KUWAIT OIL COMPANY (K.S.C.)

A subsidiary of Kuwait Petroleum Corporation

إحـــدى شركـــات مؤسســـة البتـــرول الكـويتيـة
A Subsidiary of Kuwait Petroleum Corporation

PRODUCTION & PROJECTS (GAS) GROUP
GAS PROJECTS MANAGEMENT TEAM-II

Mutriba Remote Boosting Facility (MRBF) at North Kuwait

Appendix-16

Instrumentation Technical Specification

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(Register of Commerce No. 21835)
Mutriba Remote Boosting Facility (MRBF), at North Kuwait
Appendix-16
Instrumentation Technical Specification

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Instrumentation Technical Specification

1. INTRODUCTION

1.1. The purpose of this document is to provide an outline requirement of Instrumentation, Measurement, Control & Safety systems for MRBF facility.

1.2. This Technical Specification shall be read in conjunction with Technical Specifications described under this Contract, Company supplied Project reference Drawings, Standard Drawing, KOC Standards, KOC Recommended Practices and National/International Standards/code of practices.

1.3. KOC standards, contract technical specifications & international standards shall be followed for specific requirements of Instrumentation, control & safety systems. This document identifies the major systems and provides basic selection criteria & application for the field instruments.

2. APPLICABLE CODES AND STANDARDS

2.1. The Instrument & Control shall conform in design, materials and performance, except where otherwise specified, with the current issue and amendments of the applicable codes and standards prevailing on the effective date of the Contract.

2.2. In the event of conflict between the standards and the codes referenced herein, the most stringent requirement shall apply.

2.3. Any exceptions or deviations from this specification, along with their merits and justifications, shall be brought to the attention of the Company.

2.4. Compliance with this specification shall not relieve the manufacturer of its responsibility to supply equipment suited to meet the specified service conditions and applicable regulations, codes and standards.

2.5. All equipment and systems of Facility shall be as per prevailing Company Standards and/or International codes and standards. (details of standards will be attached later)

2.6. ABBREVIATIONS

AMS	Asset Management System
BDV	Blowdown Valve
CCTV	Closed Circuit Television
DCS	Distributed Control System
ESD	Emergency Shutdown System
ESDV	ESD Valve
F&G	Fire & Gas

FACP	Fire Alarm Control Panel
FAT	Factory Acceptance Test
FFG	Flame Front Generator
FGS	F&G System
FO	Fiber Optic
FOPP	Fiber Optic Patch Panel
GOR	Gas Oil Ratio
GPS	Global Positioning System
GVF	Gas Volume Fraction
H_2S	Hydrogen Sulphide
HART	Highway Addressable Remote Transducer
HC	Hydrocarbon
HE	High Energy
HIPPS	High Integrity Pressure Protection System
HMI	Human Machine Interface
I/O	Input / Output
ICSS	Integrated Control and Safety System
IRP	Interposing Relay Panel
IS	Intrinsic Safety
JB	Junction Box
KOC	Kuwait Oil Company
KVM	Keyboard, Video, Monitor/Mouse
LAN	Local Area Network
LED	Light Emitting Diode
LP	Low Pressure

LSD	Large Screen Display
MCT	Multi Cable Transit
MOS	Maintenance Override Switch
MOV	Motor Operated valve
MPFM	Multi-phase Flowmeter
MTO	Material Take Off
NIS	Non-Intrinsically Safe
NVR	Network Video Recorders
O&M	Operation & Maintenance
OEM	Original Equipment Manufacturer
OPC	OLE for Process Control
PAGA	Public Address General Alarm
PC	Personnel Computer
P&ID	Piping & Instrumentation Diagram
PLC	Programmable Logic Controller
POS	Operation Override Switch
PST	Partial Stroke Test
QA/QC	Quality Assurance/Quality Control
RFI	Radio Frequency Interference
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition System
SIL	Safety Integrity Level
SOE	Sequence of Events
SPI	Smart Plant Instrumentation
TCP/IP	Transfer Control Protocol/Internet Protocol

TEG	Tri-Ethylene Glycol
UCP	Unit Control Panel
UPS	Uninterruptible Power Supply
UV/IR	Ultra Violet / Infra-Red
VFD	Variable Frequency Drive
VRU	Vacuum Recovery Unit
WLR	Water Liquid Ratio

3. BASIC ENGINEERING INFORMATION

3.1. Service Conditions : All instrumentation & control shall be suitable for the prevailing site ambient conditions and climatic conditions as detailed in “KOC Standard for Basic Design Data (KOC-G-007)”.

3.2. Sour Service Requirements : For sour services, the wetted parts of the field instrumentation shall be in compliance with NACE MR-01-75 / ISO 15156. The instrumentation in sour service shall be suitably designed to have minimum amount of leak paths and avoid toxic release to the atmosphere.

3.3. Protection from Environment :The minimum acceptable standard of protection against water or dust ingress is to BS EN 60529 (IEC 60529) degree of protection IP 65.

3.4. Electronic parts shall be environmentally sealed or designed to operate without change of atmosphere (breathing).

3.5. Sun shields are required for all electronic instruments or panels for protection from the direct sun.

3.6. Additional cooling may be required to maintain the instrument or field panel below 70°C (165°F) or the maximum instrument or panel design temperature, whichever is the lower. The CONTRACTOR is responsible for providing such cooling either within the instrument design or within the panel design as a feature of the installation of the instrument or panel.

3.7. All instruments shall be suitable for the site ambient conditions and relative humidity.

3.8. Hazardous Area

3.8.1. General Information on the allocation of hazardous area divisions and responsibilities shall be as specified in the "Hazardous Area Layout Drawings”. The

Contractor/Vendor/Purchaser shall be responsible for the hazardous areas and of protection methods to ensure the safety of the complete Facility.

3.8.2. All electrical or electronic field instruments shall be suitable for installation in the defined hazardous area location.

3.8.3. All installation of electrical/electronic equipment in hazardous areas shall be in accordance with the requirements of KOC-E-004.

3.8.4. The process field Instruments shall be intrinsic safe to EEx ia IIB T4. The junction boxes / field panels for intrinsic safe instruments and flameproof instruments shall be certified to EEx ia IIB T4 and EEx e IIB T4 respectively.

3.8.5. Instruments for installation in classified areas shall be labelled, listed, certified by recognized testing authority.

3.8.6. Any ambiguity of the Hazardous Area Classification, Weatherproof or Explosion proof selection shall be brought to the attention of the COMPANY for clarification and approval.

3.8.7. Certification under IEC will be as "Zone 0/1/2, IIA/B/C, T1/2/3/4/5/6, Ex 'xx'" and weather proof to IP XX as per IEC 60529.

3.9. Standardization of equipment

3.9.1. As far, as is practicable, variations in the selection of instruments and systems shall be kept to a minimum. This is to reduce engineering, procurement, commissioning, maintenance, training and operations costs.

3.10. EMC/RFI Immunity

3.10.1. All the electronic instrumentation shall comply with Electromagnetic Compatibility (EMC) and radio frequency interference (RFI) requirements in standard IEC 61000 or applicable standard. Compliance must be demonstrated by way of testing and certification.

4. POWER SUPPLY

4.1. Instruments & Controls shall be powered through PCS-UPS with two hours back-up for DCS, ESD, HIPPS, UCP, PAGA, CCTV and related interface equipment's. FGS and related interface equipment's shall be powered through FGS-UPS with 24 hours & 30 minutes back-up.

4.2. To the maximum, extent possible, instruments shall be supplied with 24 VDC, power. Provision of suitable size TB's shall be provided in the marshalling cabinets to power up field instruments requiring external power.

4.3. Instruments requiring 110 VAC, shall be fed from the UPS. Dedicated field power distribution JB's & power cables shall be provided for instruments requiring external

power.

4.4. Fire Alarm (Control) Panel (FAPs) and Fire Suppression Panels (FSPs) shall be provided with stand-alone dedicated batteries for 24 Hour & 30 minutes power backup and fed from plant Emergency distribution feeder.

4.5. UPS power supply shall be redundant for the ICSS, LAN, CCTV, PAGA, Telecom components including network switches, servers, controllers, marshalling & package vendor supplied control and safety systems.

4.6. UPS power to the consumers located in control room & sub-station shall be supplied through the UPS PDB panels located in respective area and segregated for DCS, ESD & FGS.

4.7. 6KVA PCS-UPS power to be reserved for Company supplied panels with necessary distribution arrangement in the MCB.

5. INTEGRATED CONTROL AND SAFETY SYSTEM(ICSS)

5.1. GENERAL

5.1.1. MRBF facility shall be shall be provided with ICSS system, a truly integrated architecture of DCS, ESD, FGS and HIPPS for monitoring and control of the Facility to meet the plant safety, product quality, throughput, efficiency and economic operation automatically controlled from the central control room.

5.1.2. ICSS shall be a true integrated system with all the three systems sitting on the same data highway without the use of any intermediate interface hardware. Control & safety systems shall be physically, functionally & logically separated. Requirements as specified in KOC-I-019, KOC-I-004 & KOC-I-005 for ICSS, ESD and FGS shall be followed. PLC based control & monitoring system shall not be used.

5.1.3. Each of the ICSS sub-systems (DCS, ESD, FGS & HIPPS) shall be entirely segregated from others within own dedicated cabinets and shall have their own redundant power supplies and communication internally segregated. Contractor to logically segregate the I/O's and location of marshalling panels considering cables lengths & routing. Line monitoring shall be provided for F&G and ESD signals. ICSS I/O cards shall be HART pass through. Marshalling & System panels shall be installed in the MCB and Instrumentation room of nearest sub-stations.

5.1.4. To the maximum extent possible all the package control & safety systems shall also be implemented in facility ICSS unless any guarantee/warranty, performance or operational requirements are set by the package vendor which can't be handled by the facility ICSS. I/O's for the packages shall be segregated at I/O, marshalling and system level.

5.1.5. Engineering & Operator Stations, servers, printers & large screen displays shall be located in the MCB.

5.1.6. Dedicated Engineering workstations shall be provided for DCS, ESD and FGS. Engineering Stations shall be located in the Engineering Room of MCB.

5.1.7. Connectivity between sub-stations & MCB shall be through dedicated redundant fiber optic cables. Redundant fiber optic cables shall follow different cable laying routes. Separate FO cables shall be used for DCS, ESD & FGS. Redundant & dedicated network switches & FOPP shall be provided for FO connectivity through single mode FO cables

5.1.8. All the servers, network switches & FOPP's shall be redundant. All the Servers, workstations, network switches, Firewalls, KVMs, FOPP's and related hardware's shall be rack mounted installed in segregated server or network cabinets. HMI Monitors and Mouse /Keyboards shall be provided with KVM extenders and installed on the Operator / Engineering consoles of MCB.

5.1.9. Redundant ICSS controllers shall be segregated based on the process units. Latest series of hardware & software versions with proven track record shall be selected for the ICSS.

5.1.10. Instrumentation room of sub-station shall be un-manned & used only to install the panels. False flooring shall be provided in the instrumentation room of sub-station & MCB for routing of system cables on the trays. Provision of connecting a laptop PC shall be provided for the troubleshooting, configurations, maintenance, start-up and commissioning in the Instrumentation room of sub-stations.

5.1.11. Following rack-mounted redundant servers shall be provided in the servers cabinet in MCB :-

a) Historian servers
b) SOE Server
c) Alarm management servers
d) AMS servers
e) OPC servers
f) GPS servers

5.1.12. Servers shall not be a single point of failure which can effect data network transmission & operation of the facility. Workstation / server, shall have hard-disk redundancy based on RAID architecture. Redundant processors inside one station shall not constitute sufficiency of redundancy.

5.1.13. DCS shall be time synchronized with the GPS server whereas other ICSS subsystems (ESD, FGS & HIPPS) and all third-party systems (E.g: UCPs, E-SCADA, MPFM) shall be synchronized to DCS.

5.1.14. ESD and FGS shall be minimum SIL-3 certified as per IEC-61508 & 61511 irrespective of SIL assessment outcomes.

5.1.15. IP based Auto dialing facility to interface with COMPANY Fire/Emergency Line upon detection of confirmed fire shall be provided from F&G System.

5.1.16. Contractor shall carryout Control Hazard & Operability study (CHAZOP) as per clause 9.12 of KOC-I-001 & 14.4.4 of KOC-I-019.

5.1.17. Contractor shall carryout SIL assessment study as per KOC standards and provide closeout reports for closing of recommendations.

5.1.18. SIL verification study shall be carried out after the SIL assessment & the report shall be submitted for company review.

5.1.19. Pre-alarms shall be generated from field transmitters connected to DCS. Trips to be implemented on ESD from dedicated trip transmitters.

5.1.20. Dedicated UPS shall be provided for control and safety systems. UPS autonomy time shall be as per KOC standard. UPS power to the panels shall be provided through dedicated UPS power distribution cabinets.

5.1.21. Inter panel cables shall be routed through the cable trays installed below the false floor. Trays shall be segregated for power & signal cables. Panels shall be installed on the panel frames provided on the false flooring.

5.1.22. Software & Hardware licenses for all the systems including third party packages shall be transferable in the name of Company. Transfer of software licenses shall be without any implication & liability to the Company.

5.1.23. The ICSS systems shall be fully secure and free from cyber breach. The complete hardware and software requirements shall be provided for cybersecurity in compliance with Clause 29.0 of KOC-I-019.

5.1.24. ICSS and associated equipment electronics (PCBs and other hardware) shall be manufactured & coated to suit minimum G2 corrosive atmosphere as per ANSI / ISA-71.04 as well as KOC Facilities corrosive environmental conditions.

5.1.25. Refer Annexure-1 to this technical specification for the proposed ICSS System Architecture for the MRBF facility.

5.2. HIPPS

5.2.1. HIPPS shall include (but not limited to), SIL 3 certified logic solver, shutdown valves (2 numbers) with partial stroke capability, Three (3) electronic pressure transmitters, cabinet and accessories.

5.2.2. HIPPS valves shall be provided for the production header to pump suction as per P&ID.

5.2.3. Complete HIPPS to be certified for SIL 3 in accordance with the IEC 61508 and IEC 61511 standards. Specifications of HIPPS shall be as per KOC-I-001 section 9.9. HIPPS valves shall be in 1oo2 & transmitters in 2oo3 voting.

5.2.4. Typically, the overall response time of the HIPPS system shall be less than 2

seconds, the response time shall be verified through surge calculation as well.

5.3. THIRD PARTY COMMUNICATION

5.3.1. The ICSS shall be provided with data transfer interfaces for monitoring and control from / to various Facility third-party systems where third party control & safety systems are provided, they shall be interfaced with the facility ICSS through redundant Modbus communication shall be fully redundant.

5.3.2. Dedicated DCS controllers, interface modules, network switches, firewall, FOPP, network panel and other network hardware shall be provided for third party interfaces.

5.3.3. Monitoring, control and alarm functions for third party packages shall be provided on the DCS Operator workstations.

5.3.4. 5-nos of spare ports shall be provided in the third party network switch for integrating the facility interface signals, by others.

5.3.5. ICSS communication interfaces for data exchange with third-party corporate systems shall be based on OPC-UA utilizing TCP/IP network with firewall & router.

5.3.6. OPC servers shall be redundant and made available to OPC clients. Required number of software licenses & hardware ports shall be provided in OPC servers. Each OPC Interface shall support real-time process data (DA), real-time alarm and event data (A&E), and historical data (HDA) with Tunneler.

5.3.7. Firewall & router shall be designed as per KOC specifications supporting downstream existing network communications. Each OPC hardware & software shall be compatible to OPC UA, HDA, A&E protocols required for external OPC interfaces.

5.4. CABINETS

5.4.1. Cabinets shall be located in the Instrumentation room of Sub-stations & marshalling room of the control building. Design of Cabinets shall comply with KOC-I-007. All the network cables, signal cables, power cables for the ICSS, LAN, Telecom hardware in the control room & engineering room shall be concealed in building wall & false floor through cable trays & ducts without any requirement of cable conduits, trays or ducts protruding outside on the wall or floor.

5.4.2. Cabinets shall be segregated at I/O marshalling and system level as per the process area. Separate cabinets for I/O marshalling shall be provided for each ICSS subsystems.

5.4.3. Functionally and physically dedicated Interposing rely cabinets for DCS & ESD systems shall be provided for circuit isolation / interface between electrical MCC and instrumentation control and safety systems.

5.4.4. Panels earthing shall be as per KOC-I-007 & Appendix 22 of KOC-I-002. All field cables armor landing in marshalling cabinets shall be earthed using cable glands having Earthing connection provisions.

5.5. WORK STATIONS & CONSOLES

5.5.1. Dual 23-inch LED Widescreen monitor shall be provided as operator workstations mounted on the consoles in control room. Configuration of dual monitors shall be horizontal (side-side) to enable better visibility of wall mounted LSD's.

5.5.2. Three number of 70" LED type LSD shall be provided for process graphics, F&G display and process CCTV. Operator should be able call any graphics on any LSD's.

5.5.3. Servers & workstation machines shall be installed in the Server Cabinets in the marshalling Room of MCB, whereas their Monitors and Mouse /Keyboards shall be provided with KVM extenders and installed on the Operator / Engineering consoles as applicable.

5.5.4. Consoles & furniture in the control room shall be ergonomically designed.

5.6. PUSH BUTTON PANELS

5.6.1. ESD & FGS FASCIA push button station shall be provided according to clause 17.4 of KOC-I-019 in control room for the implementation of emergency shutdown, monitoring, and reset & first out alarms, MOS & POS. POS's & MOS shall be identified in the Cause & Effect diagrams. 20% Spare wired indication lamps, Push buttons & switches shall be provided in addition to 50% spare space.

5.6.2. Dedicated hardwired mimic panel shall be provided for F&G system containing status of fire zones, MOS, POS, fire water pumps status & control, jockey pumps status & control, deluge valves status & control and fire water tank level status.

5.6.3. Hardwired connection between ESD / FGS marshalling cabinets and the push button panel Wiring termination methods shall follow KOC standards and shall not require special means like inline soldering or PCB component mounting. Marshalling cabinets for the push button panel signals to be located in the MCB.

5.7. PRINTERS

5.7.1. Following printers shall be provided :-

a) One no. of A4 Size Black & White laser printer for report printing in Control Room
b) One no. of A3 Size Color laser printer for Alarm & trend printing in Control Room
c) One no. of A3 Size Color laser printer for FGS Alarm printing in Control Room
d) One no. of A3 Size Color laser printer in Engineering Room
e) One no. of A4 size color laser printer for third-party systems

5.7.2. All the Printers shall be grouped together & ergonomically located in the corner of the control room installed on suitable consoles. Refer Annexure to this technical specification for control room layout showing arrangement of stations & printers.

6. BUILDING FIRE ALARM PANEL

6.1. Building fire alarm panel shall be supplied for MCB, Sub-stations & other facility buildings complete with addressable type smoke detectors, heat detectors, MCP and audible & visual alarms.

6.2. The FAP shall be interfaced with facility F&G System through redundant links & provided with auto dialing system. Mineral insulated cables shall be used for the wiring of addressable smoke detectors inside the buildings. Diagnostic alarms for FACP's shall be hardwired to the facility F&G system.

6.3. Building fire alarm panels complying with applicable NFPA standards shall be provided at Central Control Building, Sub-stations, Laboratory & other buildings within the facility.

6.4. Confirmed alarm & executive action signals from the FACP to the facility F&G system shall be hardwired.

6.5. FACP shall be located at strategic location of the building which is normally manned e.g. at the exits.

6.6. Fire suppression control panel (FSCP) shall be provided for substations as per KOC-L-024.

7. FLARES INSTRUMENTATION

7.1. Flare system & instrumentation shall be provided as per section KOC-ME-021. Dedicated FFG & HE ignition panel shall be provided for LP & HP flares. Flares pilot monitoring & ignition shall be possible both from LCP and remotely from DCS. The field operator should be able to select the local or remote operation through a Local/Remote selector switch provided on the local FFG & HE ignition Panel. Status of Local/Remote switch should be available on DCS as well as on local panel indication lamp. DCS operator should be able to reset or abort the sequence.

7.2. HE ignition sequence shall be automatic based on the flare flameout logic. HE spark ignition power cables shall be dedicated for each pilot.

7.3. Start-up, purging sequence, shutdown & monitoring data shall be available on the DCS through redundant serial links. Shutdown logic solver & instruments causing shutdown shall be min. SIL-2 certified, irrespective of SIL assessment outcomes. Local panels shall be certified for the hazardous area of installation, complied with environmental conditions & provided with sunshade. All the local panels shall be front facing without any side mounting and the operator should be able to operate or see the status of FFG flame & access HE ignition from front side. Pyrometers shall

be provided for flare monitoring.

7.4. Each pilot shall be provided with dual thermocouples, both wired. Each thermocouple shall be provided with dual temperature elements, one element wired & other as spare. Thermocouple failure alarm shall be available on local FFG panel & DCS.

7.5. FFG, HE ignition Panel, Valves and other equipment on the flare line shall be located at a safe distance from the flare as determined by Thermal Radiation & Toxic Gas Dispersion studies such that Operation & routine maintenance can be carried out.

7.6. Facility CCTV system shall cover flares for monitoring the flare from control room.

8. BURNER MANAGEMENT SYSTEM

8.1. Burner management system & instrumentation shall be provided for start-up, sequencing & shutdown of burners as per section 10.0 of KOC-MV-009.

8.2. The BMS and field safety instruments shall be certified as a minimum SIL-2. Flame scanners wherever installed shall be provided in 2oo2 configuration & achieve minimum SIL-2 requirements.

9. PAGA SYSTEM

9.1. The plant paging system including field devices, cables, junction boxes, shall be supplied in compliance with KOC-I-016. Contractor to carry out Sound Pressure Level Study (SPL) to ensure equal & adequate sound levels in each zone of the facility. Complete facility including the buildings like sub-stations, MCB, Laboratory, and Guardhouse shall be covered by PAGA.

9.2. The PA system shall distribute alarm tones, pre-recorded messages, emergency voice messages and routine voice messages to all or selected zones of the facility, in a reliable manner by the use of loudspeakers. PAGA shall be hardwire interfaced with facility FGS for automatic Emergency message.

9.3. User interface shall be located in the MCB. PAGA system faults signals shall be hardwired to the facility DCS. Redundant UPS power to be supplied to the PAGA system.

10. CCTV SYSTEM

10.1. CCTV System consists of CCTV system and the field mounted (Process & Security) CCTV cameras. Cameras shall be IP based & connected to the system located in MCB through fiber optic cables. CCTV distance coverage study shall be carried out to finalize the number of camera's required in the processing facility.

10.2. CCTV controller workstation with joystick shall be installed in the MCB & security

cabin. 70" LSD shall be provided in the Control room of MCB for monitoring of CCTV. CCTV system shall be capable of storing the recording of up to 120 days on a redundant NVR server. Fault alarms from the CCTV system shall be hardwired wired to the facility DCS. Redundant NVR server shall be rack mounted in 19" rack cabinet. All Ethernet switches and fiber optic patch panels to be rack mounted in 19" cabinet. CCTV cabinets shall be manufactured as per KOC-I-007. Power to the CCTV system shall be provided from the UPS through redundant feeders.

10.3. The CCTV camera, junction box and accessories shall be suitable for Zone 2, IIB & T4, Ex'd' and Ingress Protection shall be IP65 minimum depending on the area of installation.

10.4. Indoor camera shall be rated to min. IP42. All cameras shall be provided with 2 Alarm inputs & 1 relay output. Outdoor cameras shall be with PTZ functionality. Cameras shall be of min. 1920 X 1080 resolution. All cameras shall be with Infrared (IR) Illumination. PTZ camera IR Range shall be min. 150M. Fixed and dome cameras shall be provided on the facility fence & their IR range shall be minimum 30M. PTZ camera shall be with 20X optical zoom and wiper. All the Cameras shall be supplied with UPS power.

11. FACILITY LAN & TELECOM

11.1. Contractor shall provide LAN & Telecom network for the facility office computers, printers, IP Telephones and wireless access points. Contractor to provided a local LAN/Telecom network where only Contractor PC's and local IP phones can be connected as required for daily communication/activities purposes and the same shall not be connected to KOC Corporate Network.

11.2. Contractor shall arrange internet connection for regular use within the facility as required during construction, commissioning, operation and maintenance, through the existing service providers.

11.3. Contractor shall develop detailed Telephone & LAN outlet layout drawings dedicated for Contractor network and Company network according to the furniture layouts of MCB, submit them for Company review.

12. FIELD INSTRUMENTATION – ON-SKID & OFF-SKID

12.1. GENERAL

12.1.1. As far as practically possible all the field instruments, control valves & shutdown valves shall be part of skid. Off-skid Instruments shall be as minimum.

12.1.2. Field devices shall be selected as per KOC standard and shall be particularly robust to suit the environment and the hazardous area requirements.

12.1.3. Instruments causing shutdown Level-1, 2, 3 and 4 shall be minimum SIL-2 certified irrespective of SIL assessment outcomes.

12.1.4. Instruments causing Level-1 & Level-2 shutdowns shall be provided with 2oo3 transmitters. Discrepancy alarm shall be provided for 2oo3 and 1oo2 transmitters.

12.1.5. Degradation logic philosophy for process shutdown should consider 2oo3 to 1oo2 and 1oo2 to 1oo1 voting logic without shutdown. Any lower level degradation should lead to Emergency Shutdown. In case of shutdown with potential nuisance trip such as flame scanner the degradation logic suggested by the vendor will be reviewed as special case.

12.1.6. Calibration range for the instruments used for process measurement & control and trip functions on the same equipment shall be same. Transmitters local display Engineering unit shall be same as DCS operator display, which shall follow Appendix-I of KOC-I-001.

12.1.7. Protection method for the field instruments shall be IS. All field instruments shall be smart type, IP 66, provided with integral local indication & loop powered through the marshalling cabinets. Externally powered instruments shall be minimized, in unavoidable cases, such instruments shall be 24 VDC external powered from respective marshalling cabinets & output signal shall be IS type. In unavoidable cases where IS certified instrument is not available, Ex'd' can be used as the method of protection.

12.1.8. Instruments causing Emergency Shutdown (Level 1,2,3,4) shall not share the same process tapings with any other instrument.

12.1.9. All electronic Instruments including packages shall be 2-wire, 24 V DC, 4-20 mA analogue signal with superimposed diagnostic HART protocol.

12.1.10. All the transmitters & positioners of the facility shall be made available on AMS located at MCB. All the package control & safety instruments shall also be available on AMS.

12.1.11. Standard hook-ups shall be followed for Electrical, installation & process connections of field instruments. Pneumatic tubing shall be minimum SS316. All tube fittings shall be double compression with twin ferrule type.

12.1.12. No switches shall be used; all process measurement instruments shall use transmitters.

12.1.13. Minimum flange rating for flanged instruments shall be 300#. Above 300#, pipe class shall be followed.

12.1.14. Contractor can propose the use of wireless transmitters only for open loops, where the service is non-critical and long cable lengths are encountered causing high voltage drops. This shall be subjected to company review & approval.

12.1.15. Transmitters on high temperature & high viscosity service shall use remote seal diaphragms with capillary tubes. Flushing rings shall be provided on remote seals.

12.2. LEVEL MEASUREMENT

12.2.1. Level Instruments shall be designed, installed and tested in compliance with KOC-I-027. Side-side chamber mounted Guided Wave Radar type level transmitters shall be preferred for level measurement. GWR shall be used for Interface Level measurement, control & trip functions in Separators. Probes shall be designed such as to cover both LL & HH level settings.

12.2.2. Transmitter shall be maintainable without shutdown/depressurization of the vessel/tank. Where there are two level transmitters for the same service and same equipment, two different types of level measurement techniques shall be used for example one may be radar and other may be capillary type differential pressure. Factors like dielectric constant of the liquid, presence of emulsion, sludge, sand & vapors shall be evaluated while selecting Guided wave radar level transmitters.

12.2.3. Dedicated tapings on the vessel/line shall be used for instruments performing trip/shutdown & control/monitoring functions. Shutdown level instruments shall not share connections or standpipes with control and monitoring instruments.

12.2.4. Remote seal type differential pressure level transmitters shall be provided with flushing rings.

12.2.5. Side-side chamber mounted level transmitters shall be used for horizontal & vertical vessels. Level instruments on tanks to be top mounted.

12.2.6. Level gauges shall be designed to cover entire range or more of the level transmitter. Preferred level gauges are magnetic type. Level transmitters shall be 2-wire,24 V DC, 4-20 mA analogue signal with superimposed diagnostic HART protocol.

12.2.7. Magneto strictive type combined level gauge & Transmitter can be used for level measurement & control applications to minimize number of nozzles on the vessels. Transmitter with integral display shall be located at the bottom of chamber.

12.2.8. Pressure / temperature rating of the Level instruments must be equal or greater than the design pressure / temperature rating of the vessel to which they are connected.

12.2.9. Reflex gauges shall be used on the clean services and the transparent gauge shall be used for the acid, caustic services. LED type backlighting shall be installed where appropriate.

12.2.10. Provisions for the drain & vent of level instruments shall be provided. Device mounting will be such that the level indicators are given good access for readability and routine maintenance. Acceptable means of access will include walkways, platforms and ladders depending upon the specific application. Stilling wells shall be provided for level transmitters on tanks.

12.3. FLOW MEASUREMENT

12.3.1. Flowmeters shall be designed, installed and tested in compliance with KOC-I-026.

wherever process conditions allow, DP type (square-edged concentric orifice plates) flowmeter is preferred. Ultrasonic/DP type flowmeter is preferred for gas flow measurement with pressure & temperature compensation. Magnetic flowmeter complete with grounding rings is preferred for water flow measurement. Vortex flowmeter is preferred for steam flow measurement. Coriolis mass flowmeter is preferred for oil flow measurements. Venturi meter is preferred for large line size air flow measurements. For flare gas flow measurements Multipath Ultrasonic flow meters with online retractable assembly with double block and bleed under pressurized conditions is preferred.

12.3.2. The upstream and downstream straight length of pipes shall be maintained for flowmeters based on the type of meter being selected as per Appendix-B of KOC-I-026.

12.3.3. Diaphragm seal type flowmeters shall be provided with flushing system.

12.3.4. Gas flowmeters shall be provided with pressure & temperature compensation, the flow compensation shall be made to account for the variations in pressure and temperature and shall be carried-out as per established National / International standards to base conditions.

12.3.5. The flowmeters shall be the latest "state-of-art" microprocessor based, having flanged connections for in-line type flowmeters with integral sensor and transmitter. Flowmeter transmitters shall be 2-wire,24 V DC, 4-20 mA analogue signal with superimposed diagnostic HART protocol.

12.3.6. In all cases due consideration shall be given to operating conditions, required accuracy, required turndown, allowable pressure drop, fluid property, low maintenance requirements, type of measurement requirements (e.g. operational, allocation, fiscal) for selecting the type of flowmeter.

12.4. MULTI PHASE FLOW METER (MPFM)

12.4.1. Vendor shall design, engineer, procure, factory-fabricate, test and supply 1 No. MPFM with all hardware/software necessary to complete system as per Technical specification. The system shall be supplied in fully assembled, fully programmed, fully tested and ready for installation condition in accordance with the project related documents and other relevant International Standards and Codes specified.

12.4.2. The MPFM shall be full-range three-phase water cut meter. The gas/liquid flow rate measurement and water cut determination shall be carried out independent of each other. Total mass flow rate measuring device shall be used.

12.4.3. The design of the multi-phase flow meter shall include but not limited the following:

a. Fluid measurements such as Pressure, Temperature Differential Pressure.

b. Meter for Gas, Oil, Water fraction calculation.

c. Flow conditioning (as required), piping, valve and bypass lines to meet the piping specifications.

d. Power supply suitable for the available power source.

e. Data Acquisition and Flow calculator.

f. Able to operate in 0-100 % GOR and 0-100% GVF.

g. Water cut in %

h. Shall be independent of flow conditions and flow regime

12.4.4. Contractor/ Vendor is responsible for arranging the necessary license and government/ Company compliance required for importing & handling the radiation source, if nucleonic type of MPFM is proposed.

12.4.5. The MPFM shall be designed with due consideration to the following without effecting its performance:

a. Small deposition of wax

b. Presence of solids/sands

c. Scaling (less than ~1mm)

d. Erosion

e. Salinity Variations

12.4.6. The multiphase flow meter shall operate effectively (proper accuracy and performance) with any flow condition. Shall be able to provide instantaneous measurement of oil, water and gas flow rates in-line.

12.4.7. It shall be possible to install MPFM in both vertical & horizontal lines without degrading of performance. It shall be capable of remote unmanned operation with remote/dynamic calibration capability.

12.4.8. All wetted parts of MPFM shall be Inconel 625 and in compliance with NACE requirements of MR0175. The material for piping, valves and tubes shall be as per the Piping material specification.

12.4.9. A flow computer shall be provided to perform all high speed calculations. Flow computer for MPFM shall be supplied as an integral part of skid. Suitable enclosure shall be provided with local display and shall be certified to installed in Hazardous zone. VENDOR shall select the dimension of enclosure as required. Local flow computer of MPFM shall be provided with local display.

12.4.10. Flow computer shall be responsible for the following:

a. Data collection from all instruments

b. Flow calculations

c. Interacts with operator work station

d. Self-diagnostics and trouble shouting

e. Remote configuration through Work station

12.4.11. A provision is to be made to transfer all the following signals to the operator work station through serial link:

a. Oil flow (Std BOPD).

b. Gas flow (MSCF/D, m3/h OR Kg/h).

c. Water flow (BWPD or m3/h).

d. Temperature (°C or °F).

e. Pressure (barg or psig).

f. MPFM Status information.

g. VENDOR shall indicate if more values are available (like specific gravity, viscosity values, flow totals).

h. All the volumetric/ mass flow rates, actual / standard and cumulative flow.

i. Water Cut, Gas Oil Ratio, Gas Volume Fraction are required.

j. Meter diagnostics

12.4.12. The minimum degree of protection for the field mounted (outdoor) junction boxes or enclosures containing electronic components shall not be less than IP 65. For all indoor mounted equipment shall be of minimum IP 42 protection. The junction boxes / field panels for intrinsic safe instruments and flameproof instruments shall be certified to EEx ia IIB T4 and EEx e IIB T4 respectively. All analog signals shall be of IS type and barriers for the same shall be provided as applicable.

12.4.13. Vendor shall ensure that all instruments are selected in line with General Specification of Instruments.

12.4.14. Field mounted flow computer shall be designed to meet the temperature limits as per KOC-G-007. Flow computer shall be interfaced with MPFM work station in control room through dual redundant Fiber Optic cable/twisted pair cable. System shall be time synchronized based on time clock from GPS Server over the communication through DCS.

12.4.15. All the instruments shall have SS tag plate showing the tag number allotted by the Purchaser, model no, manufactures name, wetted part material, NACE requirement, as minimum.

12.4.16. Data sheets for all instruments shall be issued for approval prior to procurement / construction.

12.5. MPFM WORK STATION TECHNICAL REQUIREMENT

12.5.1. Work Station along with printer for MPFM shall be supplied by vendor and the same

shall be installed in control room. The Operator work station shall provide the capability to perform operation and monitoring of MPFM from Control Room.

12.5.2. The MPFM shall be interfaced with DCS through Modbus TCP/IP protocol. Necessary Graphics shall be developed for MPFM work stations as per requirement.

12.5.3. MPFM workstation shall fulfill the following requirement as a minimum:

a. Storage of historical values for MPFM in Company approved type of files for archiving well test data. The DAC shall have adequate storage capacity to archive well test data for at least 1 year.

b. Transmission of Data to ICSS and onward transmission.

c. Data manipulation capabilities such as charting (Such as to MS Excel Charts) such as simple arithmetic operations

d. Trends - with user definable time periods

e. Remote calibration and parameter setting

f. Diagnostics - flow regime envelope over a period

12.5.4. Vendor shall provide with the proposal a detailed architecture diagram depicting all interconnections.

12.6. PRESSURE MEASUREMENT

12.6.1. Pressure measurement Instruments shall be designed, installed and tested in compliance with KOC-I-024.

12.6.2. Electronic transmitters shall be of the strain gauge, piezo resistive or capacitance type. Transmitters shall be rated to 1450 psi (100 barg), or 150 per cent of the maximum operating pressures, whichever is the greater.

12.6.3. Pressure transmitters for ESD application shall be SIL 2 certified. For general service, pressure gauges shall have bourdon tube measuring element. Bellows or diaphragm seal type pressure gauges shall be used in low pressure applications. Diaphragm seals type to be considered for viscous or slurry services including fluids tending to crystallize.

12.7. TEMPERATURE MEASUREMENT

12.7.1. Temperature measurement Instruments shall be designed, installed and tested in compliance with KOC-I-025.

12.7.2. In general Thermowells shall be specified for all temperature detecting elements. The thermowell material shall be SS316 as a minimum and the minimum flange rating process connection shall be 1 ½" 300# RF on pipework & 2" 300# RF on vessels.

12.7.3. Resistance Temperature Detectors (RTDs) shall be duplex, three-wire RTD elements

with platinum PT-100.

12.7.4. Temperature gauges shall be bimetallic with minimum 6in. or 150mm dial hermetically sealed, every angle, 9.5 mm stem, with external pointer adjustment.

13. CUSTODY TRANSFER METERING

13.1. This system determines the amounts transferred at the custody transfer points for natural gas and hydrocarbon liquids and allocation to a production system.

13.2. Following are designated Custody transfer metering systems associated with MRBF facility.

Tag No	Function	Recommended Meter type
MPF-XXX-001	Export Gas Metering System	Coriolis Type
MPF-XXX-002	Export Liquid Metering System	Coriolis Type

13.3. The meter shall be arranged in a skid and the skid shall be complete with meter runs, flow meter, Analyzer, pressure, temperature instrumentation, fast loop sample system, grab sampler, valves, electrical, instruments, fittings and be supplied as a fully piped, cabled up to junction box and instrumented package.

13.4. This system shall be provided with flow Computer to determine the amounts transferred at the custody transfer points for hydrocarbon liquids or gas from facility.

13.5. Flow computers shall have the capability to perform the required computations without the need for programming (i.e., application specific configuration only). Flow computers associated with custody transfer measurements shall have no functions other than those associated with the flow measurement or sampling. Signal transmission between the meter and secondary devices and the flow computer shall 4-20mA signal. Flow computers shall be installed at the nearest Instrumentation room of the sub-station.

13.6. For export flow meters, the calibration shall establish the uncertainty of the flow meter against standard measuring device such as master meter. Prior to installation, the flow meter shall be calibrated at a NIST certified or flow calibration facility accredited to ISO/IEC 17025.

14. QUALITY MEASUREMENTS

14.1. These meters determine the quality of gas/liquid produced from the facility.

14.2. Following are designated Allocation attribution metering systems at MRBF associated with this project. Minimum requirements are included in this list which shall be updated further by the MPF package supplier during detail engineering.

14.3. Online Analyzers shall be used for quality measurements.

Tag No	Function
MPF-AIT-XXX	Online H_2S measurement in export liquid.
MPF-AIT-XXX	Online H_2S in export Gas
MPF-AIT-XXX	Online H_2S in Fuel gas polishing unit outlet

14.4. Quantity and type of analyzers shall be finalized based on vendor licensor recommendations.

15. EMERGENCY SHUTDOWN & CONTROL VALVES

15.1. ESD & Control valves shall be designed, installed and tested in compliance with KOC-I-010. Actuators for ESDV shall be spring return pneumatic cylinder actuators. ESDV shall be fitted with smart positioner to allow partial stroke testing (PST) for predictive maintenance purposes, only wherever recommended in SIL assessment & verification studies.

15.2. Partial stroke requirement shall be based on the Test interval as recommended in the SIL assessment and SIL verification study. Such ESDVs shall be supplied with partial stroke testing facility from the control room. ESDVs shall form a part of the Safety Instrumented Function (SIF) and shall comply with the SIL design requirements.

15.3. All BDVs shall have same function as ESDV, except valve failure action, which is failed to open & without partial stroke testing.

15.4. Auto Reset and Remote Reset functions shall be available for the ESDVs. Critical ESDV's shall only be provided with field manual reset.

15.5. The ESD and Blow-down valves shall have air reserve tank for minimum 3 stroke operations, valve open and close feedback switches & local indication, local and remote open and close facilities. Open and close feedback switches shall be Intrinsically Safe (IS) and proximity type.

15.6. The Air tank shall be provided with two Electronic Pressure transmitters, relief valve, pressure gauge and accessories. The ESD and Blowdown valves shall comply with KOC-PR-003.

15.7. ESD Valves and actuators (complete assembly) shall be certified for minimum SIL-2 application irrespective of SIL assessment outcomes.

15.8. Control valve shall be selected to meet the pressure drop, temperature, performance and rangeability requirements. Globe valves shall be selected for standard application. Butterfly valves shall be selected for large size process lines, for reasons

of economy and low-pressure drop. The pressure rating of control valves shall be to pipe line rating with a minimum of ANSI class 300 for valves of 200 mm (8") sizes and below.

15.9. Shutdown valves shall be Double-seated full-ported ball valves are used for on-off application, eccentric rotating plug valves are used for large volume, low-pressure drop applications, fire safe and shall have leakage class as tight shutoff. Shutdown valves actuator shall be installed parallel to the pipeline.

15.10. Specifications are also applicable to Emergency Shutdown & Control Valves supplied by the package vendors.

15.11. All the valves material of construction shall be based on Appendix-13 (Piping Technical Specifications) and its Annexures as a minimum requirement.

16. FIRE & GAS DETECTORS

16.1. All fire and gas detectors including flammable gas, toxic gas, UV/IR fire, heat, smoke detectors, manual call point, beacon & sounder shall follow KOC Standard KOC-L-006. Audio/visual alarm unit for HC, H2S and fire indications (with three (3) different tones and colors such as amber, blue and red). Manual call point shall be resettable type with explosion proof for outdoor installation. The call points shall be equipped with current limiting resistors fitted inside the unit and not wired into terminals provided for field wiring.

16.2. Number, type, location, elevation & orientation of F&G detector shall be according to the recommendations of fire & gas mapping study. F&G mapping study & report shall be as per KOC-L-036 based on ISA TR84.00.07 using facility 3D models.

16.3. Manual alarm call points shall be provided such that personnel shall not travel more than 30mtrs and at strategic locations such as escape route, exites from process area, to activate the alarm.

16.4. F&G detectors causing executive actions shall follow 2ooN voting logic where N is minimum three number of detectors in each fire zone. Manual call points shall be provided at strategic locations as per the best practices.

16.5. Hydrogen detectors shall be provided in the battery rooms. Heat detectors shall be provided in the transformer bays.

16.6. Flammable and Toxic gas detectors shall be provided at the intake of HVAC's for monitoring ingress of gas inside building. The detectors shall be 2oo3 voting configuration connected to FGS/FAP and interfaced with HVAC system through hardwire for internal circulation mode / shutting down of HVAC system.

16.7. H2S and Hydrocarbon Detectors shall be provided in HVAC inlet duct where HVAC system is provided. The Fire Alarm Panel shall be interfaced with HVAC system through hardwire interface for shutting down of HVAC system / closing of fire

dampers as applicable to turn the HVAC in internal circulation mode.

16.8. Flame Detector, Toxic and Hydrocarbon Gas detectors shall be provided in the analyzer shelters where provided and integrated in to plant FGS. Audio and visual alarm to be provided outside analyzer shelter to alert the operator.

17. PACKAGE INSTRUMENTATION

17.1. Instrumentation Technical Specifications for the requirements of Package Instrumentation shall follow the main plant Instrument and KOC-I-008. As far as practically possible all the field instruments, control valves & shutdown valves shall be part of skid. Off-skid Instruments shall be kept as minimum as possible.

17.2. Junction box(s) on the pre-wired packages shall be located on the side of main cable trench or tray to avoid long cable loops & trenches connecting the junction box to marshalling cabinets. All the skid-mounted instruments shall be easily accessible considering operation, maintenance, removal, installation & people movement requirements. Contractor and Package Vendor shall demonstrate the accessibility requirements during the 3D model review.

17.3. All the packages shall be subjected to HAZOP, SIL studies & 3D model review in the presence of package supplier.

17.4. Package vendor shall provide the reliability data of all the field instruments, shutdown valves & systems used for shutdown service for SIL verification study & report.

17.5. Packaged Unit Vendor shall connect all package input/output (I/O) signals associated with control, monitoring and shutdown of his unit to skid edge mounted junction boxes.

17.6. Wherever practical control, monitoring and shutdown of the packaged units shall be implemented in the facility ICSS unless any guarantee / warrantee & operational requirements demands dedicated systems installed in Unit Control Panel(UCP).

17.7. Where a package is supplied with a UCP, Manufacturer shall provide a suitable PLC for control of package. The package PLC shall have redundancy for power supply, CPU, I/O Modules, communication modules and other peripherals depending upon the reliability and availability requirements.

17.8. Where packages with UCPs have safety instrumented functions within the package controls, the UCP shall employ a dedicated logic solver for such functions. The logic solver shall be SIL-2 rated or higher to meet the maximum levels assigned during the SIL assessment study. Certification of the SIL rating shall be in accordance with the requirements of IEC 61508 /IEC 61511 and KOC-I-017.

17.9. Package control & safety system shall be subjected to HAZOP & SIL study and vendor shall comply the study recommendations and provide SIL verification report.

18. CABLES AND JUNCTION BOXES

18.1. Cables types shall be segregated based on systems (DCS, ESD, FGS), signal types (IS, NIS, Analogue, Digital) & power. Contractor shall standardize the type of cables to provide flexibility in use. Number of cable types shall be minimized.

18.2. All Instrument cables shall be as per "KOC Standard for Instrument Cables (KOC-I-011)" and installed in accordance with KOC-I-002, KOC-E-008 and Company Standard Drawings.

18.3. Cables for F&G and ESD shall be of Fire Resistance type and Flame Retardant type for all other instrumentation cables as per KOC-I-0011.

18.4. Fiber Optic Cables design and installation shall be as per KOC-T-006 and KOC-T-008.

18.5. Cable Entry to the buildings shall be through MCT's, segregated as per service like DCS, ESD, F&G and Power cables.

18.6. SS316 Junction boxes shall be segregated based on systems, power & signal. Maximum possible Junction boxes shall be part of packages installed & pre-wired on the skid battery limits. Junction box to be certified for hazardous area of use.

18.7. Number of Junction boxes to be optimized based on skid location.

18.8. Junction box(s) on the pre-wired packages shall be located on the side of main cable trench or tray to avoid long cable loops connecting the junction box to marshalling cabinets.

18.9. Cable trays shall be fire-proofed as per section 8.1 of KOC-C-027 (KOC Standard for fireproofing of structural steelwork) as per HSE study recommendation.

18.10. Unsued cable entries on JB's shall be plugged with certified plugs.

19. INSTRUMENTS INSTALLATION

19.1. Instruments shall be installed ensuring easy accessibility during maintenance and easy readability by field operators. Upstream & Downstream straight pipe run requirements shall be provided for the flow instruments as per the vendor recommendation. All air supply tubing/fittings/valves shall be of 316SS material. Instrument installation & hook-up for instruments shall be as per KOC-I-002 and KOC Standard Drawings. All tube fittings are double compression with twin ferrule type.

19.2. Material of constructions of instruments being exposed to the process fluid shall be selected based on Piping Technical Specifications and its Annexures as a minimum requirement.

19.3. All sour service materials shall be certified for latest revision of NACE MR 0175/

ISO 15156. Instrument air system shall be SS316.

19.4. Instrument cables shall be installed in direct buried underground trenches or built in concrete troughs or run above ground through suitable trays/ supports, as detailed in the cable layout drawings. Instrument cables shall be segregated and installed as per the KOC-I-002.

19.5. Cable duct banks shall be installed for cables under buildings and roads or wherever required for other load-bearing applications.

19.6. Tag Numbering

19.6.1. Field Instruments: Instruments tag number shall follow the systems/skids. e.g., MRBF-PIT-01XX where 01 is the skid number & XX is the sequence number. For Duty/standby & parallel equipment's suffix, A/B can be used.

19.6.2. Cable & Junction Box : Cables & junction box shall be tagged as per clause 10.7 of KOC-I-002. E.g. MRBF-JBP (A) – 01XX where 01 is the skid number & XX is the sequence number.

19.6.3. Cabinets: The Control & Safety Systems equipment (cabinets / panels, workstations / servers, printers and display) shall be tagged as per Appendix-1 of KOC-I-019.

19.7. INSTRUMENT ELECTRICAL INTERFACE

19.7.1. All the electrical motor control & trip commands from the control & safety system shall be implemented hardwired through the IRP's. Physically & functionally dedicated IRP's shall be provided for DCS & ESD systems located in the respective sub-stations. Specifications of the IRP's shall comply with KOC-I-007. IRP relays used for the trip functions shall be min. SIL-2 certified irrespective of SIL assessment outcomes. Motor running signals can be pass through signals from the IRP's. Instrument/Electrical interface shall be as per clause 9.14 of KOC-I-001.

19.7.2. IRP panel fault signals shall be hardwired to the DCS.

19.7.3. VFD analogue control signals shall be passed through the DCS IRP.

20. INSTRUMENT INTERFACE/INTEGRATION WORKS WITH COMPANY

20.1. Following provision for tie-in and interface shall be provided by Contractor in the for integration with Company facility:

20.1.1. Necessary provision and permission to access the ICSS OPC Path for future data exchange with Company's third-party corporate systems.

20.1.2. The Instrumentation, MOVs and Fire & Gas signals from PIG Launcher area shall be integrated in to facility ICSS.

20.1.3. Dedicated DCS operator station shall be provided in SADA room of MCB for monitoring and controlling the PIG Launcher area signals.

20.1.4. Necessary provision shall be provided for Pig Launcher area cables entry to facility, cable ducts for road crossing, space in the cable trench and MCT for cable entry to MCB and SS.

20.1.5. Spare space, floor opening and cabinet frames for Company supplied panels in the telecom room.

20.1.6. Provide Category 6 (Augmented) UTP cables for all rooms connected to dual Cat6A RJ45 Outlet of MCB from Telecom room for Company network. Company network shall not be shared with any other network.

20.2. External Fiber optic cable from the existing Fiber network of the Company to the facility shall be supplied, laid and commissioned by others. Contractor shall provide the required space in the telecom room, trenches/trays, control building entry MCT's, manholes for the incoming cables and space for LAN Cabinet, fibre optic cabinet, Telephone cabinet in the telecom room.

21. 3D MODEL

21.1. 3D models shall be built & reviewed at appropriate stages (30%, 60%, and 90% model review) for the operation & maintenance access of following:-

a) Field instruments
b) Control & shutdown valves with associated local panels & air vessels.
c) Local Gauges
d) Process tapping's of inline Instruments
e) Analyzer panel & sample routing
f) Fire & Gas Detectors
g) Manual Call Points
h) CCTV's
i) PAGA devices
j) Junction Boxes
k) Local Panels with HMI, Indication lamps & Push Buttons
l) Cable trenches & Trays
m) Control room Operator stations
n) Marshalling room panel locations

22. SPARING PHILOSOPHY

22.1. Marshalling rooms of MCB & Sub-stations - 30% spare space
22.2. Marshalling cabinets - 20% spare space & 20% wired spare I/O's
22.3. Network, Server & System cabinets - 30% spare space
22.4. FOPP's & network switches - 30% spare connections & ports
22.5. 50% Spares to be provided in the building cable entries
22.6. Junction Box's – 20 % spare wired, 20% spare space, 20% spare cable

entries

22.7. 50 % Cable trenches / trays & spare space

22.8. 50% MCT / Cable entries & duct banks

22.9. Construction, commissioning & Operation spares to be provided.

23. INSTRUMENTATION ENGINEERING & DESIGN SOFTWARE

23.1. Latest version of SPI shall be used for the automated generation of instrumentation design engineering deliverables. Intention for the use of SPI is to minimise the required engineering man-hours, maintain drawings consistency for the complete facility including the package vendors & minimise design errors.

23.2. As a minimum following design deliverables shall be generated through SPI:-

a) Instrument Index
b) I/O list
c) Trip & Alarm Schedule
d) Instrument Datasheets
e) I/O allocations
f) JB wiring
g) Marshalling wiring
h) Loop Drawings
i) MTO (BOM)
j) Cable Schedule
k) Drum Schedule
l) Instrument Hook-ups
m) Instrument & JB ‘s Tag plate schedule

23.3. In case where the package vendors are unable to generate SPI design documents, main contractor shall produce the documents in SPI with inputs from package vendor.

24. TESTING & INSPECTION

24.1. GENERAL

24.1.1. Contractor shall carry out inspection of each instrument installation for conformance to specification and drawings prior to mechanical completion. Contractor shall ensure compliance to all applicable KOC & international standards including good engineering and construction practices.

24.1.2. Contractor shall advise the Company Representative of the schedule of testing and pre-commissioning activities for witness.

24.1.3. Before testing or calibrating any instruments, Contractor shall submit the procedure to the Company Representative with a comprehensive list of the test and calibration equipment to be used and certify that these test and calibration equipment has a standard accuracy greater than the manufacturers stated accuracy for the instruments

to be tested or calibrated.

24.1.4. After testing all connections and entries shall be temporarily sealed to prevent subsequent ingress of moisture and dirt.

24.1.5. Contractor shall conduct wiring "continuity test" for all the newly installed cables.

24.1.6. On completion of each test, the stage reached in the testing procedure shall be indicated by fixing to each instrument or installation, a colored label conforming to the following code:

Yellow	:	Pressure Tested
Green	:	Cables Tested
White	:	Loop Checked
Red	:	Test Failed (Written message shall be added giving reason for Failure)

24.1.7. This identification shall be shown on all components in the loop, thereby making all personnel aware of the status of any installation.

24.1.8. Contractor shall conduct megger test on all cables, prior to commissioning. Contractor shall ensure that all instruments and devices are disconnected from the conductors before "Megger test" is conducted.

24.1.9. The instrument loops shall be function checked and simulated prior to commissioning.

24.1.10. Loop folders shall enclose calibration certificate Vendor manuals, Instrument Loop Diagrams, cable Megger check sheet, punch list sheet and cover sheet shall be submitted for Company information.

24.1.11. Continuity and loop testing shall be performed to establish integrity of the field wiring system. (Software configurations and field-testing associated with ICSS and any other systems shall be done by respective OEM Vendor).

24.1.12. The Contractor shall ensure that all the systems, field instruments and other equipment offered shall be supplied by the manufacturers who shall also be on the Company's approved manufacturer's list. For items not covered by this list the Contractor shall submit his proposed vendors (for each item) complete with QA/QC manual, users list and detailed catalogues (for each Vendor proposed) for Company's review and approval of the proposed Vendor. All relevant test certificates shall be submitted for Company's review and approval.

24.1.13. The Contractor shall be responsible for all submittals of complete design information to Company and for obtaining all necessary approval certificates prior to the commencement of installation and commissioning Works.

24.2. INSPECTION & TESTING REQUIREMENTS

24.2.1. The instruments, Control & Safety Systems, equipment and materials supplied shall be subject to the Company's inspection and approval and shall be checked for compliance with the Technical Specification of this Contract, approved documents and purchase order.

24.2.2. The Contractor/Vendor shall prepare an inspection and test plan (ITP) and submit for Company's approval.

24.3. Acceptance Test Procedures

24.3.1. The Acceptance procedures shall be developed to enable the safe demonstration and validation of the supplied instruments and associated equipment.

24.3.2. A test plan shall be developed by the Vendor for conducting Factory Acceptance Test (FAT), Site Acceptance Test (SAT) and performance acceptance test (PAT) for all major equipment as per KOC Standards (015-I-009).

24.4. FACTORY ACCEPTANCE TEST

24.4.1. The FAT shall be performed at the approved manufacturer's Works where the system is engineered, manufactured and assembled. If the Manufacturing premises and the assembling premises are different then the FAT shall be carried out at the place of manufacturing and not at the place of assembling. Manufacturer shall carry out pre-FAT prior to FAT and the reports shall be made available during FAT for Company's review.

24.4.2. FAT shall consists of software & hardware tests. All the logic & graphics shall be tested during softwrae test. Hardware test shall consists of system integrity test, verification of bill of material, all the I/O's test, redundancy tests and visual inspections. Detailed FAT procedures shall be approved by the COMPANY.

24.4.3. At least fifteen (15) days' notice of confirmation of the schedule date for the FAT shall be given by the Contractor to the Company prior to FAT commencement.

24.4.4. Manufacturer / Contractor shall clear all FAT punch points prior to shipment.

24.4.5. This inspection shall not relieve the Contractor of any obligation to fulfil all the conditions of this specification. The responsibility for inspection during installation rests with the Contractor.

24.4.6. Waiver of any inspection by the Company does not relieve the Contractor of the responsibility for proper installation. This responsibility shall continue until the loops are in satisfactory operating condition.

24.4.7. All relevant tests shall be conducted for the successful integration of the system.

24.5. SITE ACCEPTANCE TEST

24.5.1. Subsequent to the installation, integration and commissioning of each system, a Site

Acceptance Test shall be carried out. The SAT shall retest any parts of the System that were shown deficient during the FAT and also a subset of original FAT to demonstrate the System that is tested.

24.5.2. SAT shall emphasize that the performance of each system is validated under operating conditions and shall demonstrate seamless integration with other systems.

24.6. CALIBRATION AND FUNCTIONAL TESTING

24.6.1. Before testing or calibrating any instruments, submit the procedure to the Company Representative with a comprehensive list of the test and calibration equipment to be used and certify that these test and calibration equipment has a standard accuracy greater than the manufacturers stated accuracy for the instruments to be tested or calibrated.

24.6.2. The Contractor shall be responsible for calibration and testing of all instrumentation and interfaces with electrical system/equipment.

24.6.3. All calibrations /testing equipment and accessories shall be arranged by Contractor as recommended by supplier.

24.6.4. Field calibration shall be possible without shutdown or isolation of equipment.

24.6.5. Calibration and testing procedures and report formats shall be prepared by Contractor as per the Vendor procedure.

24.6.6. Error between actual and theoretical calibration figures shall not exceed those specified by the manufacturer.

24.6.7. Contractor shall have performed the following tests:

24.6.8. All instruments shall be checked for compliance with the instrument specifications, data sheets and purchase orders, and shall be subjected to such test as are necessary to demonstrate proper operation.

24.6.9. All instrument installations shall be in accordance with manufacturer's recommendations and shall have all symbols, name plates checked for spelling, tagging, size an material.

24.6.10. All circuits shall be checked for continuity, insulation, termination, tagging operability and compliance within this specification.

24.6.11. All alarm circuits shall be checked for correct operation

25. PRE-COMMISSIONING AND COMMISSIONING

25.1. The Contractor shall be responsible for checking all the loops from field instruments to control room, electrical interfaces and back for proper operation prior to commissioning of the equipment.

25.2. Switch on power to the instrument loops and check the calibration/setting of the instruments and devices including shutdown system.

25.3. The detailed procedure for loop checking shall be developed by the Contractor and approved by the Company. The Contractor shall prepare loop folders, one for each loop, and shall as a minimum comprise of the following documents in the same order.

a) Loop check sheet
b) Commissioning sign-out sheet (SAT certificate)
c) Pre-commissioning check list.
d) Commissioning punch list sheet
e) Pre-commissioning punch list sheet
f) Pre-commissioning test reports (insulation/continuity / impulse tubing).
g) Instrument loop diagram.
h) Respective P&IDs that cover the entire loop.
i) Instrument data sheets of all the instruments in the loop.
j) Instruments calibration reports (all instruments in the loop).
k) Related field JB and marshalling wiring diagrams.
l) Applicable typical pneumatic hook-up diagram.
m) Instruments area location / layout diagram

25.4. All loops checking and testing shall be properly recorded by the Contractor and may be witnessed the Company.

25.5. Instrument impulse lines shall be flushed along with the main lines. All line instruments and valves shall be removed before flushing.

25.6. The impulse lines shall be isolated near the lap points and shall be plugged / capped at the instrument ends before the hydrostatic test. The impulse lines between first isolation valves and instruments shall be tested hydraulically at 1.5 limes the maximum operating pressure after flushing. The impulse lines shall be blown with air after the hydrostatic tests (for drying of lines).

25.7. The Contractor shall be responsible for checking all the field instrumentation for proper operation prior to commissioning of the equipment/plant.

25.8. The Contractor shall carry out commissioning after completion of the activities above as minimum under the supervision of the Company providing necessary material, equipment and manpower.

26. ANNEXURES

Annexure	Doc. Number	Description
1	MRBF-IN-1101	ICSS System Architecture
2	MRBF-IN-1102	Fire & Gas Detectors Layout
3	MRBF-IN-1103	MCB Equipment Layout Ground Floor Plan
4	MRBF-IN-1104	MCB Equipment Layout First Floor Plan