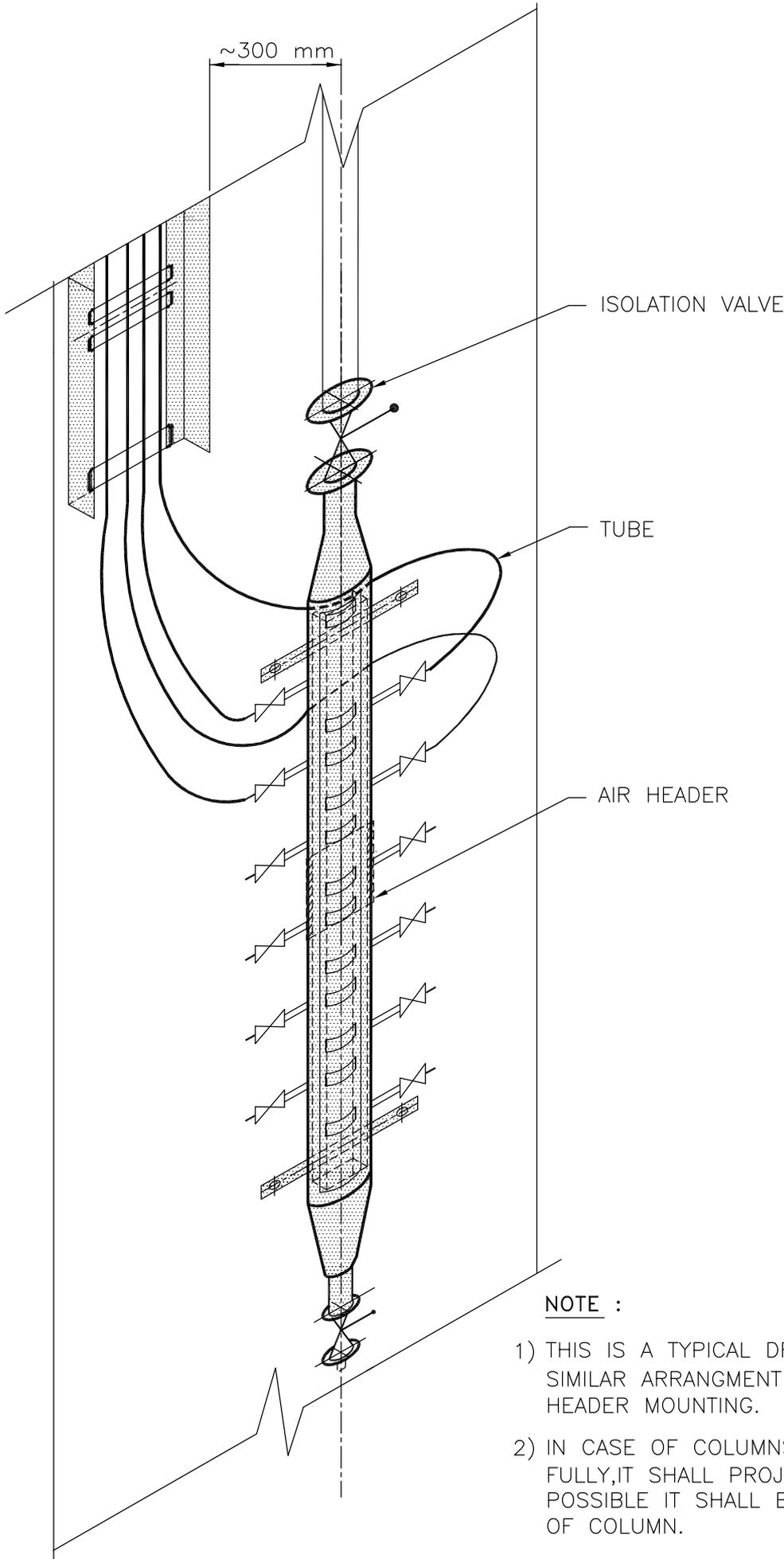
SIDE VIEW

- ① MAIN CABLE
- ② BRANCH CABLES
- ③ JUNCTION BOX

NOTE :

THIS IS A TYPICAL DRAWING FOR JB & TRAY INSTALLATION ON COLUMN.SIMILAR ARRANGEMENT SHALL BE MADE FOR OTHER OF JUNCTION BOX MOUNTINGS ON STANCHION.

TYPICAL INSTRUMENT AIR HEADER
 INSTALLATION ON COLUMN



NOTE :

- 1) THIS IS A TYPICAL DRAWING FOR AIRHEADER INSTALLATION. SIMILAR ARRANGMENT SHALL BE MADE FOR ALL AIR HEADER MOUNTING.
- 2) IN CASE OF COLUMNS WHERE TRAY IS NOT SUPPORTED FULLY,IT SHALL PROJECT OUT.HOWEVER AS FAR AS POSSIBLE IT SHALL BE MAINTAINED ON THE SAME FACE OF COLUMN.

STANDARDS FOR ORIFICE PLATE ASSEMBLIES

SQUARE EDGED CONCENTRIC ORIFICE PLATE FOR ORIFICE PLATE FLANGES AS PER ANSI (LINE SIZE ≥ 2")

A GENERAL NOTES:

1. Nominal size, rating, D, d, r, and material according to the specification sheets attached.
2. The manufacturer shall provide a drain hole in the orifice plate only if specified. Diameter of drain hole shall not exceed 0.1d and no part of the hole shall lie within a circle, concentric with orifice, of diameter (D-0.2d). The outer edge of the drain hole shall be circle, concentric with orifice, of diameter (D-0.2d). The outer edge of the drain hole shall be as close to pipe wall as practicable. Correction formula for drain hole is

$$d_m = d[1 - 0.55 (d_k/d)^2]$$

d_k = Drain hole diameter,
d = bore diameter,
 d_m = Corrected bore diameter.

3. The normal orifice plate must be flat [Max. departure : 0.125 mm per 25.4mm]
4. Upstream face of the orifice plate shall have a roughness criterion $R_a \leq 10^{-4}d$ within a circle of D.
5. The inlet edge of the orifice plate must be sharp and square so that it will not reflect a beam of light when viewed without magnification. Wire drawn or rounded edges must be avoided. For $d \leq 25\text{mm}$ visual inspection is not sufficient and radius shall be measured.
6. Tolerances :

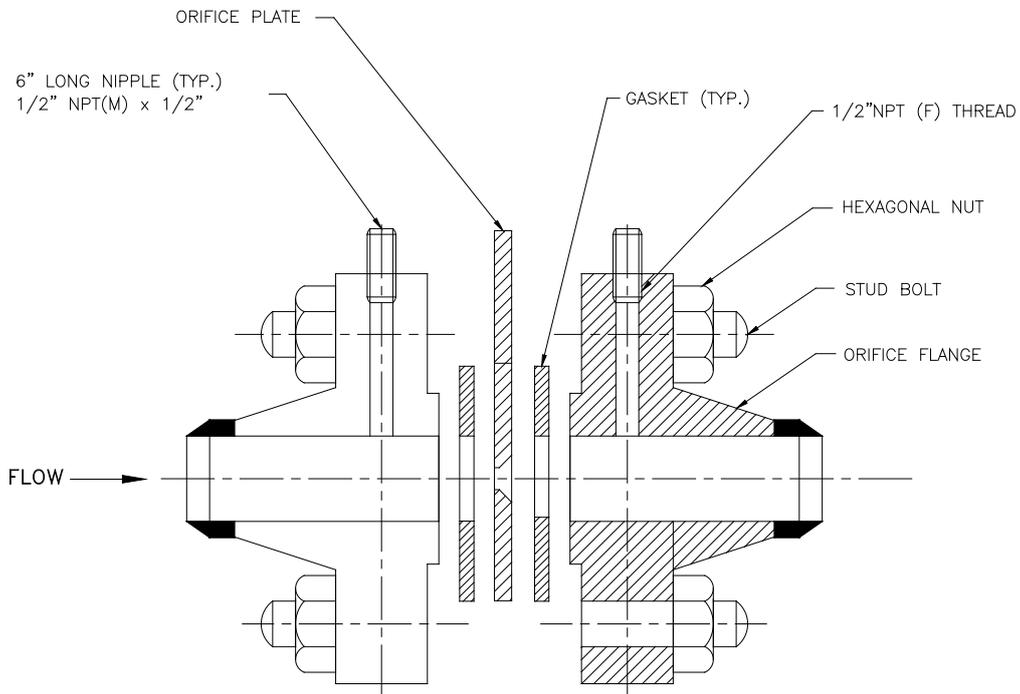
A	±0.4mm
B	±0.25mm
C	±0.4mm
d	±0.05% of mean 'd' *

dk	±0.051
R	+0 -1.59mm
e	±0.001 D
E	±0.001 D

- * Minimum 4 readings to be taken at equal angles.

STANDARDS FOR ORIFICE PLATE ASSEMBLIES

B ORIFICE ASSEMBLY



NOTE:-

L1 = 25.4 mm ± 0.5 mm (AFTER FULL GASKET COMPRESSION)
WHEN $\beta > 0.6$ & $D < 150$ mm.

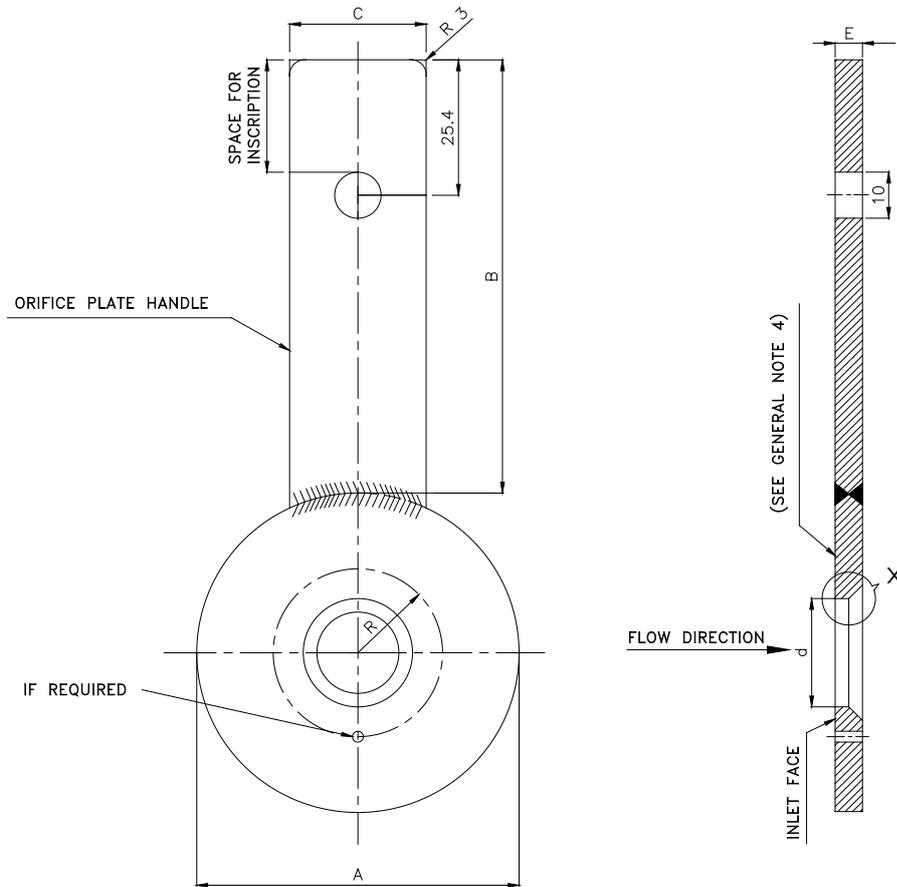
L2 = 25.4 mm ± 1 mm (AFTER FULL GASKET COMPRESSION)
WHEN $\beta < 0.6$ OR WHEN $\beta > 0.6$ & $150 < D < 1000$ mm.

L1 - UPSTREAM TAP LOCATION (C) TO UPSTREAM FACE OF ORIFICE.

L2 - DOWNSTREAM TAP LOCATION (C) TO DOWNSTREAM FACE OF ORIFICE.

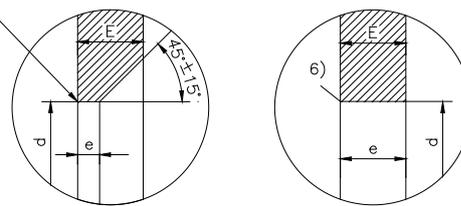
STANDARDS FOR ORIFICE PLATE ASSEMBLIES

C DETAILS OF ORIFICE PLATE



DETAIL-'X'

SEE GENERAL NOTE 5



$e < E$

$e = E$

CHAMFER OF OUTLET FACE CORNER AT $e < E$
 NO CHAMFER AT $e = E$ (SEE TABLE 1)

NOTES:

- i) ALL DIMENSIONS IN mm.
- ii) DO NOT SCALE THIS DRAWING.

STANDARDS FOR ORIFICE PLATE ASSEMBLIES

D TABLES GIVING DIMENSIONAL DETAILS

TABLE - I

SIZE INCH	A						B	C	e	E	SIZE INCH
	150#	300#	600#	900#	1500#	2500#					
2	104.8	111.1	111.1	142.9	142.9	146.1	100		0.79	3.18	2
3	136.5	149.2	149.1	168.3	174.6	196.9					3
4	174.6	181.1	193.7	206.4	209.6	235					4
6	222.3	250.7	266.7	288.9	282.6	317.5	125	25	1.59	3.18	6
8	279.4	308	320.7	358.8	352.4	387.4					8
10	339.7	362	400.1	435	435	476.3	150	38	3.18	6.35	10
12	409.6	422.3	457.2	498.5	520.7	549.4					12
14	450.9	485.8	492.1	520.7	577.9	-					14
16	514.4	539.8	565.2	574.7	641.4	-					16
18	549.3	596.9	612.8	638.2	704.9	-					18
20	606.4	654.1	682.6	698.5	755.7	-					20
24	717.6	774.7	790.6	838.2	901.7	-		9.52	9.52	24	

NOTES:-

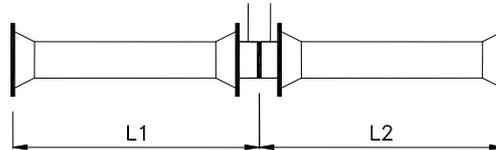
- i) ALL DIMENSIONS ARE IN mm EXCEPT LINE SIZES WHICH ARE IN INCHES.
- ii) D-INSIDE DIAMETER OF PIPE.
- iii) R, G-GENERAL NOTE 2.
- iv) EXTREME COMBINATION OF TEMP,PRESSURE & HIGH DIFFERENTIALS CAN REQUIRE ORIFICE PLATES THICKER THAN THOSE SPECIFIED IN TABLE.
- v) SEE GENERAL NOTE 6 FOR TOLERENCES.

STANDARDS FOR ORIFICE PLATE ASSEMBLIES

METER RUN ORIFICE ASSEMBLY (FOR 1" & 1 1/2" SIZE)

A GENERAL NOTES:

1. Straight Length Requirements



SIZE	L1	L2
1"	1250	300
1 1/2"	2000	350

2. Pipes shall be of SCH 40 min. higher schedules to be considered if specified.
3. The pipes shall have high quality smooth internal surfaces. Uniform equivalent roughness "K" shall be < 0.03 mm. If pipe is machined, the surface finish shall be better than 0.3 micrometer.
4. Corner taps shall be used as per attached sketch.
5. β shall be chosen in such a way that following conditions shall be satisfied.
 - a) $0.23 \leq \beta \leq 0.7$
 - b) $0.032 \leq C \beta^2 (1 - \beta^4)^{-0.5} \leq 0.35$
6. Complete assembly shall be calibrated at a standard laboratory.
7. Meter-run size, rating, D,d,r and material shall be according to the specification sheets attached.
8. The manufacturer shall provide a drain hole in the orifice plate only if this is specified in the individual data sheets. Diameter of drain hole shall not exceed 0.1d and no part of the drain hole shall lie within a circle concentric with orifice of diameter (D-0.2d). The outer edge of the drain hole shall be as close to pipe wall as practicable. Orifice bore shall be corrected for drain hole using following formula.

$$d_m = d [1 - 0.55(d_k/d)^2]$$

- d_k - Drain hole diameter
- d - Calculated bore diameter
- d_m - Corrected bore diameter

9. The normal orifice plate must be flat (Max. departure 0.125 mm per 25.4mm)
10. The surface of the orifice plate must be free of mechanical damage and polished on the inlet face. Upstream face of the orifice plate shall have a roughness criterion $R_a \leq 10^{-4} d$ within a circle of diameter D.
11. Tolerances :

D_a	$\pm 1\text{mm}$
D_i	+1 -0mm
G	$\pm 0.051\text{mm}$
d	$\pm 0.05\%$ of mean 'd' *

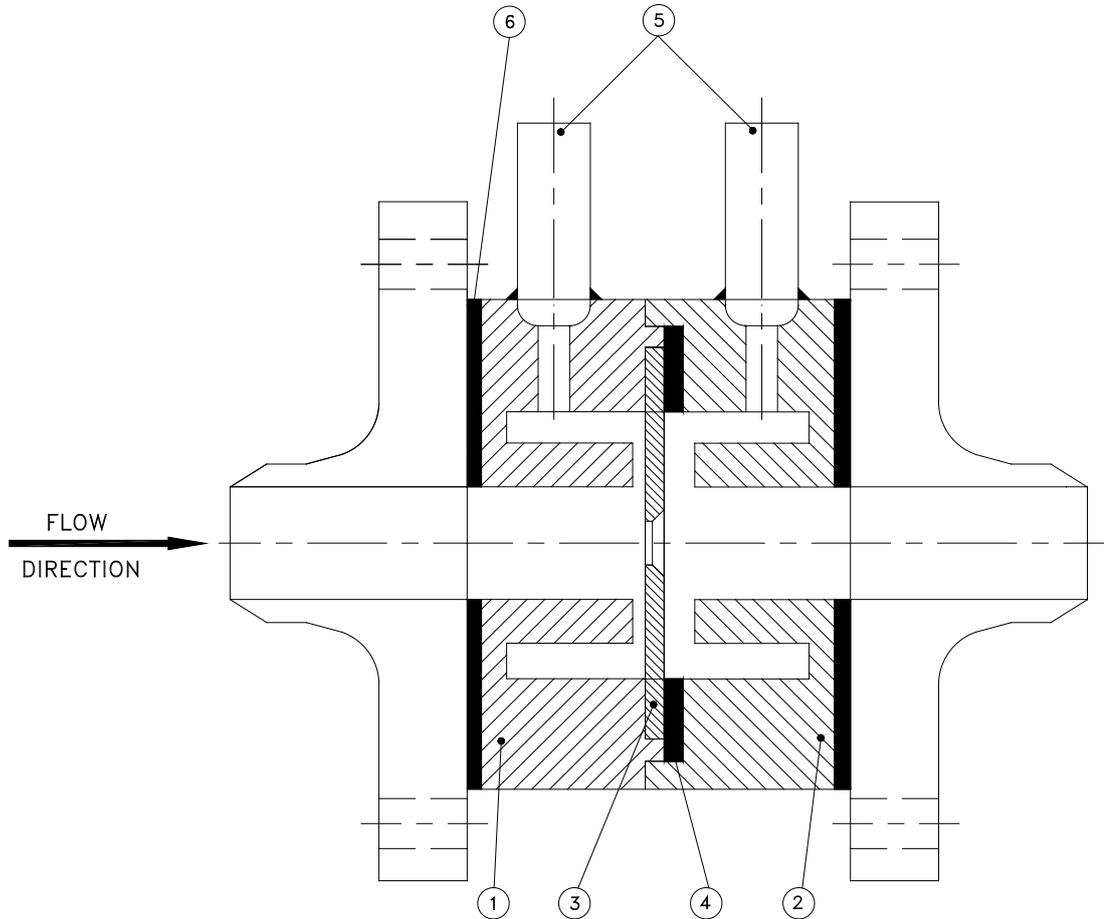
R	+0 -1.59mm
e	$\pm 0.001 D$
E	$\pm 0.001 D$
-	-

- * Minimum 4 readings to be taken at equal angles.

12. The inlet edge of the orifice plate must be sharp and square so that it will not reflect a beam of light when viewed without magnification. Wire drawn or rounded edges must be avoided. Radius of edge shall not be greater than 0.0004d. For $d < 25$ mm visual inspection is not sufficient.

STANDARDS FOR ORIFICE PLATE ASSEMBLIES

B ORIFICE ASSEMBLY:



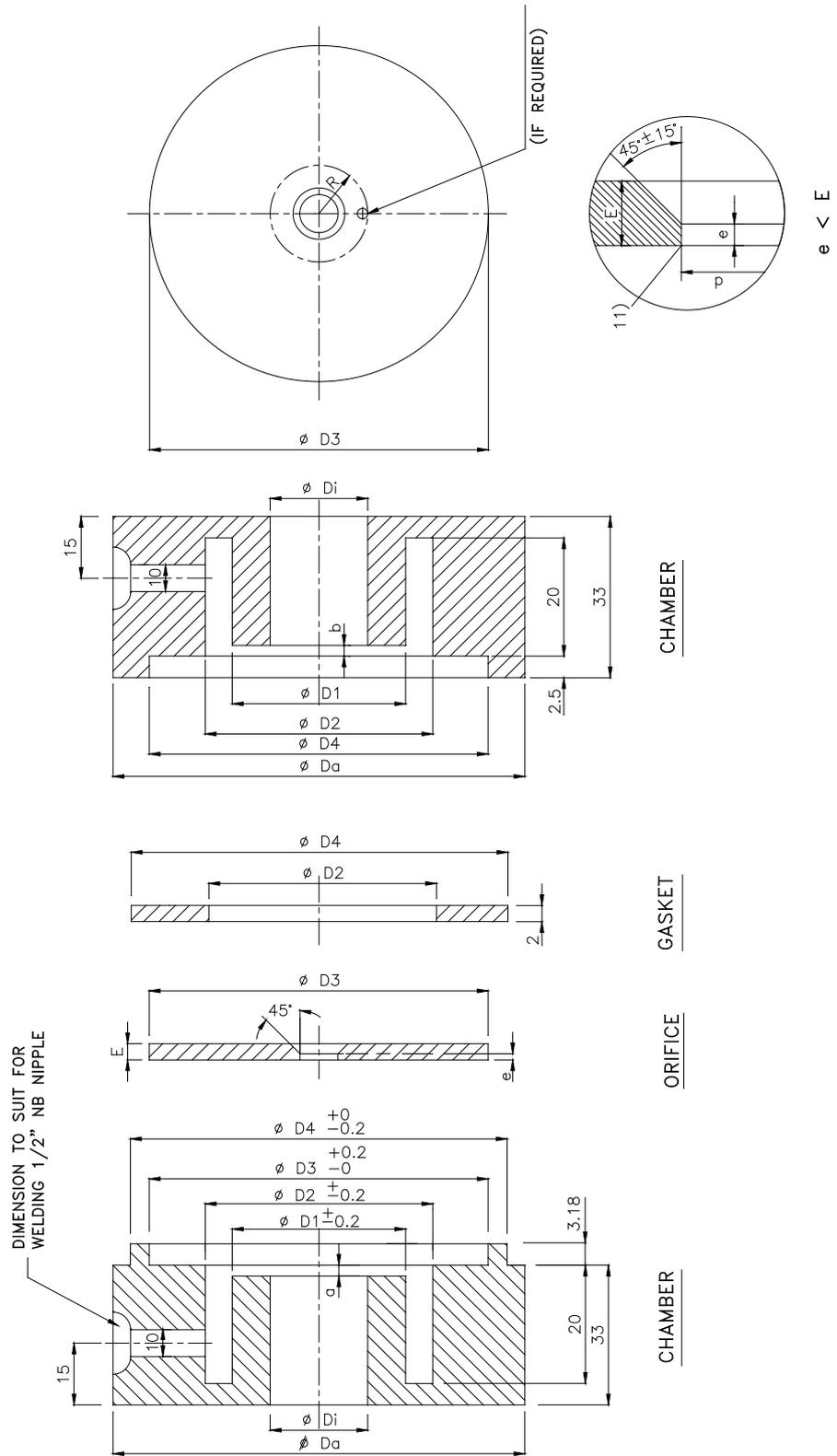
6	2	GASKET (TYP.)
5	2	150 mm NIPPLE 1/2" NB X
4	1	GASKET
3	1	ORIFICE PLATE
2	1	ANNULAR CHAMBER/DOWN STREAM SIDE
1	1	ANNULAR CHAMBER/UPSTREAM SIDE
PART	PIECE	DESCRIPTION

SIZE	E	e	D1	D2	D3	a	b	150#		300#		600#		900# / 1500#		2500#	
								D4	Da	D4	Da	D4	Da	D4	Da	D4	Da
25	3.18	0.43	36	46	52	1.5	1	62	66.55	66	73	66	73	73	79.37	79	85.72
40		0.68	54	64	70	1.5	1	80	85.85	89	95.25	89	95.25	92	98.55	111	117.47

NOTE : i) All dimensions are in mm.

STANDARDS FOR ORIFICE PLATE ASSEMBLIES

C DETAILS OF CARRIER RING :





thyssenkrupp

नालको NALCO

नेशनल एल्युमिनियम कम्पनी लिमिटेड
National Aluminium Company Ltd.

1.0 MTPA ALUMINA REFINERY STREAM-5
DAMANJODI, ODISHA

FLANGED THERMOWELL TEMPERATURE GAUGE

U A N

6695

DRG.No

6695-INS-G00-EB-0020

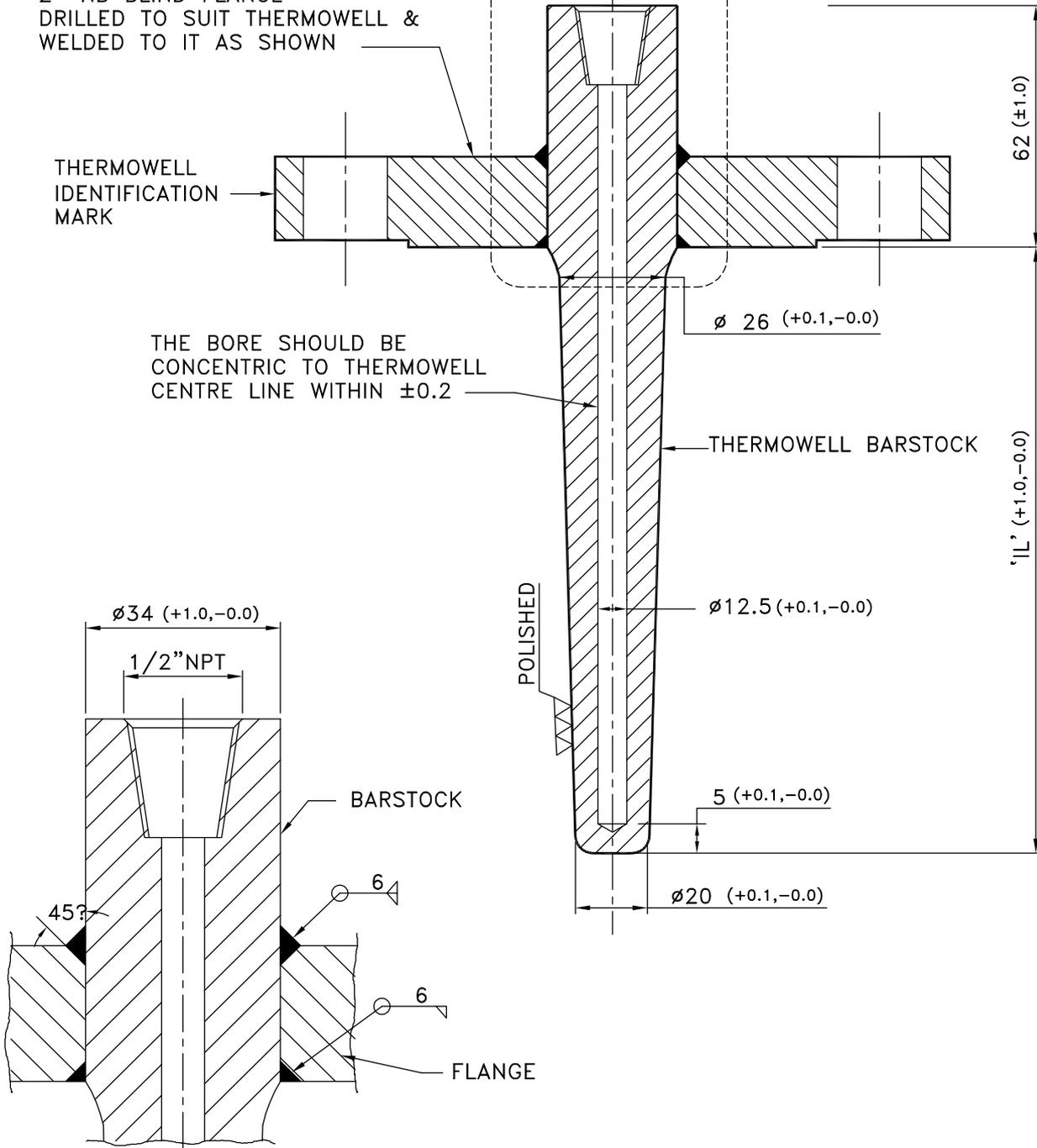
SHEET- 01

2" NB BLIND FLANGE
DRILLED TO SUIT THERMOWELL &
WELDED TO IT AS SHOWN

THERMOWELL
IDENTIFICATION
MARK

THE BORE SHOULD BE
CONCENTRIC TO THERMOWELL
CENTRE LINE WITHIN ± 0.2

DETAIL 'A'



DETAIL 'A'

NOTES:

- 1) ALL DIMENSIONS ARE IN mm.
- 2) DETAILS LIKE FLANGE RATING, FACING, SURFACE FINISH, INSERTION LENGTH 'L', MATERIAL OF WELL AND FLANGE ETC., ARE INDICATED AGAINST INDIVIDUAL TAG NUMBERS.



thyssenkrupp

नालको NALCO

नेशनल एल्युमिनियम कम्पनी लिमिटेड
National Aluminium Company Ltd.

1.0 MTPA ALUMINA REFINERY STREAM-5
DAMANJODI, ODISHA

FLANGED THERMOWELL RTD & THERMOCOUPLE

U A N

6695

DRG.No

6695-INS-G00-EB-0021

SHEET- 02

2" NB BLIND FLANGE
DRILLED TO SUIT THERMOWELL &
WELDED TO IT AS SHOWN

THERMOWELL
IDENTIFICATION
MARK

THE BORE SHOULD BE
CONCENTRIC TO THERMOWELL
CENTRE LINE WITHIN ± 0.2

DETAIL 'A'

62 (± 1.0)

$\phi 26 (+0.1, -0.0)$

THERMOWELL BARSTOCK

'L' ($\pm 1.0, -0.0$)

$\phi = \text{SENSOR BULB OD} + 0.5$
($+0.1, -0.0$)

POLISHED

5 ($+0.1, -0.0$)

$\phi 16 (+0.1, -0.0)$

$\phi 34 (+1.0, -0.0)$

1/2" NPT

BARSTOCK

45°

6

6

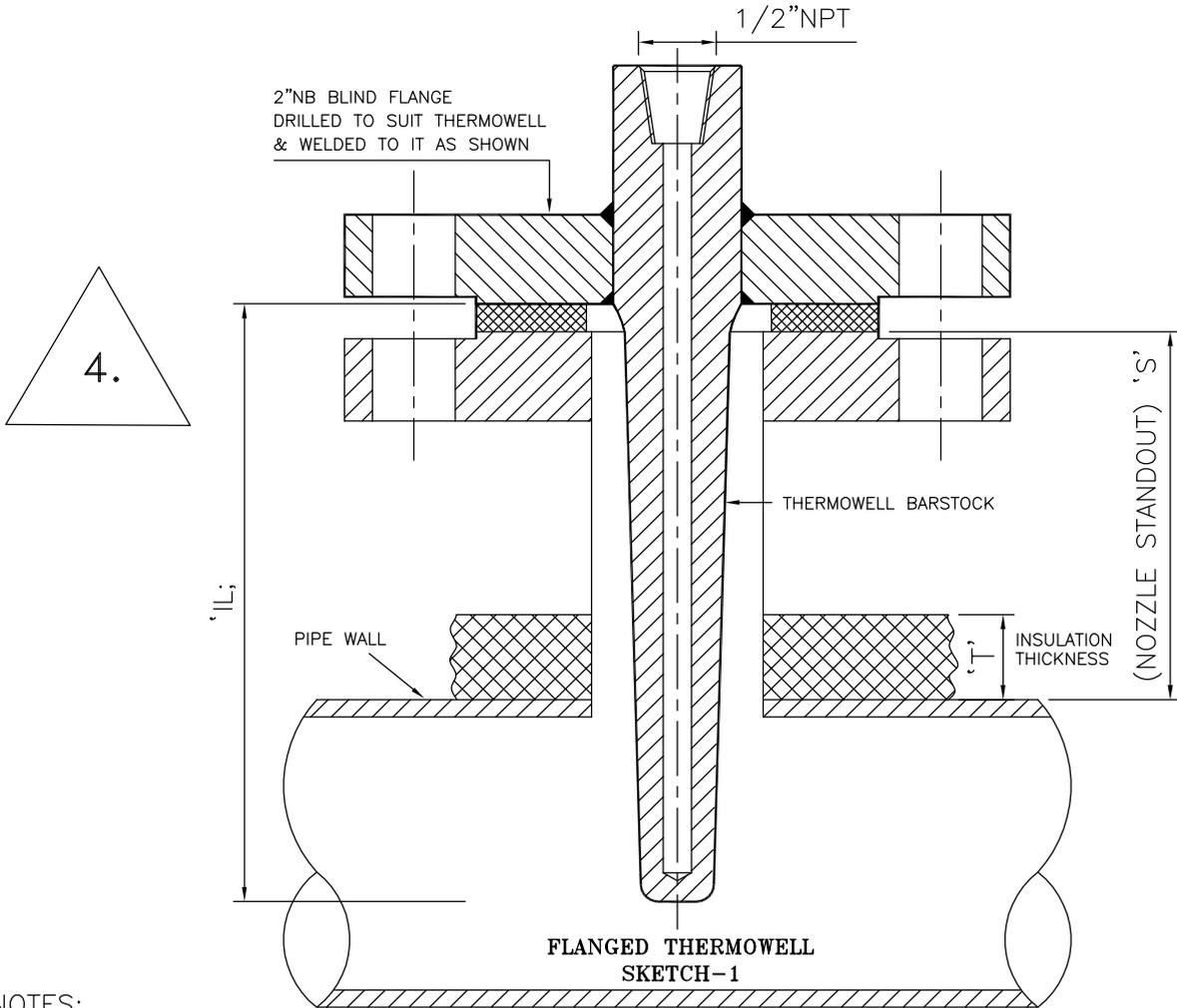
FLANGE

DETAIL 'A'

NOTES:

- 1) ALL DIMENSIONS ARE IN mm.
- 2) DETAILS LIKE FLANGE RATING, FACING, SURFACE FINISH, INSERTION LENGTH 'L', MATERIAL OF WELL AND FLANGE ETC., ARE INDICATED AGAINST INDIVIDUAL TAG NUMBERS.

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NOTES:

1. INSERTION LENGTH FOR 3" PIPE ARE SUITABLE UPTO SCHEDULE 80 PIPE.
IN CASE OF 3" PIPE FOR SCHEDULES HIGHER THAN 80, THERMOWELL MAY FOUL WITH PIPE.
2. INSERTION LENGTH FOR FLANGED THERMOWELL IS INDICATED FOR NOZZLE STANDOUT INDICATED.
IN CASE OF DIFFERENT NOZZLE STANDOUT (eg. PLASTIC & LINED PIPES), "IL" SHALL BE ADJUSTED ACCORDINGLY.

TABLE: 'A' (FLANGED THERMOWELL)

		INSERTION LENGTH 'IL' mm				
		REFER NOTE 1 & 2.				
	't' INSULATION THICK	0 ≤ 50	> 50 ≤ 100	> 100 ≤ 150	> 150 ≤ 200	> 200
LINE SIZE (mm) ↓	(Nozzle 'S' Standout) →	(150mm)	(200mm)	(250mm)	(300mm)	(350mm)
80-150 (3"-6") (NOTE1)		220	270	320	370	420
200-400 (8"-16")		270	320	370	420	470
450 > 18"		320	370	420	470	-
TANK- [*] ↓ VESSELS	(Nozzle 'S' Standout) →	(200mm)	(200mm)	(250mm)	(300mm)	
NO SCALE		370	370	420	470	-
> 50 MM SCALE		420	420	470	520	-
> 100 MM SCALE		470	470	520	570	-
> 150 MM SCALE		520	520	570	620	-

(Check MQ drawings for Nozzle stand-out, Equipment internals like agitator etc. & scaling length inside the equipment)

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	system_io_type	location	system	system_location_satellite		sorted_loop_number	Remark	rev_no
tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
Tags Indicated below are for Tagging Philosphy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.														

STANDARD INDEX COLUMNS FOR SUBMISSION

TAG NUMBER	P&ID	LINE NUMBER	EQUIPMENT NUMBER-	Associated Instrument Number(Details to be included as required for corelation of tags)	SERVICE (With Abbreviation & Shall be less than 24 character)	INSTRUMENT TYPE DESCRIPTION (REFER NOTE BELOW)	STATUS	I/O TYPE	LOCATION	SYSTEM	SYSTEM LOCATION (SATELLITE RACK ROOM)	Serial Communications to DCS(Modbus,Profibus)	SORTED LOOP NUMBER	REMARK FOR UNDERSTANDING INDEX	INDEX REV NO
Flow(Magmeter) loop with Speed control															
FE 233-153	Include	Indicate Line Number	NA		FLUSHING LIQR TO HT233-105 INJ HTR	MAGNETIC FLOWMETER FLOWTUBE	UHDE	NA	FIELD	NA	NA		F 233-153-01	Alcan indicated Sensor tag in P&ID and Index	0
FIT 233-153	Include	Indicate Line Number	NA		FLUSHING LIQR TO HT233-105 INJ HTR	MAGNETIC FLOWMETER TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		F 233-153-02		0
FI 233-153	Include	NA	NA		FLUSHING LIQR TO HT233-105 INJ HTR	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		F 233-153-03	Include As Applicable	0
FIC 233-153	Include	NA	NA		FLUSHING LIQR TO HT233-105 INJ HTR	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		F 233-153-04	Include As Applicable	0
FCV 233-153	Include	Indicate Line Number	NA		FLUSHING LIQR TO HT233-105 INJ HTR	BUTTERFLY VALVE-CONTROL VALVE FF	UHDE	FBV-AO	FIELD	DCS	570-01		F 233-153-05	Instrument type as per Alcan	0
PUSC 233-102	Include	DSA239-0010-200E	PU239-102		PU233-102 DIL ACID PMP SPEED CNTRL	PUMP SPEED CONTROLLER	FN	AO	570-01	DCS	570-01		F 233-153-06	Include As Applicable- Applicable for all VFD	0
Flow loop (with compensated Annubar)															
FE 233-013	Include	Indicate Line Number	NA		SLP TO EX233-101 LOW TEMP SLR HTR	AVERAGING PITOT TUBE PRIMARY ELEMENT	UHDE	NA	FIELD	NA	NA		F 233-013-01	Alcan indicated Sensor tag in P&ID and Index	0
FIT 233-013	Include	Indicate Line Number			SLP TO EX233-101 LOW TEMP SLR HTR	AVERAGING PITOT TUBE TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		F 233-013-02		0
TE 233-013	Include	Indicate Line Number	NA		SLP TO EX233-101 LOW TEMP SLR HTR	AVG PITOT TUBE INTEGRAL TEMP ELEMENT	UHDE	NA	FIELD	NA	NA		F 233-013-03		0
TI 233-013	Include	NA	NA		SLP TO EX233-101 LOW TEMP SLR HTR	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		F 233-013-04	Include if TE indicated in P&ID	0
FI 233-013	Include	NA	NA		SLP TO EX233-101 LOW TEMP SLR HTR	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		F 233-013-05	Include As Applicable	0
FIC 233-013	Include	NA	NA		SLP TO EX233-101 LOW TEMP SLR HTR	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		F 233-013-06	Include As Applicable	0
FCV 233-013	Include	Indicate Line Number	NA		SLP TO EX233-101 LOW TEMP SLR HTR	GLOBE VALVE-CONTROL VALVE FF	UHDE	FBV-AO	FIELD	DCS	570-01		F 233-013-07		0
Flow Loop -vortex meter															
FE 234-410	Include	Indicate Line Number	NA		STM PURGE TO DIGSTR VE234-101 PSV234-110	VORTEX FLOWMETER FLOWTUBE	UHDE	NA	FIELD	NA	NA		F 234-410-01		0
FIT 234-410	Include	Indicate Line Number	NA		STM PURGE TO DIGSTR VE234-101 PSV234-110	VORTEX FLOWMETER TRANSMITTER FF	UHDE	FB-AI	DCS	DCS	570-01		F 234-410-02		0
FI 234-410	Include	NA	NA		STM PURGE TO DIGSTR VE234-101 PSV234-110	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		F 234-410-03		0
FIC 234-410	Include	NA	NA		STM PURGE TO DIGSTR VE234-101 PSV234-110	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		F 234-410-04		0
FQI 234-410	Include	NA	NA		STM PURGE TO DIGSTR VE234-101 PSV234-110	TOTALIZER-DCS	NA	SOFT	DCS	DCS	570-01		F 234-410-05	Include As Applicable	0
Pressure gauge															
PI 335-270	Include	Indicate Line Number(If Applicable)	If applicable		VP335-101 VAC PMP	PRESSURE GAUGE	UHDE	NA	FIELD	NA	NA		PI335-270-01		1
Pressure transmitter															
PIT 335-030	Include	Indicate Line Number(If Applicable)	If applicable		VE335-102 VAC VSL	PRESSURE TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		P 335-030-01	Sensor Tag not to be indicated	0
PI 335-030	Include	NA	NA		VE335-102 VAC VSL	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		P 335-030-02	Include As Applicable	0
PIC 335-030	Include	NA	NA		VE335-102 VAC VSL	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		P 335-030-03	Include As Applicable	0

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
Tags Indicated below are for Tagging Philosphy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.														

STANDARD INDEX COLUMNS FOR SUBMISSION

TAG NUMBER	P&ID	LINE NUMBER	EQUIPMENT NUMBER-	Associated Instrument Number(Details to be included as requiredfor corelation of tags)	SERVICE (With Abbreviation & Shall be less than 24 character)	INSTRUMENT TYPE DESCRIPTION (REFER NOTE BELOW)	STATUS	I/O TYPE	LOCATION	SYSTEM	SYSTEM LOCATION (SATELLITE RACK ROOM)	Serial Communic ations to DCS(Modbus,Profibus)	SORTED LOOP NUMBER	REMARK FOR UNDERSTANDING INDEX	INDEX REV NO
PCV 335-030	Include	Indicate Line Number	NA		VE335-102 VAC VSL	BUTTERFLY VALVE-CONTROL VALVE FF	UHDE	FBV-AO	FIELD	DCS	570-01		P 335-030-04		0
Differential Pressure Transmitter															
PDIT 335-516	Include	Indicate Line Number(If Applicable)	If applicable		AB335-101A AIR BLWR INLET FLTR	DIFFERENTIAL PRESSURE TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		PD335-516-01		0
PDI 335-516	Include	NA	NA		AB335-101A AIR BLWR INLET FLTR	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		PD335-516-02	Include As Applicable	0
PDIC 335-516	Include	NA	NA		AB335-101A AIR BLWR INLET FLTR	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		PD335-516-03	Include As Applicable	0
DP Level transmitter															
LIT 233-045	Include	NA	VE233-106		VE233-106 PURE COND COLN VSL	DP LEVEL TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		L 233-045-01	Sensor Tag not to be indicated	0
LI 233-045	Include	NA	NA		VE233-106 PURE COND COLN VSL	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		L 233-045-02		0
LIC 233-045	Include	NA	NA		VE233-106 PURE COND COLN VSL	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		L 233-045-03		0
LIL 233-045	Include	NA	VE233-106		VE233-106 PURE COND COLN VSL	LOOP POWERED INDICATOR FF	UHDE	FB-AO	FIELD	DCS	570-01		L 233-045-04		0
Radar Level transmitter															
LE 233-054	Include	NA	TK233-101		TK233-101 PREDES TK	RADAR LEVEL ELEMENT	UHDE	NA	FIELD	NA	NA		L 233-054-01	Aican indicated Senor tag in P&ID and Index	0
LIT 233-054	Include	NA	TK233-101		TK233-101 PREDES TK	RADAR LEVEL TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		L 233-054-02		0
LI 233-054	Include	NA	NA		TK233-101 PREDES TK	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		L 233-054-03	Include As Applicable	0
LIC 233-054	Include	NA	NA		TK233-101 PREDES TK	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		L 233-054-04	Include As Applicable	0
LAHH239-005A	Include	NA	TK239-101		TK239-101 CONC SULPHURIC ACID TK	SIREN AND STROBE ALARM-FIELD	UHDE	DO	Field	DCS	570-04		L 233-054-05	220 VAC Wired Through DO Relay	1
HSLHH239-005A	Include	NA	TK239-101		TK239-101 CONC SULPHURIC ACID TK	SIREN AND STROBE ALARM ACK-FIELD	UHDE	DI	Field	DCS	570-04		L 239-005-06		1
LHXL233-054	Include	NA	TK233-101		TK233-101 PREDES TK	LAMP INDICATION-LP	UHDE	DO	LP	DCS	570-01		L 233-054-06	Include As Applicable-Generally not applicable	1
Nucleonic Density transmitter															
DX 233-095	Include	Indicate Line Number	NA		PU233-114A DIGSTR FD PMP	NUCLEONIC DENSITY METER SOURCE	UHDE	NA	FIELD	NA	NA		D 233-095-01		0
DT 233-095	Include	Indicate Line Number	NA		PU233-114A DIGSTR FD PMP	NUCLEONIC DENSITY METER TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		D 233-095-02	Include As Applicable	0
DIC 233-095	Include	NA	NA		PU233-114A DIGSTR FD PMP	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		D 233-095-03	Include As Applicable	0
DI 233-095	Include	NA	NA		PU233-114A DIGSTR FD PMP	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		D 233-095-03	Include As Applicable	0
DIL 233-095	Include	Indicate Line Number	NA		PU233-114A DIGSTR FD PMP	NUCLEONIC DENSITY METER LOCAL IND FF	UHDE	FB-AO	FIELD	DCS	570-01		D 233-095-04		0
Temperature Element with Head Mounted or remote mounted transmitter															
TE 233-053	Include	Indicate Line Number(If Applicable)	If applicable		HT233-105 INJ HTR SLR OUTLET	TEMPERATURE ELEMENT	UHDE	NA	FIELD	NA	NA		T 233-053-01		0
TW 233-053	Include	Indicate Line Number(If Applicable)	If applicable		HT233-105 INJ HTR SLR OUTLET	THERMOWELL	UHDE	NA	FIELD	NA	NA		T 233-053-02		0
TT 233-053	Include	Indicate Line Number(If Applicable)	If applicable		HT233-105 INJ HTR SLR OUTLET	HEAD MOUNT TEMPERATURE TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		T 233-053-03	Include As Applicable	0
TIT 233-053	Include	Indicate Line Number(If Applicable)	If applicable		HT233-105 INJ HTR SLR OUTLET	REMOTE MOUNT TEMP IND TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		T 233-053-04	Include As Applicable	0
TI 233-053	Include	NA	NA		HT233-105 INJ HTR SLR OUTLET	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		T 233-053-05	Include As Applicable	0
TIC 233-053	Include	NA	NA		HT233-105 INJ HTR SLR OUTLET	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		T 233-053-06	Include As Applicable	0

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
Tags Indicated below are for Tagging Philosphy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.														

STANDARD INDEX COLUMNS FOR SUBMISSION

TAG NUMBER	P&ID	LINE NUMBER	EQUIPMENT NUMBER-	Associated Instrument Number(Details to be included as requiredfor corelation of tags)	SERVICE (With Abbreviation & Shall be less than 24 character)	INSTRUMENT TYPE DESCRIPTION (REFER NOTE BELOW)	STATUS	I/O TYPE	LOCATION	SYSTEM	SYSTEM LOCATION (SATELLITE RACK ROOM)	Serial Communic ations to DCS(Modbus,Profibus)	SORTED LOOP NUMBER	REMARK FOR UNDERSTANDING INDEX	INDEX REV NO
Surface Mionuted Temperature element & Tranmitter															
TE 233-135	Include	Indicate Line Number(If Applicable)	If applicable		EX233-101A LOW TEMP SLR HTR SHELL	SURFACE MOUNTED TEMP ELEMENT	UHDE	NA	FIELD	NA	NA		T 233-135-01		0
TIT 233-135	Include	Indicate Line Number(If Applicable)	If applicable		EX233-101A LOW TEMP SLR HTR SHELL	SURFACE MOUNTED TEMP TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		T 233-135-02		0
TI 233-135	Include	NA	NA		EX233-101A LOW TEMP SLR HTR SHELL	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		T 233-135-03	Include As Applicable	0
Motor winding temperature with Multiplexure															
TT 233-044	Include	NA	Indicate pump No		MULTIPLEXURE FOR TE 233-044A TO FF	MOTOR WINDING TEMP TRANSMITTER (MUX) FF	UHDE	FBMUX-AI	FIELD	DCS	570-01		T 233-044-01	For all HT Motor & LT VFD (More than 220kW)-Refer Electrical GES.	1
TE 233-044A	Include	NA	Indicate pump No		PU233-104A PURE COND PMP R PHASE POS1	TEMPERATURE ELEMENT(MUX)	FN	NA	FIELD	NA	NA		T 233-044-02	If specifically indicated in P&ID	0
TI 233-044A	Include	NA	NA		PU233-104A PURE COND PMP R PHASE POS1	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		T 233-044-03	If specifically indicated in P&ID	0
TE 233-044B	Include	NA	Indicate pump No		PU233-104A PURE COND PMP R PHASE POS2	TEMPERATURE ELEMENT(MUX)	FN	NA	FIELD	NA	NA		T 233-044-04	If specifically indicated in P&ID	0
TI 233-044B	Include	NA	NA		PU233-104A PURE COND PMP R PHASE POS2	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		T 233-044-05	If specifically indicated in P&ID	0
TE 233-044C	Include	NA	Indicate pump No		PU233-104A PURE COND PMP Y PHASE POS1	TEMPERATURE ELEMENT(MUX)	FN	NA	FIELD	NA	NA		T 233-044-06	If specifically indicated in P&ID	0
TI 233-044C	Include	NA	NA		PU233-104A PURE COND PMP Y PHASE POS1	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		T 233-044-07	If specifically indicated in P&ID	0
TE 233-044D	Include	NA	Indicate pump No		PU233-104A PURE COND PMP Y PHASE POS2	TEMPERATURE ELEMENT(MUX)	FN	NA	FIELD	NA	NA		T 233-044-08	If specifically indicated in P&ID	0
TI 233-044D	Include	NA	NA		PU233-104A PURE COND PMP Y PHASE POS2	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		T 233-044-09	If specifically indicated in P&ID	0
TE 233-044E	Include	NA	Indicate pump No		PU233-104A PURE COND PMP B PHASE POS1	TEMPERATURE ELEMENT(MUX)	FN	NA	FIELD	NA	NA		T 233-044-10	If specifically indicated in P&ID	0
TI 233-044E	Include	NA	NA		PU233-104A PURE COND PMP B PHASE POS1	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		T 233-044-11	If specifically indicated in P&ID	0
TE 233-044F	Include	NA	Indicate pump No		PU233-104A PURE COND PMP B PHASE POS2	TEMPERATURE ELEMENT(MUX)	FN	NA	FIELD	NA	NA		T 233-044-12	If specifically indicated in P&ID	0
TI 233-044F	Include	NA	NA		PU233-104A PURE COND PMP B PHASE POS2	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		T 233-044-13	If specifically indicated in P&ID	0
Motor winding temperature serial Link															
TI 233-044A	Include	NA	NA		PU233-104A PURE COND PMP R PHASE POS1	INDICATOR-DCS	NA	SAI	570-01	DCS	570-01		T 233-044-01	Modbus Serial communication from Temp scanner in 570-01. If indicated in P&ID- Generally Not indicated	0
TI 233-044B	Include	NA	NA		PU233-104A PURE COND PMP R PHASE POS2	INDICATOR-DCS	NA	SAI	570-01	DCS	570-01		T 233-044-02	Modbus Serial communication from Temp scanner in 570-01. If indicated in P&ID- Generally Not indicated	0
TI 233-044C	Include	NA	NA		PU233-104A PURE COND PMP Y PHASE POS1	INDICATOR-DCS	NA	SAI	570-01	DCS	570-01		T 233-044-03	Modbus Serial communication from Temp scanner in 570-01. If indicated in P&ID- Generally Not indicated	0
TI 233-044D	Include	NA	NA		PU233-104A PURE COND PMP Y PHASE POS2	INDICATOR-DCS	NA	SAI	570-01	DCS	570-01		T 233-044-04	Modbus Serial communication from Temp scanner in 570-01. If indicated in P&ID- Generally Not indicated	0
TI 233-044E	Include	NA	NA		PU233-104A PURE COND PMP B PHASE POS1	INDICATOR-DCS	NA	SAI	570-01	DCS	570-01		T 233-044-05	Modbus Serial communication from Temp scanner in 570-01. If indicated in P&ID- Generally Not indicated	0
TI 233-044F	Include	NA	NA		PU233-104A PURE COND PMP B PHASE POS2	INDICATOR-DCS	NA	SAI	570-01	DCS	570-01		T 233-044-06	Modbus Serial communication from Temp scanner in 570-01. If indicated in P&ID- Generally Not indicated	0
Conductivity Tranmitter															
CE 233-046	Include	Indicate Line Number	NA		PU233-104A&B PURE COND PMPS DISCH	CONDUCTIVITY SENSOR	UHDE	NA	FIELD	NA	NA		C 233-046-01		0
CIT 233-046	Include	Indicate Line Number	NA		PU233-104A&B PURE COND PMPS DISCH	CONDUCTIVITY TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		C 233-046-02		0
CI 233-046	Include	NA	NA		PU233-104A&B PURE COND PMPS DISCH	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		C 233-046-03	Include As Applicable	0
CIC 233-046	Include	NA	NA		PU233-104A&B PURE COND PMPS DISCH	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		C 233-046-04	Include As Applicable	0
Molar Ratio															

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
<p align="center">Tags Indicated below are for Tagging Philosphy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.</p>														

STANDARD INDEX COLUMNS FOR SUBMISSION

TAG NUMBER	P&ID	LINE NUMBER	EQUIPMENT NUMBER-	Associated Instrument Number(Details to be included as requiredfor corelation of tags)	SERVICE (With Abbreviation & Shall be less than 24 character)	INSTRUMENT TYPE DESCRIPTION (REFER NOTE BELOW)	STATUS	I/O TYPE	LOCATION	SYSTEM	SYSTEM LOCATION (SATELLITE RACK ROOM)	Serial Communic ations to DCS(Modbus,Profibus)	SORTED LOOP NUMBER	REMARK FOR UNDERSTANDING INDEX	INDEX REV NO
CE 234-153	Include	Indicate Line Number	NA		DIGESTION TRAIN #1 MOLAR RATIO FD	MOLAR RATIO METER FLOWTUBE	UHDE	NA	FIELD	NA	NA		C 234-153-01		0
CIT 234-153	Include	Indicate Line Number	NA		DIGESTION TRAIN #1 MOLAR RATIO FD	MOLAR RATIO METER TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		C 234-153-02		0
Clarity Transmitter															
AIT 241-137	Include	Indicate Line Number	NA		TK241-101 DEEP CONE WASHER	CLARITY TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		A 241-137-01		0
AI 241-137	Include	Indicate Line Number	NA		TK241-101 DEEP CONE WASHER	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		A 241-137-02		1
ON-OFF valve Fieldbus															
XV 233-130	Include	Indicate Line Number	NA		SLP TO EX233-101 LOW TEMP SLR HTR	BUTTERFLY VALVE-SHUT-OFF VALVE	UHDE	NA	FIELD	NA	NA		X 233-130-01		0
UY 233-130	Include	NA	NA		SLP TO EX233-101 LOW TEMP SLR HTR CMND	SOLENOID VALVE FF	UHDE	FBV-DO	FIELD	DCS	570-01		X 233-130-02		0
ZSH 233-130	Include	NA	NA		SLP TO EX233-101 LOW TEMP SLR HTR OPN IND	LIMIT SWITCH OPEN FF	UHDE	NA	FIELD	DCS	570-01		X 233-130-03		0
ZSL 233-130	Include	NA	NA		SLP TO EX233-101 LOW TEMP SLR HTR CLS IND	LIMIT SWITCH CLOSE FF	UHDE	NA	FIELD	DCS	570-01		X 233-130-04		0
HSXV 233-130	Include	NA	NA		SLP TO EX233-101 LOW TEMP SLR HTR CMND-DCS SW	ON-OFF VALVE COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	570-01		X 233-130-05	To be provided based on confirmation from process	0
AUTO RODDING DEVICE WITH DP TRANSMITTER															
LIT 234-113	Include	NA	VE234-101		VE234-101 DIGSTR LVL	DP LEVEL TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		L 234-113-01		1
LI 234-113	Include	NA	VE234-101		VE234-101 DIGSTR LVL	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		L 234-113-16		1
CV 234-113A	Include	Indicate Line Number	VE234-101	LIT 234-113	VE234-101 DIGSTR- ARD-HP SIDE	AUTO-RODDING DEVICE	UHDE	NA	FIELD	NA	NA		L 234-113-02	One DO & 2 DI will be connected to DCS vial FF Digital Interface Unit	1
CUY 234-113A	Include	NA	VE234-101		VE234-101 DIGSTR- ARD CMND-HP SIDE	AUTO-RODDING SOLENOID VALVE	UHDE	NA	FIELD	DCS	570-01		L 234-113-03		1
CZSH 234-113A	Include	NA	VE234-101		VE234-101 DIGSTR-ARD OUT POSN-HP SIDE	AUTO-RODDING LIMIT SWITCH OPEN	UHDE	NA	FIELD	DCS	570-01		L 234-113-04		1
CZSL 234-113A	Include	NA	VE234-101		VE234-101 DIGSTR- ARD IN POSN-HP SIDE	AUTO-RODDING LIMIT SWITCH CLOSE	UHDE	NA	FIELD	DCS	570-01		L 234-113-05		1
CMUX 234-113A	Include	NA	VE234-101		DIGITAL INTERFACE UNIT FOR CV234-113A	DIGITAL SIGNAL INTERFACE UNIT FF	UHDE	FB-DO	FIELD	DCS	570-01		L 234-113-06	As per Alcan reply one Mux per cleargaurd	1
CV 234-113B	Include	NA	VE234-101	LIT 234-113	VE234-101 DIGSTR- LP SIDE	AUTO-RODDING DEVICE	UHDE	NA	FIELD	NA	NA		L 234-113-07	LP Side to be included for Level transmitter as if indicated in P&ID	1
CUY 234-113B	Include	NA	VE234-101		VE234-101 DIGSTR- ARD CMND-LP SIDE	AUTO-RODDING SOLENOID VALVE	UHDE	NA	FIELD	DCS	570-01		L 234-113-08		1
CZSH 234-113B	Include	NA	VE234-101		VE234-101 DIGSTR-ARD OUT POSN-LP SIDE	AUTO-RODDING LIMIT SWITCH OPEN	UHDE	NA	FIELD	DCS	570-01		L 234-113-09		1
CZSL 234-113B	Include	NA	VE234-101		VE234-101 DIGSTR- ARD IN POSN-LP SIDE	AUTO-RODDING LIMIT SWITCH CLOSE	UHDE	NA	FIELD	DCS	570-01		L 234-113-10		1
CMUX 234-113B	Include	NA	VE234-101		DIGITAL INTERFACE UNIT FOR CV234-113B	DIGITAL SIGNAL INTERFACE UNIT FF	UHDE	FB-DO	FIELD	DCS	570-01		L 234-113-11	As per Alcan reply one Mux per cleargaurd	1
HSCV 234-113A	Include	NA	VE234-101		VE234-101 DIGSTR- HP SIDEARD CMND-DCS SW	AUTO-RODDING COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	570-01		L 234-113-12		1
HSRCV234-113A	Include	NA	VE234-101		VE234-101 DIGSTR- HP SIDE ARD TIMER RESET-LP	AUTO-RODDING RESET SWITCH-LP	UHDE	NA	LP	DCS	570-01		L 234-113-13	Signal may be integrated in Multiinput Function block	1
HSCV 234-113B	Include	NA	VE234-101		VE234-101 DIGSTR-LP SIDE ARD CMND-DCS SW	AUTO-RODDING COMMAND SWITCH-DCS	UHDE	SOFT	DCS	DCS	570-01		L 234-113-14		1
HSRCV234-113B	Include	NA	VE234-101		VE234-101 DIGSTR- LP SIDE ARD TIMER RESET-LP	AUTO-RODDING RESET SWITCH-LP	UHDE	NA	LP	DCS	570-01		L 234-113-15	Signal may be integrated in Multiinput Function block	1
LX 234-113A	Include	NA	VE234-101	LIT 234-113	VE234-101 DIGSTR-ARD-HP SIDE	PURGE WATER PANEL(ARD)	UHDE	NA	FIELD	NA	NA		L 234-113-04-01		1
LX 234-113B	Include	NA	VE234-101	LIT 234-113	VE234-101 DIGSTR-ARD-LP SIDE	PURGE WATER PANEL(ARD)	UHDE	NA	FIELD	NA	NA		L 234-113-05-01		1
LXV 234-113A	Include	NA	VE234-101	LIT 234-113	VE234-101 DIGSTR-ARD-HP SIDE	PRESSURE REGULATOR (PURGE)	UHDE	NA	FIELD	NA	NA		L 234-113-04-02		1
LXV 234-113B	Include	NA	VE234-101	LIT 234-113	VE234-101 DIGSTR-ARD-LP SIDE	PRESSURE REGULATOR (PURGE)	UHDE	NA	FIELD	NA	NA		L 234-113-05-02		1
AUTO RODDING DEVICE WITH PRESSURE TRANSMITTER															

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
<p style="color: red; text-align: center;">Tags Indicated below are for Tagging Philsophy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.</p>														

STANDARD INDEX COLUMNS FOR SUBMISSION

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PIT 234-121	234-0-PID-0013	Indicate Line Number-As applicable	VE234-101		VE234-101 DIGSTR	PRESSURE TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	570-01		P 234-121-01		0
PI 234-121	234-0-PID-0013	Indicate Line Number-As applicable	NA		VE234-101 DIGSTR	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		P 234-121-02		0
PX 234-121	234-0-PID-0013	Indicate Line Number-As applicable	VE234-101	PIT 234-121	VE234-101 DIGSTR	PURGE WATER PANEL(ARD)	UHDE	NA	FIELD	NA	NA		P 234-121-03		0
CV 234-121	234-0-PID-0013	Indicate Line Number-As applicable	VE234-101	PIT 234-121	VE234-101 DIGSTR- ARD-HP SIDE	AUTO-RODDING DEVICE	UHDE	NA	FIELD	NA	NA		P 234-121-04		0
CUY 234-121	234-0-PID-0013	Indicate Line Number-As applicable	VE234-101		VE234-101 DIGSTR- ARD CMND-HP SIDE	AUTO-RODDING SOLENOID VALVE	UHDE	NA	FIELD	DCS	570-01		P 234-121-05		0
CZSH 234-121	234-0-PID-0013	Indicate Line Number-As applicable	VE234-101		VE234-101 DIGSTR-ARD OUT POSN-HP SIDE	AUTO-RODDING LIMIT SWITCH OPEN	UHDE	NA	FIELD	DCS	570-01		P 234-121-06		0
CZSL 234-121	234-0-PID-0013	Indicate Line Number-As applicable	VE234-101		VE234-101 DIGSTR- ARD IN POSN-HP SIDE	AUTO-RODDING LIMIT SWITCH CLOSE	UHDE	NA	FIELD	DCS	570-01		P 234-121-07		0
CMUX 234-121	234-0-PID-0013	Indicate Line Number-As applicable	VE234-101		DIGITAL INTERFACE UNIT FOR CV234-120	DIGITAL SIGNAL INTERFACE UNIT FF	UHDE	FB-DO	FIELD	DCS	570-01		P 234-121-08		0
HSCV 234-121	234-0-PID-0013	Indicate Line Number-As applicable	VE234-101		VE234-101 DIGSTR ARD CMND-DCS SW	AUTO-RODDING COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	570-01		P 234-121-09		0
HSRCV234-121	234-0-PID-0013	Indicate Line Number-As applicable	VE234-101		VE234-101 DIGSTR ARD TIMER RESET-LP	AUTO-RODDING RESET SWITCH-LP	NA	FB-DI	LP	DCS	570-01		P 234-121-10	I/O To be Integrated with Mux.	1
PXV 234-121	234-0-PID-0013	Indicate Line Number-As applicable	VE234-101	PIT 234-121	VE234-101 DIGSTR-ARD	PRESSURE REGULATOR (PURGE)	UHDE	NA	FIELD	NA	NA		P 234-121-11	Pressure Regulator (Purge) shall be included for eachh pugging assembly	1
PURGE ASSEMBLY- LT Purge water Panel- (Purging for Auto Rodder)															
LX 234-137A	Include	NA	VE234-103	LIT 234-137	VE234-103 DIGSTR-HP SIDE	PURGE WATER PANEL(ARD)	UHDE	NA	FIELD	NA	NA		L 234-137-04-01	Panel used for Auto rodder.	1
LX 234-137B	Include	NA	VE234-103	LIT 234-137	VE234-103 DIGSTR-LP SIDE	PURGE WATER PANEL(ARD)	UHDE	NA	FIELD	NA	NA		L 234-137-10-01	Panel used for Auto rodder- LP leg purgind to be provided based on P&ID	1
LXV 234-137A	Include	NA	VE234-103	LIT 234-137	VE234-103 DIGSTR-ARD-HP SIDE	PRESSURE REGULATOR (PURGE)	UHDE	NA	FIELD	NA	NA		L 234-137-04-02	Pressure Regulator (Purge) shall be included for eachh pugging assembly	1
LXV 234-137B	Include	NA	VE234-103	LIT 234-137	VE234-103 DIGSTR-ARD-LP SIDE	PRESSURE REGULATOR (PURGE)	UHDE	NA	FIELD	NA	NA		L 234-137-10-02	Pressure Regulator (Purge) shall be included for eachh pugging assembly	1
PURGE ASSEMBLY- LT Purge water Panel- (Purging without Auto Rodder)															
LX 234-001A	Include	NA	VE234-103	LIT 234-001	VE234-103 DIGSTR-HP SIDE	PURGE ROTAMETER	UHDE	NA	FIELD	NA	NA		L 234-001-04-01	Rotameter used for purging.	1
LX 234-001B	Include	NA	VE234-103	LIT 234-001	VE234-103 DIGSTR-LP SIDE	PURGE ROTAMETER	UHDE	NA	FIELD	NA	NA		L 234-001-05-01	Rotameter used for purging.	1
LXV 234-001A	Include	NA	VE234-103	LIT 234-001	VE234-103 DIGSTR-ARD-HP SIDE	PRESSURE REGULATOR (PURGE)	UHDE	NA	FIELD	NA	NA		L 234-001-04-02	Pressure Regulator (Purge) shall be included for eachh pugging assembly	1
LXV 234-001B	Include	NA	VE234-103	LIT 234-001	VE234-103 DIGSTR-ARD-HP SIDE	PRESSURE REGULATOR (PURGE)	UHDE	NA	FIELD	NA	NA		L 234-001-05-02	Pressure Regulator (Purge) shall be included for eachh pugging assembly	1
PURGE ASSEMBLY- PT Purge water Panel- (Purging for Auto Rodder)															
PX 234-139	Include	include if applicable	VE234-103	PIT 234-139	VE234-103 DIGSTR	PURGE WATER PANEL(ARD)	UHDE	NA	FIELD	NA	NA		P 234-139-03-01	Include as per P&ID.	1
PXV 234-139	Include	include if applicable	VE234-103	PIT 234-139	VE234-103 DIGSTR-ARD	PRESSURE REGULATOR (PURGE)	UHDE	NA	FIELD	NA	NA		P 234-139-03-02	Pressure Regulator (Purge) shall be included for eachh pugging assembly	1
PURGE ASSEMBLY- PT Purge water Panel- (Purging without Auto Rodder)															

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
Tags Indicated below are for Tagging Philosphy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.														

STANDARD INDEX COLUMNS FOR SUBMISSION

TAG NUMBER	P&ID	LINE NUMBER	EQUIPMENT NUMBER-	Associated Instrument Number(Details to be included as requiredfor corelation of tags)	SERVICE (With Abbreviation & Shall be less than 24 character)	INSTRUMENT TYPE DESCRIPTION (REFER NOTE BELOW)	STATUS	I/O TYPE	LOCATION	SYSTEM	SYSTEM LOCATION (SATELLITE RACK ROOM)	Serial Communic ations to DCS(Modbus,Profibus)	SORTED LOOP NUMBER	REMARK FOR UNDERSTANDING INDEX	INDEX REV NO
PX 234-001	Include	include if applicable	include iinstrument tag		VE234-103 DIGSTR	PURGE ROTAMETER	UHDE	NA	FIELD	NA	NA		P 234-001-03-01	Include as per P&ID.	1
PXV 234-001	Include	include if applicable	include iinstrument tag		VE234-103 DIGSTR	PRESSURE REGULATOR (PURGE)	UHDE	NA	FIELD	NA	NA		P 234-001-03-02	Pressure Regulator (Purge) shall be included for each pugging assembly	1
MOTOR OPERATED VALVE															
MOV 240-053	Include	indicate line number	NA		PU240-103A TCA PMP DISCH SHUT-OFF VLV	ANGLE VALVE-SHUT-OFF VALVE	UHDE	FBM-DO	FIELD	NA	NA		MV240-053-01		0
MVOP 240-053	Include	NA	NA		PU240-103A TCA PMP DISCH SHUT-OFF VLV OPN CMND	MOV OPEN COMMAND FF	NA	NA	FIELD	DCS	570-09		MV240-053-02		0
MVCL 240-053	Include	NA	NA		PU240-103A TCA PMP DISCH SHUT-OFF VLV CLS CMND	MOV CLOSE COMMAND FF	NA	NA	FIELD	DCS	570-09		MV240-053-03		0
MZSH 240-053	Include	NA	NA		PU240-103A TCA PMP DISCH SHUT-OFF VLV OPN IND	MOV OPEN INDICATION FF	NA	NA	FIELD	DCS	570-09		MV240-053-04		0
MZSL 240-053	Include	NA	NA		PU240-103A TCA PMP DISCH SHUT-OFF VLV CLS IND	MOV CLOSE INDICATION FF	NA	NA	FIELD	DCS	570-09		MV240-053-05		0
MTOR 240-053	Include	NA	NA		PU240-103A TCA PMP DISCH SHUT-OFF VLV TORQUE FLT	MOV TORQUE FAULT FF	NA	NA	FIELD	DCS	570-09		MV240-053-06		0
MVECL240-053	Include	NA	NA		PU240-103A TCA PMP DISCH SHUT-OFF VLV EMERG CLS	MOV EMERGENCY CLOSE COMMAND	NA	DO	FIELD	DCS	570-09		MV240-053-07		0
HSMV 240-053	Include	NA	NA		PU240-103A TCA PMP DISCH SHUT-OFF VLV CMND-DCS SW	MOV COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	570-09		MV240-053-08	To be provided based on confirmation from process	0
REGULATOR															
PCV 234-288	Include	indicate line number	NA		INSTRUMENT STM (1100 KPAG) HDR	MANUAL PRESSURE REGULATOR	UHDE	NA	FIELD	NA	NA		PR234-288-01		0
ANALYSER LOOP															
AE 234-236	Include	include if applicable	include if applicable		DIGSTR BLOW OFF PMP PU234-104A DISCH	CAUSTIC CONC ANALYSER FLOWTUBE	UHDE	NA	FIELD	NA	NA		A 234-236-01		0
AIT 234-236	Include	NA	NA		DIGSTR BLOW OFF PMP PU234-104A DISCH	CAUSTIC CONC ANALYSER TRANSMITTER	UHDE	AI	FIELD	DCS	570-01		A 234-236-02		0
AI 234-236	Include	NA	NA		DIGSTR BLOW OFF PMP PU234-104A DISCH	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		A 234-236-03		0
SUMP LOOP															
LE 234-003	Include	NA	SU234-120	SU234-120	SU234-120 SUMP	ULTRASONIC LEVEL ELEMENT	UHDE	NA	FIELD	NA	NA		L 234-003-01	Ultrasonic Sump Level loop	0
LIT 234-003	Include	NA	SU234-120	SU234-120	SU234-120 SUMP	ULTRASONIC LEVEL TRANSMITTER	UHDE	AI-LP	FIELD	NA	NA		L 234-003-02	Ultrasonic Sump Level loop	0
LIC 234-003	Include	NA	NA	SU234-120	SU234-120 SUMP	ULTRASONIC LEVEL CONTROLLER-LOCAL	UHDE	NA	FIELD	NA	NA		L 234-003-03		0
LAH 233-003	Include	NA	SU234-120	SU234-120	SU234-120 SUMP	HIGH LEVEL ALARM	NA	NA	LP	NA	NA		L 234-003-04	Siren & Hooter to be energised from Local controller & not from DCS	0
LAL 233-003	Include	NA	SU234-120	SU234-120	SU234-120 SUMP	LOW LEVEL ALARM	NA	NA	LP	NA	NA		L 234-003-05	Siren & Hooter to be energised from Local controller & not from DCS	0
XA 234-003	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP FLT	SUMP PUMP FAULT	NA	DI	LP	DCS	570-01		L 234-003-06		0
LAHH 233-003	Include	NA	SU234-120	SU234-120	SU234-120 SUMP	SIREN AND STROBE-LP	UHDE	NA	LP	NA	NA		L 234-003-07	Siren & Hooter to be energised from Local controller & not from DCS	0
PUYL 234-120	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP RUN IND	PUMP RUN INDICATION	NA	DI	LP	DCS	570-01		L 234-003-08	Contact to be multiplied in LP for indication in Field & DCS	1
PUFLT234-120	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP TRIP IND	PUMP TRIP INDICATION(TRIP ON FAULT)	NA	DI	LP	DCS	570-01		L 234-003-09	Contact to be multiplied in LP for indication in Field & DCS	1
PUYXL234-120	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP RUN IND IN LP	LAMP INDICATION-LP	UHDE	DI-LP	LP	NA	NA		L 234-003-10	Contact to be multiplied in LP for indication in Field & DCS	1
PUFXL234-120	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP TRIP IND IN LP	LAMP INDICATION-LP	UHDE	DI-LP	LP	NA	NA		L 234-003-11	Contact to be multiplied in LP for indication in Field & DCS	1
PUSTR234-120	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP STR CMND FRM LP	PUMP START COMMAND-LP	NA	DO-LP	LP	NA	NA		L 234-003-12	Pump start & stopn command from Field to MCC.	0
PUSTP234-120	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP STP CMND FRM LP	PUMP STOP COMMAND-LP	NA	DO-LP	LP	NA	NA		L 234-003-13	Pump start & stopn command from Field to MCC.	0
PURSE234-120	Include	NA	PU234-120	SU234-120	PU234-120 SMP PMP RDY TO STR ELEC	PUMP READY TO START ELECT	NA	DI-LP	LP	MCC	570-01		L 234-003-18		1
HS 234-120	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP AUTO/MAN/OFF SEL SW IN LP	AUTO/OFF/MANUAL SWITCH-LP	UHDE	DO-LP	LP	MCC	570-01		L 234-003-14	Selector switch in LP	0

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
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STANDARD INDEX COLUMNS FOR SUBMISSION

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HSSTR234-120	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP STR SW IN LP	PUMP START COMMAND SWITCH-LP	NA	NA	LP	NA	NA		L 234-003-15	PUMP Start Push button in Local Panel	0
HSSTP234-120	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP STP SW IN LP	PUMP STOP COMMAND SWITCH-LP	NA	NA	LP	NA	NA		L 234-003-16	PUMP Start Push button in Local Panel	0
HSLHH233-120	Include	NA	SU233-120	SU234-120	SU233-120 SMP LVL-SIREN RST	SIREN AND STROBE SUMP ALARM ACK-FIELD	UHDE	DI	LP	DCS	570-01		L 233-003-29		1
PUI 234-120	Include	NA	PU234-120	SU234-120	PU234-120 SUMP PMP CURRENT IND	PUMP CURRENT INDICATION	NA	AI	570-01	DCS	570-01		L 234-003-17		0
AGSTR234-120	Include	NA	AG234-120	SU234-120	SU234-120 SUMP AGTR STR CMND	AGITATOR START COMMAND	NA	DO	570-01	DCS	570-01		L 234-003-18		0
AGSTP234-120	Include	NA	AG234-120	SU234-120	SU234-120 SUMP AGTR STP CMND	AGITATOR STOP COMMAND	NA	DO	570-01	DCS	570-01		L 234-003-19		0
AGRSE234-120	Include	NA	AG234-120	SU234-120	SU234-120 SMP AGTR RDY TO STR ELEC	AGITATOR READY TO START ELECT	NA	DI	570-01	DCS	570-01		L 234-003-26		1
AGRSP234-120	Include	NA	AG234-120	SU234-120	SU234-120 SMP AGTR RDY TO STR PROC	AGITATOR READY TO START PROCESS	NA	SOFT	DCS	DCS	570-01		L 234-003-28		1
AGREM234-120	Include	NA	AG234-120	SU234-120	SU234-120 SUMP AGTR R/L CMND	AGITATOR R/L COMMAND	NA	DO	570-01	DCS	570-01		L 234-003-20		1
AGYL 234-120	Include	NA	AG234-120	SU234-120	SU234-120 SUMP AGTR RUN IND	AGITATOR RUN INDICATION	NA	DI	570-01	DCS	570-01		L 234-003-21	Contact to be multiplied in MCC for indication in Field & DCS	1
AGFLT234-120	Include	NA	AG234-120	SU234-120	SU234-120 SUMP AGTR TRIP IND	AGITATOR TRIP INDICATION(TRIP ON FAULT)	NA	DI	570-01	DCS	570-01		L 234-003-22	Contact to be multiplied in MCC for indication in Field & DCS	1
HSRAG234-120	Include	NA	AG234-120	SU234-120	SU234-120 SUMP AGTR R/L-DCS SW	AGITATOR R/L SWITCH-DCS	NA	SOFT	DCS	DCS	570-01		L 234-003-23		1
HSAG 234-120	Include	NA	AG234-120	SU234-120	SU234-120 SUMP AGTR CMND-DCS SW	AGITATOR COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	570-01		L 234-003-24		1
AGI 234-120	Include	NA	AG234-120	SU234-120	SU234-120 SUMP AGTR CURRENT IND	AGITATOR CURRENT INDICATION	NA	AI	570-01	DCS	570-01		L 234-003-25		1
AGYLA 234-120	Include	NA	AG234-120	SU234-120	SU234-120 SUMP AGTR RUN FAIL AL	AGITATOR RUN FAIL ALARM	NA	SOFT	DCS	DCS	570-01		L 234-003-30		1
PUMP LOOP															
PUSTR233-101	Include	NA	Indicate pump No		PU233-101 SLR BOOST PMP STR CMND	PUMP START COMMAND	NA	DO	570-01	DCS	570-01		PU233-101-01		0
PUSTP233-101	Include	NA	Indicate pump No		PU233-101 SLR BOOST PMP STP CMND	PUMP STOP COMMAND	NA	DO	570-01	DCS	570-01		PU233-101-02		0
PUREM233-101	Include	NA	Indicate pump No		PU233-101SLR BOOST PMP R/L CMND	PUMP R/L COMMAND	NA	DO	570-01	DCS	570-01		PU233-101-03		0
PURSE233-101	Include	NA	Indicate pump No		PU233-101 SLR BOOSTER PMP RDY TO STR ELEC	PUMP READY TO START ELECT	NA	DI	570-01	DCS	570-01		PU233-101-08-01		1
PURSP233-101	Include	NA	Indicate pump No		PU233-101 SLR BOOSTER PMP RDY TO STR PROC	PUMP READY TO START PROCESS	NA	SOFT	DCS	DCS	570-01		PU233-101-08-03		1
PUYL 233-101	Include	NA	Indicate pump No		PU233-101SLR BOOST PMP RUN IND	PUMP RUN INDICATION	NA	DI	570-01	DCS	570-01		PU233-101-04		0
PUFLT233-101	Include	NA	Indicate pump No		PU233-101SLR BOOST PMP TRIP IND	PUMP TRIP INDICATION(TRIP ON FAULT)	NA	DI	570-01	DCS	570-01		PU233-101-05		0
PUIR 233-101	Include	NA	Indicate pump No		PU233-101SLR BOOST PMP R-PHASE CURRENT IND	PUMP CURRENT INDICATION	NA	AI	570-01	DCS	570-01		PU233-101-06	Generally not Required,Refer Electrical GES for Requirement.	1
PUIY 233-101	Include	NA	Indicate pump No		PU233-101SLR BOOST PMP Y-PHASE CURRENT IND	PUMP CURRENT INDICATION	NA	AI	570-01	DCS	570-01		PU233-101-07	Generally not Required,Refer Electrical GES for Requirement.	1
PUIB 233-101	Include	NA	Indicate pump No		PU233-101SLR BOOST PMP B-PHASE CURRENT IND	PUMP CURRENT INDICATION	NA	AI	570-01	DCS	570-01		PU233-101-08	Generally not Required,Refer Electrical GES for Requirement.	1
PUI 233-101	Include	NA	Indicate pump No		PU233-101SLR BOOST PMP CURRENT IND	PUMP CURRENT INDICATION	NA	AI	570-01	DCS	570-01		PU233-101-09	Include after confirmation from Electrical-1 for LT (If required) - Required for all VFD with LT motors.Refer Electrical GES.	1
PUJI 233-101	Include	NA	Indicate pump No		PU233-101 SLR BOOST PMP PWR IND	PUMP POWER INDICATION	NA	AI	570-01	DCS	570-01		PU233-101-14	Required for HT Motor & LT VFD(>220KW) Refer Electrical GES	1
HSPU 233-101	Include	NA	Indicate pump No		PU233-101 SLR BOOST PMP CMND-DCS SW	PUMP COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	570-01		PU233-101-10		0
HSRPU233-101	Include	NA	Indicate pump No		PU233-101 SLR BOOST PMP R/L-DCS SW	PUMP R/L SWITCH-DCS	NA	SOFT	DCS	DCS	570-01		PU233-101-11		0
PUSI 233-101	Include	NA	Indicate pump No		PU233-101 SLR BOOST PMP SPEED IND	PUMP SPEED INDICATION	UHDE	SAI	570-01	DCS	570-01		PU233-101-12	Include As Applicable- Applicable for all VFD	0
PUYLA 233-101	Include	NA	Indicate pump No		PU233-101 SLR BOOST PMP RUN FAIL AL	PUMP RUN FAIL ALARM	NA	SOFT	DCS	DCS	570-01		PU233-101-13		1

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
Tags Indicated below are for Tagging Philosphy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.														

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AGITATOR LOOP															
AGSTR233-101	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR STR CMND	AGITATOR START COMMAND	NA	DO	570-01	DCS	570-01		AG233-101-01		0
AGSTP233-101	Include	NA	Indicate agitator No		AG233-101PREDES TK AGTR STP CMND	AGITATOR STOP COMMAND	NA	DO	570-01	DCS	570-01		AG233-101-02		0
AGREM233-101	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR R/L CMND	AGITATOR R/L COMMAND	NA	DO	570-01	DCS	570-01		AG233-101-03		0
AGRSE233-101	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR RDY TO STR ELEC	AGITATOR READY TO START ELECT	NA	DI	570-01	DCS	570-01		AG233-101-08-1		1
AGRSP233-101	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR RDY TO STR PROC	AGITATOR READY TO START PROCESS	NA	SOFT	DCS	DCS	570-01		AG233-101-08-03		1
AGYL 233-101	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR RUN IND	AGITATOR RUN INDICATION	NA	DI	570-01	DCS	570-01		AG233-101-04		0
AGFLT233-101	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR TRIP IND	AGITATOR TRIP INDICATION(TRIP ON FAULT)	NA	DI	570-01	DCS	570-01		AG233-101-05		0
HSRAG233-101	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR R/L-DCS SW	AGITATOR R/L SWITCH-DCS	NA	SOFT	DCS	DCS	570-01		AG233-101-06		0
HSAG 233-101	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR CMND-DCS SW	AGITATOR COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	570-01		AG233-101-07		0
AGI 233-101	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR CURRENT IND	AGITATOR CURRENT INDICATION	NA	AI	570-01	DCS	570-01		AG233-101-08		0
AGYLA233-101	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR RUN FAIL AL	AGITATOR RUN FAIL ALARM	NA	SOFT	DCS	DCS	570-01		AG233-101-08-02		1
TORQUETransmitter															
WE 233-120	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR	TORQUE ELEMENT	FN	NA	FIELD	NA	NA		W 233-120-01		0
WIT 233-120	Include	NA	Indicate agitator No		AG233-101 PREDES TK AGTR	TORQUE TRANSMITTER	FN	AI	FIELD	DCS	570-01		W 233-120-02		0
WI 233-120	Include	NA	NA		AG233-101 PREDES TK AGTR	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		W 233-120-03		0
SPEED LOOP															
SE 335-004	Include	NA	indicate equipment no.		FL335-101 COARSE SEED DISK FLTR	SPEED ELEMENT	FN	NA	FIELD	NA	NA		S 335-004-01		0
ST 335-004	Include	NA	indicate equipment no.		FL335-101 COARSE SEED DISK FLTR	SPEED TRANSMITTER FIELDBUS	FN	FB-AI	FIELD	DCS	570-03		S 335-004-02		0
SIC 335-004	Include	NA	indicate equipment no.		FL335-101 COARSE SEED DISK FLTR	CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-03		S 335-004-03		1
PROXIMITY SWITCH															
ZS 335-003	Include	NA	indicate equipment no.		FL335-101 COARSE SEED DISK FLTR	PROXIMITY SWITCH	FN	DI	FIELD	DCS	570-03		Z 335-003-01		0
DIRECT INJECTION HEATER 3-WAY VALVE															
HT 241-101	Include	indicate line number	NA		DIRECT INJ STM HTR	DIRECT INJECTION HEATER 3-WAY VALVE	UHDE	AO	FIELD	DCS	571-09		H 241-101-01		0
LEVEL SWITCH															
LSL 241-105A	Include	NA	AG241-101		AG241-101 DEEP CONE WASHER AGTR MOTOR OIL RESERVOIR	LEVEL SWITCH	UHDE	DI	FIELD	DCS	571-09		L 241-101-01		0
LAL 241-105A	Include	NA	AG241-101		AG241-101 DEEP CONE WASHER AGTR MOTOR OIL RESERVOIR	LEVEL ALARM LOW	NA	SOFT	DCS	DCS	571-09		L 241-101-02		1
WEIGHT LOOP															
ME 233-121	Include	NA	indicate equipment no.			LOAD CELL	UHDE	NA	FIELD	NA	NA		M 233-121-01		0
MIT 233-121	Include	NA	indicate equipment no.			WEIGHT TRANSMITTER	UHDE	AI	FIELD	DCS	570-01		M 233-121-02		0
MI 233-121	Include	NA	NA			INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		M 233-121-03		0
MIC 233-121	Include	NA	NA			CONTROLLER-DCS	NA	SOFT	DCS	DCS	570-01		M 233-121-04		0
VIBRATION LOOP															
VE 233-001	Include	NA	EA233-101		EA233-101 COOLER MOTOR VIBRATION	VIBRATION ELEMENT	FN	NA	FIELD	NA	NA		V 233-001-01		0
VI 233-001	Include	NA	NA		EA233-101 COOLER MOTOR VIBRATION	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-01		V 233-001-02		0

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
<p align="center">Tags Indicated below are for Tagging Philosphy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.</p>														

STANDARD INDEX COLUMNS FOR SUBMISSION

TAG NUMBER	P&ID	LINE NUMBER	EQUIPMENT NUMBER-	Associated Instrument Number(Details to be included as requiredfor corelation of tags)	SERVICE (With Abbreviation & Shall be less than 24 character)	INSTRUMENT TYPE DESCRIPTION (REFER NOTE BELOW)	STATUS	I/O TYPE	LOCATION	SYSTEM	SYSTEM LOCATION (SATELLITE RACK ROOM)	Serial Communic ations to DCS(Modbus,Profibus)	SORTED LOOP NUMBER	REMARK FOR UNDERSTANDING INDEX	INDEX REV NO
VT 233-001	Include	NA	NA		EA233-101 COOLER MOTOR VIBRATION	VIBRATION TRANSMITTER	FN	AI	FIELD	DCS	570-01		V 233-001-03		0
Hand switch															
HS 233-001	Include	NA	indicate equipment/instrument no.		TK241-101A/ B TK SEL SW	SELECTOR SWITCH-AXC	UHDE	DI	AXC	DCS	570-01		H 233-001-01		0
CORROSION TRANSMITTER															
AE 239-011	Include	DSA239-0016-200E	NA		CLNG ACID RETN MFLD DISCH	CORROSION ELEMENT	UHDE	NA	FIELD	NA	NA		A 239-011-01		0
AIT 239-011	Include	NA	NA		CLNG ACID RETN MFLD DISCH	CORROSION TRANSMITTER	UHDE	AI	FIELD	DCS	570-04		A 239-011-02		0
AI 239-011	Include	NA	NA		CLNG ACID RETN MFLD DISCH	INDICATOR-DCS	NA	SOFT	DCS	DCS	570-04		A 239-011-03		0
RESTRICTION ORIFICE															
RO 239-013	Include	DSA239-0013-200E	NA		DIL ACID RECIRC	RESTRICTION ORIFICE PLATE	UHDE	NA	FIELD	NA	NA		R 239-013-01		0
SAFETY VALVE															
PSV 239-038	Include	DSA239-0039-50E	NA		PU239-107A/B SPENT ACID PMP DISCH	PRESSURE SAFETY RELIEF VALVE	UHDE	NA	FIELD	NA	NA		SV239-038-01		0
SELECTOR SWITCH															
HS 239-023	Include	NA	TK239-104		TK239-104 SPENT ACID TK SPENT/OFF LINE SEL SW	SELECTOR SWITCH-DCS	UHDE	SOFT	DCS	DCS	570-04		H 239-023-01		0
SPLIT CONTROL(One level Tx & two pumps' control)															
LIT 249-018	Include	NA	VE249-101		VE249-101 COND VSL	DP LEVEL TRANSMITTER	UHDE	FB-AI	FIELD	DCS	571-09		L 249-018-01		1
LIC 249-018	Include	NA	VE249-101		VE249-101 COND VSL	CONTROLLER-DCS	NA	SOFT	DCS	DCS	571-09		L 249-018-02		1
PUSC 249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP DISCH	PUMP SPEED CONTROLLER	FN	AO	571-09	DCS	571-09		L 249-018-03		1
PUSC 249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP DISCH	PUMP SPEED CONTROLLER	FN	AO	571-09	DCS	571-09		L 249-018-04		1
PUSTR249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP STR CMND	PUMP START COMMAND	NA	DO	571-09	DCS	571-09		PU249-101A-01		1
PUSTP249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP STP CMND	PUMP STOP COMMAND	NA	DO	571-09	DCS	571-09		PU249-101A-02		1
HSRPU249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP R/L-DCS SW	PUMP R/L SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-101A-03		1
PUREM249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP R/L CMND	PUMP R/L COMMAND	NA	DO	571-09	DCS	571-09		PU249-101A-04		1
PUYL 249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP RUN IND	PUMP RUN INDICATION	NA	DI	571-09	DCS	571-09		PU249-101A-05		1
PURSE 249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP RDY TO STR ELEC	PUMP READY TO START ELECT	NA	DI	571-09	DCS	571-09		PU249-101A-08-01		1
PURSP 249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP RDY TO STR PROC	PUMP READY TO START PROCESS	NA	SOFT	DCS	DCS	571-09		PU249-101A-08-03		1
PUFLT249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP TRIP IND	PUMP TRIP INDICATION(TRIP ON FAULT)	NA	DI	571-09	DCS	571-09		PU249-101A-06		1
PUSI 249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP DISCH	PUMP SPEED INDICATION	NA	SAI	571-09	DCS	571-09		PU249-101A-07		1
HSPU 249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP CMND-DCS SW	PUMP COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-101A-08		1
PUI 249-101A	Include	NA	PU249-101A	VFD	PU249-101A PR. COND PMP CURRENT IND	PUMP CURRENT INDICATION	NA	AI	571-09	DCS	571-09		PU249-101A-06		1
PUSTR249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP STR CMND	PUMP START COMMAND	NA	DO	571-09	DCS	571-09		PU249-101B-01		1
PUSTP249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP STP CMND	PUMP STOP COMMAND	NA	DO	571-09	DCS	571-09		PU249-101B-02		1
HSRPU249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP R/L-DCS SW	PUMP R/L SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-101B-03		1
PUREM249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP R/L CMND	PUMP R/L COMMAND	NA	DO	571-09	DCS	571-09		PU249-101B-04		1

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
Tags Indicated below are for Tagging Philosphy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.														

STANDARD INDEX COLUMNS FOR SUBMISSION

TAG NUMBER	P&ID	LINE NUMBER	EQUIPMENT NUMBER-	Associated Instrument Number(Details to be included as requiredfor corelation of tags)	SERVICE (With Abbreviation & Shall be less than 24 character)	INSTRUMENT TYPE DESCRIPTION (REFER NOTE BELOW)	STATUS	I/O TYPE	LOCATION	SYSTEM	SYSTEM LOCATION (SATELLITE RACK ROOM)	Serial Communic ations to DCS(Modbus,Profibus)	SORTED LOOP NUMBER	REMARK FOR UNDERSTANDING INDEX	INDEX REV NO
PURSE 249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP RDY TO STR ELEC	PUMP READY TO START ELECT	NA	DI	571-09	DCS	571-09		PU249-101B-08-01		1
PURSP 249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP RDY TO STR PROC	PUMP READY TO START PROCESS	NA	SOFT	DCS	DCS	571-09		PU249-101B-08-03		1
PUYL 249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP RUN IND	PUMP RUN INDICATION	NA	DI	571-09	DCS	571-09		PU249-101B-05		1
PUFLT249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP TRIP IND	PUMP TRIP INDICATION(TRIP ON FAULT)	NA	DI	571-09	DCS	571-09		PU249-101B-06		1
PUI 249-101B	Include	NA	PU249-101B	VFD	PU249-101B PR. COND PMP CURRENT IND	PUMP CURRENT INDICATION	NA	AI	571-09	DCS	571-09		PU249-101B-06		1
PUSI 249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP DISCH	PUMP SPEED INDICATION	NA	SAI	571-09	DCS	571-09		PU249-101B-07		1
HSPU 249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP CMND-DCS SW	PUMP COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-101B-08		1
PUYLA249-101A	Include	NA	PU249-101A		PU249-101A PR. COND PMP RUN FAIL AL	PUMP RUN FAIL ALARM	NA	SOFT	DCS	DCS	571-09		PU249-101A-08-02		1
PUYLA249-101B	Include	NA	PU249-101B		PU249-101B PR. COND PMP RUN FAIL AL	PUMP RUN FAIL ALARM	NA	SOFT	DCS	DCS	571-09		PU249-101B-08-02		1
Compensated Annubar loop with temp loop (Ratio Control)															
FE 249-041	Include	FV249-0743-500C-HC	NA		FLASH VAP TO HEAT EXCHANGER EX249-102	AVERAGING PITOT TUBE PRIMARY ELEMENT	UHDE	NA	FIELD	NA	NA		F 249-041-01		1
FIT 249-041	Include	FV249-0743-500C-HC	NA		FLASH VAP TO HEAT EXCHANGER EX249-102	AVERAGING PITOT TUBE TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	571-09		F 249-041-02		1
TE 249-041	Include	FV249-0743-500C-HC	NA		FLASH VAP TO HEAT EXCHANGER EX249-102	AVG PITOT TUBE INTEGRAL TEMP ELEMENT	UHDE	NA	FIELD	NA	NA		F 249-041-03		1
TI 249-041	Include	FV249-0743-500C-HC	NA		FLASH VAP TO HEAT EXCHANGER EX249-102	INDICATOR-DCS	NA	SOFT	DCS	DCS	571-09		F 249-041-04		1
FIC 249-041	Include	FV249-0743-500C-HC	NA		FLASH VAP TO HEAT EXCHANGER EX249-102	CONTROLLER-DCS	NA	SOFT	DCS	DCS	571-09		F 249-041-05		1
FCV 249-041	Include	FV249-0743-500C-HC	NA		FLASH VAP TO HEAT EXCHANGER EX249-102	GLOBE VALVE-CONTROL VALVE FF	UHDE	FBV-AO	FIELD	DCS	571-09		F 249-041-06		1
TE 249-035	Include	WCL249-3002-250F-HC	NA		WEAK LIQR TO CAUSTICISATION TKS TK249-104/105	TEMPERATURE ELEMENT	UHDE	NA	FIELD	NA	NA		F 249-041-07		1
TW 249-035	Include	WCL249-3002-250F-HC	NA		WEAK LIQR TO CAUSTICISATION TKS TK249-104/105	THERMOWELL	UHDE	NA	FIELD	NA	NA		F 249-041-08		1
TT 249-035	Include	WCL249-3002-250F-HC	NA		WEAK LIQR TO CAUSTICISATION TKS TK249-104/105	HEAD MOUNT TEMPERATURE TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	571-09		F 249-041-09		1
TIC 249-035	Include	WCL249-3002-250F-HC	NA		WEAK LIQR TO CAUSTICISATION TKS TK249-104/105	CONTROLLER-DCS	NA	SOFT	DCS	DCS	571-09		F 249-041-10		1
Two RADAR element, selector switch, Flow element& two pumps' control [RATIO CONTROL]															
LE 249-008	Include	NA	TK249-106		TK249-106 CAUSTICISATION TK	RADAR LEVEL ELEMENT	UHDE	NA	FIELD	NA	NA		L 249-008-01		1
LIT 249-008	Include	NA	TK249-106		TK249-106 CAUSTICISATION TK	RADAR LEVEL TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	571-09		L 249-008-02		1
LI 249-008	Include	NA	TK249-106		TK249-106 CAUSTICISATION TK	INDICATOR-DCS	NA	SOFT	DCS	DCS	571-09		L 249-008-03		1
LE 249-009	Include	NA	TK249-107		TK249-107 CAUSTICISATION TK	RADAR LEVEL ELEMENT	UHDE	NA	FIELD	NA	NA		L 249-008-04		1
LIT 249-009	Include	NA	TK249-107		TK249-107 CAUSTICISATION TK	RADAR LEVEL TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	571-09		L 249-008-05		1
LI 249-009	Include	NA	TK249-107		TK249-107 CAUSTICISATION TK	INDICATOR-DCS	NA	SOFT	DCS	DCS	571-09		L 249-008-06		1
SEL 249-008	Include	NA	TK249-106		TK249-106 CAUSTICISATION TK	SELECTOR SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		L 249-008-07		1
LIC 249-008	Include	NA	TK249-106		TK249-106 CAUSTICISATION TK	CONTROLLER-DCS	NA	SOFT	DCS	DCS	571-09		L 249-008-08		1

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
<p align="center">Tags Indicated below are for Tagging Philosphy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.</p>														

STANDARD INDEX COLUMNS FOR SUBMISSION

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FE 249-010	Include	CRS249-2009-250F-HC	NA		CAUSTICISED SLURRRY PMPS PU249-102A/B DISCH	MAGNETIC FLOWMETER FLOWTUBE	UHDE	NA	FIELD	NA	NA		L 249-010-09		1
FIT 249-010	Include	CRS249-2009-250F-HC	NA		CAUSTICISED SLURRRY PMPS PU249-102A/B DISCH	MAGNETIC FLOWMETER TEMPERATURE FF	UHDE	FB-AI	FIELD	DCS	571-09		L 249-010-10		1
FIC 249-010	Include	NA	NA		CAUSTICISED SLURRRY PMPS PU249-102A/B DISCH	CONTROLLER-DCS	NA	SOFT	DCS	DCS	571-09		L 249-010-11		1
PUSC 249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP DISCH	PUMP SPEED CONTROLLER	FN	AO	571-09	DCS	571-09		L 249-010-12		1
PUSC 249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP DISCH	PUMP SPEED CONTROLLER	FN	AO	571-09	DCS	571-09		L 249-010-13		1
PUSTR249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP STR CMND	PUMP START COMMAND	NA	DO	571-09	DCS	571-09		PU249-102A-01		1
PUSTP249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP STP CMND	PUMP STOP COMMAND	NA	DO	571-09	DCS	571-09		PU249-102A-02		1
HSRPU249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP R/L-DCS SW	PUMP R/L SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-102A-03		1
PUREM249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP R/L CMND	PUMP R/L COMMAND	NA	DO	571-09	DCS	571-09		PU249-102A-04		1
PUI 249-102A	Include	NA	PU249-102A	VFD	PU249-102A CAUSTICISED SLR PMP CURRENT IND	PUMP CURRENT INDICATION	NA	AI	571-09	DCS	571-09		PU249-102A-06		1
PUYL 249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP RUN IND	PUMP RUN INDICATION	NA	DI	571-09	DCS	571-09		PU249-102A-05		1
PURSE 249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP RDY TO STR ELEC	PUMP READY TO START ELECT	NA	DI	571-09	DCS	571-09		PU249-102A-08-01		1
PURSP 249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP RDY TO STR PROC	PUMP READY TO START PROCESS	NA	SOFT	DCS	DCS	571-09		PU249-102A-08-03		1
PUFLT249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP TRIP IND	PUMP TRIP INDICATION(TRIP ON FAULT)	NA	DI	571-09	DCS	571-09		PU249-102A-06		1
PUSI 249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP DISCH	PUMP SPEED INDICATION	NA	SAI	571-09	DCS	571-09		PU249-102A-07		1
HSPU 249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP CMND-DCS SW	PUMP COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-102A-08	To be provided based on confirmation from process	1
PUSTR249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP STR CMND	PUMP START COMMAND	NA	DO	571-09	DCS	571-09		PU249-102B-01		1
PUSTP249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP STP CMND	PUMP STOP COMMAND	NA	DO	571-09	DCS	571-09		PU249-102B-02		1
HSRPU249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP R/L-DCS SW	PUMP R/L SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-102B-03		1
PUREM249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP R/L CMND	PUMP R/L COMMAND	NA	DO	571-09	DCS	571-09		PU249-102B-04		1
PUYL 249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP RUN IND	PUMP RUN INDICATION	NA	DI	571-09	DCS	571-09		PU249-102B-05		1
PUFLT249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP TRIP IND	PUMP TRIP INDICATION(TRIP ON FAULT)	NA	DI	571-09	DCS	571-09		PU249-102B-06		1
PURSE 249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP RDY TO STR ELEC	PUMP READY TO START ELECT	NA	DI	571-09	DCS	571-09		PU249-102B-08-01		1
PURSP 249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP RDY TO STR PROC	PUMP READY TO START PROCESS	NA	SOFT	571-09	DCS	571-09		PU249-102B-08-03		1
PUI 249-102B	Include	NA	PU249-102B	VFD	PU249-102B CAUSTICISED SLR PMP CURRENT IND	PUMP CURRENT INDICATION	NA	AI	571-09	DCS	571-09		PU249-102B-06		1
PUSI 249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP DISCH	PUMP SPEED INDICATION	NA	SAI	571-09	DCS	571-09		PU249-102B-07		1
HSPU 249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP CMND-DCS SW	PUMP COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-102B-08	To be provided based on confirmation from process	1
PUYLA249-102A	Include	NA	PU249-102A		PU249-102A CAUSTICISED SLR PMP RUN FAIL AL	PUMP RUN FAIL ALARM	NA	SOFT	DCS	DCS	571-09		PU249-102A-08-02		1
PUYLA249-102B	Include	NA	PU249-102B		PU249-102B CAUSTICISED SLR PMP RUN FAIL AL	PUMP RUN FAIL ALARM	NA	SOFT	DCS	DCS	571-09		PU249-102B-08-02		1
Two Flow Element,selector switch & two pumps control															
FE 249-038A	Include	LM249-2024-50G-PP	NA		LIME SLR PMPS PU249-104A DISCH	MAGNETIC FLOWMETER FLOWTUBE	UHDE	NA	FIELD	NA	NA		F 249-038-01		1

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number		instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added								Column Shited & included in Instrument Index		
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FIT 249-038A	Include	LM249-2024-50G-PP	NA		LIME SLR PMPS PU249-104A DISCH	MAGNETIC FLOWMETER TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	571-09		F 249-038-02		1
FI 249-038A	Include	LM249-2024-50G-PP	NA		LIME SLR PMPS PU249-104A DISCH	INDICATOR-DCS	NA	SOFT	DCS	DCS	571-09		F 249-038-03		1
FE 249-038B	Include	LM249-2003-50G-PP	NA		LIME SLR PMPS PU249-104B DISCH	MAGNETIC FLOWMETER FLOWTUBE	UHDE	NA	FIELD	NA	NA		F 249-038-04		1
FIT 249-038B	Include	LM249-2003-50G-PP	NA		LIME SLR PMPS PU249-104B DISCH	MAGNETIC FLOWMETER TRANSMITTER FF	UHDE	FB-AI	FIELD	DCS	571-09		F 249-038-05		1
FI 249-038B	Include	LM249-2003-50G-PP	NA		LIME SLR PMPS PU249-104B DISCH	INDICATOR-DCS	NA	SOFT	DCS	DCS	571-09		F 249-038-06		1
SEL 249-038	Include	LM249-2024-50G-PP	NA		LIME SLR PMPS PU249-104A DISCH	SELECTOR SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		F 249-038-07		1
FIC 249-038	Include	LM249-2024-50G-PP	NA		LIME SLR PMPS PU249-104A DISCH	CONTROLLER-DCS	NA	SOFT	DCS	DCS	571-09		F 249-038-08		1
PUSC 249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP DISCH	PUMP SPEED CONTROLLER	FN	AO	571-09	DCS	571-09		F 249-038-09		1
PUSC 249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP DISCH	PUMP SPEED CONTROLLER	FN	AO	571-09	DCS	571-09		F 249-038-10		1
PUSTR249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP STR CMND	PUMP START COMMAND	NA	DO	571-09	DCS	571-09		PU249-104A-01		1
PUSTP249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP STP CMND	PUMP STOP COMMAND	NA	DO	571-09	DCS	571-09		PU249-104A-02		1
HSRPU249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP R/L-DCS SW	PUMP R/L SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-104A-03		1
PUREM249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP R/L CMND	PUMP R/L COMMAND	NA	DO	571-09	DCS	571-09		PU249-104A-04		1
PUYL 249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP RUN IND	PUMP RUN INDICATION	NA	DI	571-09	DCS	571-09		PU249-104A-05		1
PUFLT249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP TRIP IND	PUMP TRIP INDICATION(TRIP ON FAULT)	NA	DI	571-09	DCS	571-09		PU249-104A-06		1
PURSE 249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP RDY TO STR ELEC	PUMP READY TO START ELECT	NA	DI	571-09	DCS	571-09		PU249-104A-08-01		1
PURSP 249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP RDY TO STR PROC	PUMP READY TO START PROCESS	NA	SOFT	DCS	DCS	571-09		PU249-104A-08-03		1
PUI 249-104A	Include	NA	PU249-104A	VFD	PU249-104A LIME SLR PMP CURRENT IND	PUMP CURRENT INDICATION	NA	AI	571-09	DCS	571-09		PU249-104A-06		1
PUSI 249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP DISCH	PUMP SPEED INDICATION	NA	SAI	571-09	DCS	571-09		PU249-104A-07		1
HSPU 249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP CMND-DCS SW	PUMP COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-104A-08	To be provided based on confirmation from process	1
PUSTR249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP STR CMND	PUMP START COMMAND	NA	DO	571-09	DCS	571-09		PU249-104B-01		1
PUSTP249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP STP CMND	PUMP STOP COMMAND	NA	DO	571-09	DCS	571-09		PU249-104B-02		1
PUI 249-104B	Include	NA	PU249-104B	VFD	PU249-104B LIME SLR PMP CURRENT IND	PUMP CURRENT INDICATION	NA	AI	571-09	DCS	571-09		PU249-104B-06		1
HSRPU249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP R/L-DCS SW	PUMP R/L SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-104B-03		1
PUREM249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP R/L CMND	PUMP R/L COMMAND	NA	DO	571-09	DCS	571-09		PU249-104B-04		1
PUYL 249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP RUN IND	PUMP RUN INDICATION	NA	DI	571-09	DCS	571-09		PU249-104B-05		1
PUFLT249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP TRIP IND	PUMP TRIP INDICATION(TRIP ON FAULT)	NA	DI	571-09	DCS	571-09		PU249-104B-06		1
PURSE 249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP RDY TO STR ELEC	PUMP READY TO START ELECT	NA	DI	571-09	DCS	571-09		PU249-104B-08-01		1
PURSP 249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP RDY TO STR PROC	PUMP READY TO START PROCESS	NA	SOFT	DCS	DCS	571-09		PU249-104B-08-03		1
PUSI 249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP DISCH	PUMP SPEED INDICATION	NA	SAI	571-09	DCS	571-09		PU249-104B-07	To be provided based on confirmation from process	1
HSPU 249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP CMND-DCS SW	PUMP COMMAND SWITCH-DCS	NA	SOFT	DCS	DCS	571-09		PU249-104B-08	To be provided based on confirmation from process	1
PUYLA249-104A	Include	NA	PU249-104A		PU249-104A LIME SLR PMP RUN FAIL AL	PUMP RUN FAIL ALARM	NA	SOFT	DCS	DCS	571-09		PU249-104A-08-02		1

STANDARD INSTRUMENT LIST

tag_number	pid	line_number	equipment_number			instrument_type_description	status	io_type	location	udf_c35	udf_c36		udf_c33	Remark	udf_c30
REVISION DETAILS				Column Added									Column Shited & included in Instrument Index		
<p style="color: red; text-align: center;">Tags Indicated below are for Tagging Philosphy,Combination of tags requirement shall be based on P&ID,Loop requirement and Electrical GES.</p>															
STANDARD INDEX COLUMNS FOR SUBMISSION															
TAG NUMBER	P&ID	LINE NUMBER	EQUIPMENT NUMBER-	Associated Instrument Number(Details to be included as requiredfor corelation of tags)	SERVICE (With Abbreviation & Shall be less than 24 character)	INSTRUMENT TYPE DESCRIPTION (REFER NOTE BELOW)	STATUS	I/O TYPE	LOCATION	SYSTEM	SYSTEM LOCATION (SATELLITE RACK ROOM)	Serial Communic ations to DCS(Modbus,Profibus)	SORTED LOOP NUMBER	REMARK FOR UNDERSTANDING INDEX	INDEX REV NO
PUYLA249-104B	Include	NA	PU249-104B		PU249-104B LIME SLR PMP RUN FAIL AL	PUMP RUN FAIL ALARM	NA	SOFT	DCS	DCS	571-09		PU249-104B-08-02		1

