PROJECT No. E1150

ENGINEERING PROCUREMENT & CONSTRUCTION FOR 1.0 MMBD SUSTAIN PHASE 1 SURFACE FACILITIES PROJECT

Contract No. 4700022962

Contractor Project No. UZ1.0MMBD

INSTRUMENT & CONTROL DESIGN BASIS

DOCUMENT CLASS: A

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REV	DATE	DESCRIPTION	PREPARED BY	REVIEWED BY	APPROVED BY	PROJ. APPROVAL

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1.0 INTRODUCTION

1.1 PROJECT OBJECTIVE

The objective is to deliver the incremental surface FACILITIES for "UPPER ZAKUM 1.0 MMBD Phase 1 PROJECT" required to sustain production through year-end 2029.

The SCOPE OF WORK shall include surface facilities adequate to meet production and injection forecast up to year-end 2029.

- Implementation of the system designed with additional capacity to sustain production beyond year-end 2029.
- Provision for Phase-2 and future facilities in terms of tie-ins and space reservation.

1.2 PROJECT SCOPE

SOW includes Engineering, Procurement, Fabrication, Testing, Transportation, Construction, Pre-Commissioning, Commissioning, Ready for Start-up, Assistance for Start-up, and completion of Performance Tests Works for the below mentioned Work Packages.

- WP A1 – Al Ghallan Island (Central Island or CI)
  - WP A1.1 – Water Injection Plant
  - WP A1.2 – Produced Water Treatment and Disposal
  - WP A1.3 – Pre-Assembled Well Manifold (PAM) and Local Equipment Room (LER)
  - WP A1.4 - Integration of UZ Power System with Onshore Grid Power "Project Lightning"
- WP A2 – Umm Al Anbar Island (West Island or WI)
  - WP A2.1 – Oil Production Enhancement
- WP A3 – Assefiya Island (South Island or SI)
  - WP A3.1 – De-Bottlenecking of Existing PWT Plant
- WP A4 – Ettouk Island (North Island or NI)
  - WP A4.1 – Produced Water Treatment and Disposal
  - WP A 4.2 – De-Bottlenecking of Existing PWT Plant
- WP A5 –Helipad on Al Ghallan Island, Assefiya Island, Ettouk Island & Umm Al Anbar Island
  - WP A5.1 – Helipad (Construction & Demolition) on AGI, ETI & Upgrade of Existing Helipad on ASI,
  - WP A5.2 -HEMS (Construction) on AGI,ETI & UAI.

2.0 PURPOSE OF THE DOCUMENT

The purpose of this document is to describe the Instrument and Control Design Basis on the artificial Islands in the Upper Zakum for '1 MMBD Sustain Phase-1-Surface Facilities Project'.

This Project is an extension of the UZ750 Project. Existing philosophy shall be followed, and any deviation shall be highlighted clearly for COMPANY review and approval.

3.0 ABBREVIATIONS AND DEFINITIONS

3.1 ABBREVIATIONS

Acronym / Reference	Description
AC	Alternating Current
ADNOC Offshore	Abu Dhabi National Oil Company Offshore
AGA	American Gas Association
AGI	Al Ghallan Island (Central Island)
AI	Analog Input
ALMS	Alarm Management System
AMS	Asset Management System
AO	Analog Output
API	American Petroleum Institute
ASI	Assefiya Island (South Island)
ASME	American Society of Mechanical Engineers
ATEX	Explosive Atmospheres – European Union Directive 2014/34/EU
BASEEFA	British Approval Service for Electrical Equipment in Flammable Atmospheres
BPCS	Basic Process Control System
BS	British Standard
CENELEC	European Committee for Electro-Technical Standardization
CESI	Centro Elettrotecnico Sperimentale Italiano
CI	Central Island
CSA	Canadian Standards Association

Acronym / Reference	Description
DAS	Downhole Acoustic Sensor
DC	Direct Current
DHGMS	Down Hole Gauge Monitoring System
DHSV	Down Hole Safety Valve
DI	Digital Input
DO	Digital Output
DP or D/P	Differential Pressure
DTS	Downhole Temperature distribution Sensor
EMC	Electro-Magnetic Compatibility
EMI	Electromagnetic Interference
EN	Européisme Norme (European Standard)
EPC	Engineering, Procurement & Construction
ESD	Emergency Shutdown
ETI	Ettouk Island (North Island)
FAT	Factory Acceptance Test
F&G	Fire and Gas
FCC	Field Control Centre
FEED	Front End Engineering Design
FF	Foundation Field Bus
FGS	Fire and Gas System
FISCO	Fieldbus Intrinsically Safe Concept
FM	Factory Mutual
FTA	Field Terminal Assembly
GRP	Glass Reinforced Plastic
GTG	Gas Turbine Generator
HART	Highway Addressable Remote Transducer

Acronym / Reference	Description
HEMS	Helicopter Emergency Medical Services
HSE	Health Safety & Environment
HSSS	Hydraulic Safety Shutdown System
HVAC	Heating, Ventilation & Air conditioning
GWR	Guided Wave Radar
ICSS	Integrated Control and Safety System
IEC	International Electro Technical Commission
IFCC	Island Field Control Centre
IO or I/O	Input Output
IPCMS	Integrated Protection, Control and Monitoring System
IP	Ingress Protection
IS	Intrinsically Safe
ISA	International Society of Automation
ISO	International Standards Organization (ISO)
ITU	International Telecommunication Union (ITU)
LAS	Link Active Scheduler
LCIE	Laboratorie Central Industries Electriques
LCP	Local Control Panel
LCR	Local Control Room
LER	Local Equipment Room
LMLS	Load Management and Load Shedding System
LP	Low Pressure
MAC	Main Automation Contractor
MBPD	Thousand Barrels Per Day
MCC	Motor Control Centre
MMBD	Million Barrels per Day

Acronym / Reference	Description
MSAS	Master Surface Annulus Safety Valve
MTO	Material take Off
MTR	Module Technical Room
MV	Master Valve
NACE	National Association of Corrosion Engineers
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NI	North Island
NIS	Non Intrinsically Safe
NPT	National (American) Standard Pipe Taper (Thread)
P&ID	Piping and Instrumentation Diagram
PAR	Pre-Assembled Rack
PAM	Pre-Assembled Module
PAU	Pre-Assembled Unit
PBU	Production Build up
PIMS	Plant Information Management System
PRM	Plant Resource Manager
PST	Partial Stroke Test
PSU	Power Supply Unit
PVL	Package Vendor List
PWT	Produced Water Treatment
RFI	Radio frequency Interference
RMMS	Rotating Machine Monitoring System
RP	Recommended Practice
RTU	Remote Terminal Unit
SCADA	Supervisory Control And Data Acquisition

Acronym / Reference	Description
SCMS	Substation Control and Monitoring system
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SI	South Island
SIS	Safety Instrumented System
SMART	Single Modular Auto ranging Transducer
SOW	Scope of Work
SPDT	Single Pole Double Throw
SPI	Smart Plant Instrumentation
SRP	Sulphate Reduction Plant
TDM	Transient Disturbance Monitoring
TCP/IP	Transmission Control Protocol / Internet Protocol
TUV	Technischer Überwachungsverein
UAI	Umm Al Anbar Island (West Island)
UCP	Unit Control Panel
UL	Underwriters Laboratories
UPS	Uninterrupted Power Supply
UZ	Upper Zakum
WI	West Island
WP	Work Package
WV	Wing Valve
ZADCO	Zakum Development Company

Note 1. ADNOC Offshore was formed through the consolidation of two of ADNOC's upstream oil and gas companies: Abu Dhabi Marine Operating Company (ADMA-OPCO) and Zakum Development Company (ZADCO).

3.2 DEFINITIONS

COMPANY	Abu Dhabi COMPANY for Offshore Petroleum Operations (COMPANY)
EPC CONTRACTOR	Target Engineering Construction Company – Sole Proprietorship L.L.C
ENGINEERING SUBCONTRACTOR	Technip Energies France – Abu Dhabi
PROJECT	Engineering, Procurement & Construction For 1.0 MMBD Sustain Phase 1 Surface Facilities Project
SUBCONTRACTOR	Is a CONTRACTOR's affiliated firm responsible for performing services related to project scope under a separate agreement.
VENDOR	Means any person supplying or arranging the supply of materials for the WORKS including related documentation and services, where necessary.
WORKS	Means any works and services performed under the AGREEMENT.

4.0 REFERENCES, CODES, AND STANDARDS

4.1 ORDER OF PRECEDENCE

1. Annexure 3E-1: Rely Upon Information
2. UAE Federal Laws and National Local Regulations
3. ADNOC HSE Standards and ADNOC Offshore Procedures
4. Project Philosophies
5. Design Basis
6. P & ID'S
7. Plot Plan
8. Project Specifications
9. Datasheets
10. COMPANY Specifications
11. All remaining Project Deliverables
12. COMPANY Standard Specification and Procedures
13. Applicable International Design Codes, Standards and Regulations

If there is any conflict among the documents included in the AGREEMENT, the most stringent requirement among them will prevail. CONTRACTOR shall promptly bring to the notice of COMPANY any such conflicts, and COMPANY shall determine the prevailing requirement and advise CONTRACTOR accordingly.

4.2 REFERENCE CODE AND STANDARDS

In general, Codes and Standards to be used for carrying out process activities for this project wherever applicable shall be as follows, but not limited to:

4.2.1. International Standards Organization (ISO)

CODE	TITLE
ISO/ IEC Guide 98-1	Uncertainty of Measurement- Part 1: Introduction to the expression of uncertainty in measurement.
ISO-1219	Fluid Power Systems and Components –Graphic Symbols and Circuit Diagram
ISO 3601-1	Fluid Systems –Sealing devices-O-rings – Part 1: inside diameters, cross-sections, tolerances and designation code
ISO 4200	Plain end Steel tubes, welded and seamless – General tables of dimensions and masses per unit length
ISO 5211	Industrial valves- Part-turn Valve Actuator Attachment
ISO 5167	Measurement of fluid flow by means of Pressure Differential Devices inserted in circular cross section conduits running full
ISO 5813	Water quality – Determination of Dissolved Oxygen –Iodometric method
ISO 5814	Water quality – Determination of Dissolved Oxygen –Electrochemical probe method
ISO 7240	Fire Detection and Alarm systems
ISO 7393-2	Water Quality – Determination of free chlorine and total chlorine – Part 2: Colorimetric method, using DPD, for routine control purposes
ISO 8201	Acoustics - Audible Emergency Evacuation Signal
ISO-9001	Quality Management System - Requirements
ISO 10497	Testing of valves: Fire type testing requirements.
ISO 10790	Measurement of Fluid Flow in closed conduits- Guidance to selection, installation and use of Coriolis meters (mass flow, density, and volume flow measurements)
ISO 12764	Measurement of Fluid Flow in closed conduits- Flow rate Measurement by means of Vortex shedding Flowmeters in circular cross-section conduits running full
ISO 20456	Measurement of fluid flow in closed conduits - Guidance for the use of electromagnetic flowmeters for conductive liquids.
ISO 13623	Petroleum and Natural Gas Industries – Pipeline Transportation Systems
ISO 13847	Petroleum and Natural Gas Industries – Pipeline Transportation Systems – Welding of Pipelines
ISO 13879	Petroleum and natural gas industries- Content and drafting of a functional specification
ISO 13880	Petroleum and natural gas industries- Content and drafting of a technical specification

CODE	TITLE
ISO 14313	Petroleum and Natural Gas Industries – Pipeline Transportation Systems – Pipeline Valves
ISO 17292	Metal Ball valves for petroleum, petrochemical and allied industries.
ISO 27002	Information technology - Security techniques - Code of practice for information security controls.

4.2.2. International Society of Automation (ISA)

CODE	TITLE
ISA – S5 Series	Instrumentation Symbols and Identification, Binary Logic Diagrams for Process operations, Graphic symbols and Instrument Loop Diagrams.
VDI/VDE 3513 Directive	Variable-area flowmeters; selection and installation recommendations.
ISA S 18.1	Standard for Annunciator Sequences and Specifications
ISA 18.2	Management of Alarm Systems for the Process Industries
ISA S20	Specification forms for Process Measurements & Control Instruments, Primary Elements & Control Valves
ISA – S51.1	Process Instrumentation Terminology
ISA –S71.01	Environmental conditions for Process Measurement and Control Systems Temperature and Humidity.
ISA –S71.04	Environmental conditions for Process Measurement and Control Systems Airborne Contaminants.
ISA 75 series	Standards & practices for Control Valves
ISA 92.0.01	Performance Requirements for Toxic Gas Detection Instruments — Hydrogen Sulphide.

4.2.3. American Petroleum Institute (API)

CODE	TITLE
API 6A	Specifications for Wellhead and Christmas Tree Equipment
API 6D	Specification for Pipeline Valves (Gate, Ball and Check)
API 6FA	Specification for Fire Test of Valves
API RP-14C	Recommended Practice for Analysis, Design, Installation and Testing of Basic Surface Safety Systems for Offshore Production Platforms
API RP-14F	Recommended Practice for Design and Installation of Electrical Equipment for Fixed and Floating Offshore Production Facilities for unclassified and Class I, Division 1 and Division 2 Locations
API RP 14G	Recommended practice for Fire protection and Control on open type offshore Production Platforms.

CODE	TITLE
API 14Z	Recommended Practice for Design and Installation of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1 and Zone 2 Locations.
API MPMS 20.3	Manual of Petroleum Measurement Standards Chapter 20.3 Measurement of Multiphase Flow.
API 520 Part - I	Sizing, Selection and Installation of Pressure Relieving devices in Refineries – Sizing and Selection
API 520 Part-II	Sizing, Selection and Installation of Pressure Relieving devices in Refineries – Installation
API STD 521	Guide to Pressure Relieving and Depressurization Systems
API STD 526	Flanged Steel Pressure Relief Valves
API STD 527	Seat tightness for Pressure Relief Valves
API RP-551	Process Measurement
API RP-552	Transmission Systems
API RP 553	Refinery Control Valves
API RP-554	Process Instrument and Control
API RP-555	Process Analysers
API RP 557	Guide to Advanced control system
API RP 576	Inspection of Pressure Relieving Devices
API 578	Positive Material Identification (PMI)
API 598	Valve Inspection and Testing
API STD 607	Fire Test for Soft Seated Quarter Turn Valves
API 609	Butterfly Valves Double Flanged, Lug and Wafer Type
API-610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries Eleventh Edition
API-STD 612	Petroleum, Petrochemical and Natural Gas Industries - Steam Turbines - Special-Purpose Applications Eighth Edition
API STD613	API Standard 613, Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services-Sixth Edition
API STD617	Axial and Centrifugal Compressors and Expander-compressors for Petroleum, Chemical and Gas Industry Services Ninth Edition
API STD 618	Reciprocating Compressors for Petroleum, Chemical, and Gas Industry Services Fifth Edition
API STD619	Rotary-Type Positive-Displacement Compressors for Petroleum, Petrochemical and Natural Gas Industries Fifth Edition
API 670	Machinery Protection Systems

CODE	TITLE
API STD672	Packaged, Integrally Geared Centrifugal Air Compressors for Petroleum, Chemical, and Gas Industry Services Fourth Edition
API RP 2218	Fire Proofing Practices in Petroleum and Petrochemical Plants
API MPMS 8	Manual of Petroleum Measurement Standards – Chapter 8 – Sampling
API MPMS 10	Manual of Petroleum Measurement Standards – Chapter 10– Sediment and Water
API MPMS 21.1	Manual of Petroleum Measurement Standards Chapter 21 Flow Measurement Using Electronic Metering Systems - Section 1 Electronic Gas Measurement
API MPMS 21.2	Manual of Petroleum Measurement Standards Chapter 21 Flow Measurement Using Electronic Metering Systems - Section 2 Flow Measurement using Electronic Metering Systems, inferred mass
API MPMS TR 2570	Manual of Petroleum Measurement Standards – Draft standard– Continuous On-line Measurement of Water Content in Petroleum (Crude Oil and Condensate)
API PUBL 4635	Compilation of Field Analytical Methods for Assessing Petroleum Product Releases
API PUBL 2566	State of the art multiphase flow metering

4.2.4. American Society of Mechanical Engineers (ASME)

CODE	TITLE
ASME B 1.20.1	Pipe Threads, General Purpose (Inch)
ASME B 16.5	Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24 Metric/Inch Standard
ASME B16.10	Face to Face and End to End – Dimension of Valve
ASME B16.11	Forged fitting, Socket welding and threaded
ASME B16.20	Metallic Gaskets for Pipe Flanges
ASME B16.21	Non-Metallic Flat Gaskets for Pipe Flanges
ASME B16.25	Butt welded ends for pipe, valves, flanges and fittings
ASME B16.34	Valves - Flanged, threaded and welding ends.
ASME B16.36	Orifice Flanges
ASME B18.2.1	Square and Hex Bolts & Screws (inch series)
ASME B18.2.2	Square and Hex nuts (inch series)
ASME B31.3	ASME Code for Process Piping

CODE	TITLE
ASME B31.4	Pipeline Transportation Systems for Liquid Hydrocarbons and Water Liquids
ASME B31.5	Refrigeration Piping
ASME B31.8	Gas transmission and Distribution Piping Systems
ASME B36.10	Welded and Seamless wrought steel pipe
ASME B36.19	Stainless Steel Pipe
ASME B40.100	Pressure Gauges and Gauge Attachments
ASME B40.200	Thermometers
ASME PTC 19.3	Temperature Measurement Instruments and Apparatus (Performance Test Codes).
ASME PTC 25	Performance Test Codes-Pressure Relief Devices
ASME SEC III DIV 1	Boilers and Pressure Vessels Code – Rules for Construction of Pressure Vessels
ASME SEC VIII, Div 1	Boiler and pressure vessel code Section VIII Div1 – Rules for construction of Pressure Vessels
ASME SEC VIII, Div 2	Boiler and pressure vessel code Section VIII Div 2 – Alternative rules
ASME SEC IX	Boiler and pressure vessel code section IX – welding and brazing qualifications
ASME MFC-1	Glossary of Terms used in the Measurement of Fluid Flow in Pipes
ASME MFC –3M	Measurement of Fluid Flow in Pipes using Orifice, Nozzle and Venturi tubes
ASME MFC –6M	Measurement of Fluid Flow in Pipes Using Vortex Flow meters
ASME MFC –14M	Measurement of Fluid Flow using Small Bore Precision Orifice Meters
ASME MFC –16M	Measurement of Fluid Flow in Closed conduits by means of Electromagnetic Flow meters
ASME MFC –18M	Measurement of Fluid using Variable Area Meters
ASTM A123 / A123M-09	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A182	Standard Specification for Forged or Rolled Alloy Steel Flanges, Forged fittings, and Valves and Parts for High Temperature Service
ASTM A269	Standard specification for Seamless and welded austenitic stainless steel tubing for general service
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A479	Specification for Stainless Steel Bars and Shapes for use in Boilers and Other Pressure Vessels

CODE	TITLE
ASTM A790	Standard Specification for Seamless and Welded Ferritic / Austenitic Stainless Steel Pipe
ASTM B164	Standard Specification for Nickel-copper Alloy Rod, Bar and Wire
ASTM B165	Standard Specification for nickel-copper alloy (UNS N04400) Seamless Pipe and Tube
ASTM B423	Standard Specification for Nickel-Iron-Chromium-Molybdenum – Copper Alloy (UNS N08825 and N08221) Seamless Pipe and tubes
ASTM B564	Standard Specification for Nickel Alloy Forgings
ASTM B 677	Standard Specification for UNS 08904, UNS 08925 and UNS 08926 Seamless Pipe and Tube
ASTM D 635	Standard Test Method for Rate of burning and/or Extent and Time of Burning of Plastics in a Horizontal position
ASTM D 888	Standard Test Methods for Dissolved Oxygen in Water
ASTM D 1253	Standard Test Method for Residual Chlorine in Water
ASTM D1356	Standard Terminology Related to Sampling of the Ambient Atmosphere
ASTM D1357	Standard Practice for Planning the Sampling of the Ambient Atmosphere
ASTM D1914	Standard Practice for Conversion Units and Factors Relating to Sampling and Analysis of Atmospheres
ASTM D4430	Standard Practice for Determining the Operational Comparability of Meteorological Measurements
ASTM D5096	Standard Test Method for Determining the Performance of a Cup Anemometer or Propeller Anemometer
ASTM D5366	Standard Test Method for Determining the Dynamic Performance of a Wind Vane
ASTM D5741	Standard Practice for Characterizing Surface Wind Using a Wind Vane and Rotating Anemometer
ASTM D 3764–01	Standard Practice for Validation of Process Stream Analyzer Systems and Correlation
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F1198	Standard Guide for Shipboard Fire Detection Systems
ANSI/FCI 70-2	Fluid controls Institute – Quality control standard for Control valve seat leakage
ANSI/ISA TR96.05.01	Partial Stroke Testing of Automated Block valves
ANSI / NEMA ICS 6	Enclosures for Industrial controls and systems
ANSI/FM 3260	American National Standard for Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling

4.2.5. National Association of Corrosion Engineers (NACE)

CODE	TITLE
NACE MR-0175 / ISO 15156	Petroleum and Natural Gas industries- Materials for use in H2S containing environments in Oil and Gas Production.

4.2.6. International Electrotechnical Commission (IEC)

CODE	TITLE
IEC 60028	International Standard of Resistance for Copper
IEC 60034	Rotating Electrical Machines
IEC 62443	Industrial Communication Network
IEC 60068	Basic Environmental Testing Procedures for Electronic Components and Electronic Equipment
IEC 60079	Electrical apparatus for Explosive gas atmospheres
IEC 60092- 360	Electrical installations in Ships: Insulating Materials for Shipboard and Offshore Units, Power, Control, Instrumentation, Telecommunication Cables
IEC 60092- 370	Electrical installations in Ships: Guidance on Selection of cables for telecommunication & data transfer including Radio frequency cables
IEC 60092-376	Electrical installations in ships :Cables for control and instrumentation circuits 150/250V (300V)
IEC 60099-5	Surge Arrestors: Selection and Application Recommendations
IEC 60189-1 to 3	Low-frequency Cables and Wires with, PVC insulation and PVC Sheath
IEC 60227-1	Polyvinyl Chloride Insulated Cables of Rated Voltages up to and including 450/750 V: General Requirements
IEC 60228	Conductors of Insulated Cables
IEC 60245	Rubber Insulated Cables – Rated voltages up to and including 450/750 V
IEC 60331	Test for Electric Cables Under Fire Conditions (Fire resistant)
IEC 60332	Test for Electric Cables and Optical Cables Under Fire Conditions (Flame retardant)
IEC 60529	Degrees of Protection provided by Enclosures(IP Code)
IEC 60534	Industrial Process Control Valves
IEC 60584	Thermocouples
IEC 60751	Industrial Platinum Resistance Thermometer Sensors
IEC 60754-1	Part 1: Halogen Release Under Fire Conditions
IEC 60754-1-2	Test on Gases Evolved During Combustion of Materials from Cables - Part 1: Determination of the Amount of Halogen Acid Gas

CODE	TITLE
IEC 60811	Electric and optical fibre cables - Test methods for non-metallic materials
IEC 61000	Electromagnetic Compatibility (EMC)
IEC 61034-1	Measurement of Smoke Density of Cables Burning Under Defined Conditions - Part 1: Test Apparatus
IEC 61034-2	Measurement of Smoke Density of Cables Burning Under Defined Conditions – Part 2: Test Procedure and Requirements
IEC 61131	Programmable Controllers
IEC 61158	Digital Data Communications for measurement and Control –Field Bus for use in Industrial Control System.
IEC 61158-2	Industrial communication networks – Field bus specifications - Part 2: Physical layer specification and service definition Edition 4.0
IEC 61300-1	Fiber Optic Interconnecting Devices and Passive Components: Basic Test and Measurement Procedures: General and Guidance
IEC 61326-1	Electrical equipment for measurement, control and laboratory use-EMC Requirements. Part 1: General requirements.
IEC 61506	Industrial-Process Measurement and Control – Documentation of Application Software
IEC 61508	Functional Safety of Electrical / Electronic / Programmable Electronic Safety Related Systems.
IEC 61511	Functional Safety – Safety Instrumented Systems for the Process Industry.
IEC 61515	Mineral Insulated Thermocouple cables and Thermocouples.
IEC 61518	Mating Dimensions between differential pressure (type) measuring Instruments and flanged-on & shut-off devices up to 413 bar
IEC 61537	Cable Tray Systems and Cable Ladder Systems for Cable Management
IEC 61643-11	Low-voltage surge protective devices- Part 11- Surge protective devices connected to low-voltage power systems- Requirements and Test methods.
IEC 61643-21	Low Voltage Surge Protective Devices: Surge Protective Devices connected to Telecommunications and Signaling Networks - Performance Requirements and Testing Methods
IEC 61784-1-0	Industrial communication networks – Fieldbus Profiles General Concept
IEC 61784-1-1 to 6, 8,9,22	Industrial communication networks – Fieldbus Profiles communication profile family
IEC 61804	Function Blocks for Process Control
IEC 61892-7	Mobile and Fixed Offshore Units - Electrical installations - Hazardous Areas

CODE	TITLE
IEC TR 61831	On-line analyzer systems- Guide to design and installations
IEC 62381	Automation Systems in the Process Industry – FAT, SAT and SIT.

4.2.7. International Telecommunication Union (ITU)

CODE	TITLE
ITU G.650.1	Definitions and test methods for linear, deterministic attributes of single-mode fibre and cable
ITU G.650.2	Definitions and test methods for statistical and non-linear related attributes of single-mode fibre and cable
ITU G.650.3	Test methods for installed single-mode fibre cable sections
ITU G 651.1	Characteristics of a Multimode graded index Optical fibre Cable for optical access network
ITU G.652	Characteristics of a single-mode optical fibre and cable
ITU G.653	Characteristics of a dispersion-shifted single-mode optical fibre and cable
ITU G.655	Characteristics of a non-zero dispersion-shifted single-mode optical fibre and cable

4.2.8. National Fire Protection Association (NFPA)

CODE	TITLE
NFPA 70	National Electric Code
NFPA 72	National Fire Alarm and Signalling Code
NFPA 75	Standard for the Protection of Information Technology Equipment
NFPA 496	Standard for Purged and Pressurised Enclosures for Electrical Equipment

4.2.9. American GAS Association (AGA)

CODE	TITLE
AGA XM1602	Self-Operated Diaphragm type Natural Gas Service Regulators

4.2.10. European Standards

CODE	TITLE
BS 692	Meteorological Thermometers
BS 1339-3	Humidity: Guide to the Measurement of Humidity
BS 3463	Observation and Gauge Glasses for Pressure Vessels

CODE	TITLE
BS 5839 (Part-1)	Fire Detection and Alarm Systems for Buildings
BS 5839 (Part-8)	Fire Detection and Fire Alarm Systems for Buildings: Code of Practice for the Design, Installation, Commissioning and Maintenance of Voice Alarm Systems
BS 6004	Electric Cables - PVC Insulated, Non-Armoured Cables for Voltages up to and Including 450/750V, for Electric Power, Lighting and Internal Wiring.
BS 6259	Code of Practice for the Design, Planning, Installation, Testing and Maintenance of Sound Systems
BS 6387	Test Method for resistance to fire of cables Required to Maintain Circuit Integrity under Fire Conditions
BS 6656	Assessment of Inadvertent Ignition of Flammable Atmospheres by Radio-Frequency Radiation – Guide
BS 6701	Telecommunications Equipment and Telecommunications Cabling – Specification for Installation Operation and Maintenance
BS 7430	Code of practice for Protective earthing of electrical installations
BS 7655	Specification for Insulating and Sheathing Materials for Cables (PVC insulating & sheathing)
BS 7917	Elastomer Insulated Fire Resistant (Limited Circuit Integrity) Cables for Fixed Wiring in Ships and On Mobile and Fixed Offshore Units, Requirements and Test Methods
BS 50288-7	Multi-element metallic cables used in analogue and digital communication and control Part 7: Sectional specification for instrumentation and control cables
BS EN 54	Fire Detection and Fire Alarm Systems – Parts 3, 10, 11 & 12
BS-EN 837, part 1	Pressure gauges - part 1: Bourdon type pressure gauges - Dimensions, Metrology, Requirements and Testing
BS EN 10204	Metallic Materials – Types of Inspection. (Document on Material Testing & Certification)
BS 6121-1	Mechanical Cable glands-Part 1: Armour glands .
BS 6739	Code of practise for instrumentation in process control systems: installation, design and practise.
BS 6883	Elastomer Insulated Cables in ships and on mobile & fixed Offshore Units.

4.2.11. Other International Standards

CODE	TITLE
NEMA VE 1	Metal Cable Tray Systems

CODE	TITLE
NEMA VE 2	Cable Tray Installation Guidelines
IEEE 802.1	Bridging & Management
IEEE 802.3U	Foundation Field bus's HSE Standards
IEEE C95.1	Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
IEEE 1050	Guide for Instrumentation and Control Equipment Grounding in Generating Stations
EEMUA 191	Alarm Systems- A Guide to Design, Management and Procurement
IP-15	Model code of Safe Practice Part 15: Area Classification Code for Petroleum Installations

4.2.12. Process Industry Practices

CODE	TITLE
PIP PCCGN002	General Instrument Installation Criteria

As applicable, the latest edition of above mentioned Codes/Standards shall be used.

4.3 COMPANY STANDARDS

DOCUMENT NUMBER	DOCUMENT TITLE
A0-ENG-J-SP-003	Specification for Fire and Gas Systems
A0-ENG-J-SP-004	Specification for Instrument cables
A0-ENG-J-SP-005	Specification for Instrument tubing, fittings, and bulk materials
A0-ENG-J-SP-006	Specification for safety instrumented systems
A0-ENG-J-SP-008	Specification for process control system
A0-ENG-J-SP-009	Specification for instruments with Equipment packages
A0-ENG-J-SP-010	Specification for Pressure Instruments
A0-ENG-J-SP-011	Specification for Level Instruments
A0-ENG-J-SP-013	Specification for Flow Instruments
A0-ENG-J-SP-015	Specification for Temperature Gauge with wells
A0-ENG-J-SP-016	Specification for Control Valves and Self- actuated Regulators
A0-ENG-J-SP-017	Specification for Shutdown Valves
A0-ENG-J-SP-020	Specification for safety relief valves & rupture disks
A0-ENG-J-SP-023	Specification for Analyzers
A0-ENG-J-SP-025	Specification for instrument junction box and cable glands
A0-IG-J-SP-001	Specification for Instrument installation

DOCUMENT NUMBER	DOCUMENT TITLE
Z0-TS-J-08010	Specification for Transmitters
Z0-TS-J-05020	Specification for Temperature elements with wells
Z0-TS-J-05030	Specifications for Temperature Transmitters
Z0-TS-J-01040	Specification for Testing and Commissioning
Z0-TS-J-01050	Specification for Instrument material Selection (INMS)

~~4.3~~4.4 PROJECT REFERENCE DOCUMENTS

DOCUMENT NUMBER	DOCUMENT TITLE
E1150-BD-2000-J-0002	Instrument & Control Philosophy
E1150-TS-2000-J-0011	Specification for Package Unit Instrumentation & Control
E1150-TS-2000-J-0033	Specification for Foundation Fieldbus Design
E1150-TS-2000-J-0012	Specification for Instruments and Controls Installation
E1150-TS-2000-J-0034	Specification for Integrated Control and Safety System (ICSS)
E1150-TS-2000-J-0035	Specification for Asset Management System (AMS)
E1150-TS-2000-J-0036	Specification for Alarm Management System (ALMS)
E1150-TS-2000-J-0031	Specification for Plant Information Management System (PIMS)
E1150-TS-2000-J-0037	Specification for Operator Training Simulator (OTS)
E1150-TS-2000-J-0048	Specification for Enterprise Historian System
E1150-TS-2000-J-0049	Specification for Procedural Automation (Exapilot) (SOP)
E1150-TS-2000-J-0050	Specification for I-Field / DOF (Digital Oil Field) + MDPro
E1150-TS-2000-J-0038	Specification for Rotating Machine Monitoring System (RMMS)
E1150-TS-2000-J-0032	Specification for Network Interface and System Security Guidelines
E1150-TS-2000-J-0007	Specification for Wireless Network for ~~VR-PT Transmitters~~ Field instruments
E1150-TS-2000-J-0013	Specification for Hydraulic Safety Shutdown System (HSSS)
E1150-TS-2000-J-0006	Specification for Control Valves
E1150-TS-2000-J-0001	Specification for Choke Valves
E1150-TS-2000-J-0002	Specification for Actuated On-Off Valves
E1150-TS-2000-J-0003	Specification for Safety Relief Valves
E1150-TS-2000-J-0042	Specification for Moisture Analyzers
E1150-TS-2000-J-0044	Specification for Basic Sediment & Water (BS&W) Analyzers
E1150-TS-2000-J-0045	Specification for Dissolved Oxygen Analyzers
E1150-TS-2000-J-0046	Specification for Turbidity Analyzers

DOCUMENT NUMBER	DOCUMENT TITLE
E1150-TS-2000-J-0014	Specification for Multiphase Flowmeters
E1150-TS-2000-J-0040	Specification for ~~Instrument~~ System Cabinet ~~and Auxillary Consoles~~
E1150-TS-2000-J-0015	Specification for Fire & Gas Detectors and Devices
E1150-TS-2000-J-0016	Specification for Instrument Cable, Cable Glands and Junction Boxes
E1150-TS-2000-J-0009	Specifications for Instrument Interface requirements with existing facilities
E1150-TS-2000-J-0004	Specification for Differential Pressure Flow Elements
E1150-TS-2000-J-0021	Specification for Vortex Shedding Flow Meters
E1150-TS-2000-J-0022	Specification for Variable Area Flow Meters
E1150-TS-2000-J-0023	Specification for Electromagnetic Flow Meters
E1150-TS-2000-J-0025	Specification for Level Gauges
E1150-TS-2000-J-0026	Specification for Pressure Gauges
E1150-TS-2000-J-0027	Specification for Level Transmitters (Radar / Displacer)
E1150-TS-2000-J-0028	Specification for Pressure And Differential Pressure Transmitters
E1150-TS-2000-J-0029	Specification for Temperature Instruments With Thermowells
E1150-TS-2000-J-0010	Specification for ~~Bulk Material and~~ Instrument Material Selection
E1150-TS-2000-J-0017	Specification for Cable Tray
E1150-BD-2000-N-0001	HSE Philosophy
E1150-BD-2000-O-0001	Fire Protection Philosophy
E1150-BD-2000-O-0002	F & G Detection Philosophy
E1150-BD-2000-F-0001	Process Design Basis – Work Package A
E1150-GD-400-G-0001	Specification for General Environmental Data and Units of Measurement
E1150-BD-2000-T-0001	Telecommunication Design Basis
E1150-TS-2000-P-0001	Piping Material Specification
E1150-TS-2000-W-0004	Specification for External and Internal Coating
E1150-TS-2000-O-0002	Firefighting & Safety Equipment Specification
E1150-SR-2000-J-0002	ICSS Adequacy Report
E1150-PB-2000-G-0018	SPI Customization Document
E1150-PB-2000-G-0025	SPI Implementation Procedure
E1150-TS-400-J-XXXX	Zirku Field Instrument Specifications
E1150-BD-400-F-0002	Operating and Control Philosophy - Work Package B
E1150-SR-400-J-0001	Zirku Control System Adequacy Report
E1150-SR-2000-J-0004	Remote I/O Technology Study Report

DOCUMENT NUMBER	DOCUMENT TITLE
E1150-GD-2000-F-0006	Isolation Philosophy
E1150-GD-2000-F-0007	Vent and Drain Philosophy
E1150-TS-2000-P-0001	Piping Material Specification
E1150-TS-2000-P-0015	Specification for Ball Valves and IDBB Valves
E1150-TS-2000-P-0016	Specification for Gate, Globe, Check and Needle Valves
E1150-BD-2000-P-0002	Piping Design and construction standard
E1150-A0-2000-J-4015	Overall ICSS Architecture
E1150-A3-2000-J-4027	Overall ICSS Interface Block Diagram
E1150-TS-2000-J-0035	Specification for Asset Management System
E1150-TS-2000-J-0051	Specification for Auxiliary Console
E1150-TS-2000-J-0018	Specification for Bulk Material
E1150-BD-2000-F-0003	Process Design Basis
E1150-BD-2000-H-0001	HVAC Design Basis

5.0 ENVIRONMENTAL CONDITIONS

The environmental conditions shall be as per Process Design Basis (Doc No. E1150-BD-2000-F-0003)

All the Instruments and Control system equipment shall be designed suitable for installation under the above environmental conditions. Design considerations mentioned below shall also be followed.

Instrument and Control equipment shall be designed to operate at the temperatures specified below according to the three types of location shown below:

	INDOOR AIRCONDITIONED(2)	OUTDOOR SHELTERED (1)(2)(3)	OUTDOOR UNSHELTERED (2)(3)
Maximum	35°C (95°F)	55°C (131°F)	65°C (149°F)
Minimum	10°C (50°F)	0°C (32°F)	0°C (32°F)

Notes:

1. "Sheltered" refers to permanent, ventilated enclosures or buildings, or permanently fixed sunshades with a top and three sides.

2. For instruments which dissipate internal heat and are installed in custom engineered enclosures (e.g., enclosures not included in the original manufacturer's temperature certification), an additional 15°C shall be added to the above maximum temperatures. An example, for "indoor air conditioned" installation, the equipment must perform at 35 + 15 = 50°C. Similarly, for the "outdoor unsheltered" case, the equipment shall be designed for a maximum operating temperature of 65 + 15 = 80°C.

3. For the outdoor installations only, the designer can take credit for forced or passive cooling to eliminate or reduce the 15°C heat rise. For example, if vortex coolers are used, the heat removal capacity of the coolers may be subtracted from the generated heat. No more than 15°C reduction in temperature will be given as credit. The designer shall substantiate his claim by providing the supporting data and calculations.

The outdoor atmosphere is marine, humid (design relative humidity for equipment is 100%), saline with fine air-borne penetrating dust and sand. Traces of sour gas (H2S, SO2) and chlorine may also be present in the air. Hence, all electronic boards and components shall be designed to withstand such an environment.

6.0 UNITS OF MEASUREMENT

The Units of Measurement shall be as per Specification for General Environmental Data and Unit of Measurement (P7512-GD-2000-G-0060).

7.0 HAZARDOUS AREA & INGRESS PROTECTION REQUIREMENTS

7.1 INSTRUMENT ELECTRICAL PROTECTION METHODOLOGIES AND CERTIFICATION

The protection methods for Instruments and Enclosures mounted in Classified Electrical Hazardous Areas shall be as per IEC-60079, unless Local Statutory Codes overrule.

All the field instruments shall be certified suitable for the hazardous area Zone 1 Gas Group IIB, Temperature class T3 as a minimum. The instruments in UPS battery room shall be certified suitable for hazardous area Zone 1, Gas Group IIC, Temperature class T3 as a minimum at an ambient temperature of 55 °C.

Approved national authority (e.g. CSA, UL, BASEEFA, FM, CESI, LCIE) shall certify all Instruments, instrument equipment, devices or fittings installed in hazardous areas in which it will be used. All such equipment shall carry apparatus marking as per IECEx/ATEX.

Additional ATEX marking shall be applicable for equipment conforming to IEC / CENELEC as per EU Directive ATEX 2014/34/EU; whereas equipment conforming to North American Practices / NEMA shall carry AEx apparatus marking.

The method of hazardous area protection for Instruments and Control Equipment located in the field shall be as below:

INSTRUMENTS AND ACCESORIES	METHOD OF PROTECTION
Instruments and accessories (e.g.: Transmitters, Solenoid valves, Switches, Valve Positioners, F&G Detectors, etc.)	a) Instruments and accessories used in Foundation Fieldbus BPCS circuits: FISCO as per IEC-60079-11:2006 and 27:2008. b) Instruments and accessories used in Non-Foundation Fieldbus BPCS and Other Systems circuits: Explosion Proof/Flameproof (Ex"d" as per IEC 60079-1).
Junction boxes	a) Foundation Fieldbus Circuits: Increased Safety (Ex"e" as per IEC 60079-7). (Note 2)

INSTRUMENTS AND ACCESORIES	METHOD OF PROTECTION
	b) Non Foundation Fieldbus (i.e. Explosion Proof/Flameproof) Circuits: Explosion Proof/Flameproof (Ex"d" as per IEC 60079-1).
Cable Glands and Plugs	Ex"de" for Ex"e" certified Junction Boxes and Ex"d" for Ex"d" certified instruments and Junction boxes.
Field Mounted Local Panels and communication system.	Field mounted Local Panels and communication systems have to be preferably located in Non-Hazardous Areas. However, installation of Local Panels and communication systems in Zone 2 classified areas is allowed using the following protection methods: Increased Safety (Ex"e" as per IEC 60079-7 for enclosures and Type "n" Protection (Ex"n" as per IEC 60079-15) for electronics. (Note-1).

Notes:

1. Ex"d" enclosures to be used as protection method if Ex"n" type is not available for electronics.

~~1.~~2. The FF Junction boxes and all components inside the junction boxes including field barriers / segment protectors shall be suitable for installation in Zone 1 hazardous area. Channel Field barriers shall be Ex"i".

Where Ex"d" instruments are not available, Ex"i" shall be followed. Active barriers (Galvanic Isolator) shall be used for Ex"i" circuits.

Electrical Instruments and Enclosures shall not normally be installed in Zone 0 Hazardous Areas and shall only be done with written CONTRACTOR / COMPANY approval.

All Local Panels on the Island facilities shall preferably be placed in non-hazardous areas. If the Panel is located in a Zone 2 classified area, a certificate of conformity to IEC 60079-15 shall be delivered for the complete panel from CONTRACTOR / COMPANY approved recognized third party authority.

It shall not be assumed that the packaging of individually certified components makes a certified system/unit/cabinet/panel. An appropriate third party certification must be provided and shall be related to the complete assembled control system/unit/cabinet/panel. The third party certifying authority shall be approved by the CONTRACTOR / COMPANY. Hazardous Area certification of the complete unit shall be provided irrespective of whether all individual components inside are Hazardous area classified. This shall form the basis for acceptance, especially Analyzer panels etc.

All necessary Test Reports and Certificates shall be provided to the CONTRACTOR / COMPANY. All the certificates shall be in English language.

All Control Rooms, Local Equipment Rooms and Modular Technical Rooms shall be air conditioned, positive pressure maintained and shall be classified as Safe (Non-Hazardous) Areas. All equipment within these Control Rooms shall be certified for non-hazardous area (General Purpose) installation unless specified otherwise in Project Specifications or Data Sheets.

7.2 INGRESS PROTECTION

All field instruments and Junction Boxes shall have a certified Ingress Protection of IP-66 in accordance with IEC-60529, as a minimum.

All Outdoor Cabinets and Panels shall have a certified Ingress Protection of IP 65 as a minimum.

All Indoor Cabinets and Panels shall have a certified Ingress protection of IP 54 as a minimum.

All field instruments, cabinets and panels exposed to direct sun light shall be provided with sun shades or canopies as applicable.

8.0 SPECIAL~~SOUR~~ SERVICE REQUIREMENTS

~~8.0~~8.1 SOUR SERVICE REQUIREMENTS

All the field instruments including accessories in hydrocarbon services shall conform to the requirements of NACE Standards MR-0175/ISO15156 (latest edition).

The use of double block and bleed / single block valves for instrument isolation shall be in line with Isolation Philosophy document (Doc. No. E1150-GD-2000-F-0006). All Oil & Gas as well as hazardous chemical instrument bleed, blow down and drains shall be routed to closed drain or flare with appropriate piping / tubing in accordance with P & I diagrams and job specifications for “Vent And Drain Philosophy”, (Doc. No.E1150-GD-2000-F-0007).

8.2 LETHAL SERVICE REQUIREMENTS

For lethal service and pipe class rating of 1500# and above, hard pipe (instead of impulse tubing) shall be used for hook-up of transmitters.

All Oil & Gas as well as hazardous chemical instrument bleed, blow down and drains shall be routed to closed drain or flare with appropriate piping / tubing in accordance with P & I diagram and job specifications for “Vent And Drain Philosophy”, (Doc. No.E1150-GD-2000-F-0007).

9.0 SOFTWARE TO BE USED

Instrument Sizing	Intergraph SPI (INTools~~INTOOLS~~) Version 13.1
Instrument Database	Intergraph SPI (INTools~~INTOOLS~~) Version 13.
Instrument Drawings	Intergraph SPI (INTools~~INTOOLS~~) Version 13.and AutoCAD latest Version
Other Documents	Intergraph SPI (INTools~~INTOOLS~~) Version 13., MS Word and Excel
Modelling	Intergraph SP3D

The detail engineering design shall utilize Intergraph's SmartPlant Instrumentation (SPI or previously termed as `INtools ~~Intools~~”) to develop the instrumentation database and generate the applicable PROJECT deliverables in compliance with “SPI implementation Procedure” (E1150-PB-2000-G-0025).

The application software versions for SPI, oracle, operating system and other design software's will be in compliance with the requirements specified in the Project document “SPI Implementation Procedure (E1150-PB-2000-G-0025).

COMPANY will provide the SPI formats (.PSR files) for instrument index, I/O list, cable schedule, MTO, instrument datasheets formats, etc. listed in the document “SPI implementation Procedure” E1150-PB-2000-G-0025 for generation of the related PROJECT deliverables. Nevertheless, as part of detail engineering design, EPC CONTRACTOR / ENGINEERING SUBCONTRACTOR shall develop any necessary additional instrument datasheet formats in SPI and, if required, modify the COMPANY formats to meet PROJECT requirements. Any new format and any modified format shall be submitted as a part of “SPI Implementation Plan” for COMPANY approval before using them. The content of the fields in the format shall be filled by EPC CONTRACTOR to define the requirement completely. Separate hardware and software I/O list shall be prepared for each system. Instrument index shall include all primary and implied tags (system generated tags, INTERFACE(S) tags, alarms tags, etc.) and has not to be limited to wired instruments and local instruments. Multi-tag datasheet are not acceptable.

EPC CONTRACTOR/ ENGINEERING SUBCONTRACTOR shall prepare data sheets for instruments, safety instruments, fire and gas instruments devices and all other field instruments as part of SPI database based on approved PROJECT data. EPC CONTRACTOR shall ensure that all the SUBCONTRACTOR/VENDOR final instrumentation design documents (instrument index, I/O list, datasheets, wiring, loop diagrams, hook-ups, etc.) are generated from the SPI project database. In case where SUBCONTRACTOR/VENDORS are not able to generate the required deliverable from SPI, EPC CONTRACTOR will have the responsibility to generate the required information in SPI during execution of the PROJECT. SUBCONTRACTOR/VENDOR and EPC CONTRACTOR engineering data and deliverables shall be available in a unique PROJECT SPI database. Process datasheet for all the instruments shall be populated in SPI.

For instruments wherein the sizing calculation is involved, EPC CONTRACTOR/ ENGINEERING SUBCONTRACTOR shall populate the required data in SPI. These calculations will be used for reference only.

EPC CONTRACTOR/ ENGINEERING SUBCONTRACTOR shall ensure that all the tags are consistent across the SmartPlant Tools. EPC CONTRACTOR/ ENGINEERING SUBCONTRACTOR shall extract reports to ensure the consistency between the SmartPlant Tools' databases.

EPC CONTRACTOR/ ENGINEERING SUBCONTRACTOR shall generate MTO's for all items including bulk items. The bulk items shall as a minimum include tubes, tube fittings, cables, cable glands, junction boxes, installation items etc.

EPC CONTRACTOR/ ENGINEERING SUBCONTRACTOR shall generate the wiring diagrams, loop drawings, Fieldbus segment diagrams and hook-up drawings in SPI. All the required supporting blocks shall be developed in SmartSketch.

For cable and JB schedules, the required data shall be configured in SPI and complete deliverables shall be generated from COMPANY provided PSR reports.

At least the following deliverables shall be developed using SPI: Instrument index (similar to EXISTING FACILITIES), Input / Output lists (similar to EXISTING FACILITIES), Instrument data sheets (individual), Instrument sizing calculations (as applicable), Cable schedules, JB schedules, Loop diagrams - enhanced smart loop (similar to EXISTING FACILITIES), Foundation Fieldbus segment diagrams (similar to EXISTING FACILITIES), hook-up drawings (similar to EXISTING FACILITIES), Bill of Materials / MTO's, Interconnection wiring diagrams (similar to EXISTING FACILITIES), Alarm and set point summary (similar to EXISTING FACILITIES).

I/O list shall be separately generated for each system i.e. process control system, safety systems, fire detection & alarm system, etc.

SPI database access shall be provided to COMPANY to ensure availability and quality of data in detail engineering design.

EPC CONTRACTOR / ENGINEERING SUBCONTRACTOR shall meet the requirements for the database backup, quality audit, final upgrade to COMPANY provided Version, deliverables and PROJECT database final delivery as specified in the document "SPI implementation Procedure" (E1150-PB-2000-G-0025).

For more details related to the software, refer to SmartPlant Instrumentation Customization Document (Doc. No. E1150-PB-2000-J-0001).

10.0 PIPING INTERFACE FOR INSTRUMENT CONNECTIONS

The table below lists the standard sizes and types for "Instrument Connections" and "Process Connections". Where "Process Connection" is the connection size at the first process isolation valve (defined by the Project Piping Specifications and Data Sheets) and "Instrument Connection" is the connection at the instrument.

INSTRUMENT TYPE	PROCESS / VESSEL CONNECTION	INSTRUMENT CONNECTION
Flow Instruments		
D/P (Non-sour services)	½" flanged x ½"OD	½" NPT (F) x ½" OD
D/P (Sour services)	1" flanged x ½" OD	½" NPT(F) x ½" OD
Level Instruments		
External Displacer	2" flanged	2" flanged
Internal Displacer	4" flanged	4" flanged
External Float	2" flanged	2" flanged
Internal Float	4" flanged	4" flanged
External Radar	2" flanged	2" flanged
Internal Radar	4" flanged	4" flanged
Level Gauge	2" flanged	2" flanged
DP type	2" flanged x ½" OD	½" NPT (F) x ½" OD
DP type with remote diaphragm seal	3" flanged	3" flanged
DP type direct vessel mounted (diaphragm seal)	3" flanged	3" flanged
Pressure Instruments		
Pressure gauge and DP gauge (on pipe, Non-sour services)	1" flanged x ½"NPT (F)	½" NPT(M)
Pressure gauge and DP gauge (on pipe, Sour services)	2" flanged x ½"NPT (F)	½" NPT(M)
Pressure transmitter and DP transmitter (on pipe, Non-sour services)	1" flanged x ½" OD	½" NPT(F) x ½" OD
Pressure transmitter and DP transmitter (on pipe, Sour services)	2" flanged x ½" OD	½" NPT(F) x ½" OD
Pressure gauge and DP gauge (on vessel)	2" flanged x ½"NPT (F)	½" NPT(M)

INSTRUMENT TYPE	PROCESS / VESSEL CONNECTION	INSTRUMENT CONNECTION
Pressure transmitter and DP transmitter (on vessel, Sour services)	2" flanged x ½" OD	½" NPT(F) x ½" OD
Inst. with diaphragm seal (pipe or vessel)	3" flanged	3" flanged
Temperature Instruments		
Thermowell on pipe	1 1/2" flanged or 2" flanged (Note 12)	1 1/2" flanged or 2" flanged (Note 12)
Thermowell on vessel	2" flanged	2" flanged

Refer project Instrument Process hook-up Drawing-AGI/CI (E1150-A3-2000-J-2009), Instrument Process hook-up Drawing-ETI/NI (E1150-A3-2100-J-2009), Instrument Process hook-up Drawing-UAI/WI (E1150-A3-2300-J-2009), Instrument Process hook-up Drawing-ASI/SI (E1150-A3-2200-J-2009).

Notes:

1. For diaphragm seal, the seal is the instrument connection.
2. Instrument drain/vent shall be connected as per Instrument hook-up drawings and Piping and Instrumentation Diagram (P&ID).
3. Flanged end connection rating shall be 300# RF, as a minimum for Instruments mounted on Process equipment.
4. For pipe class with higher ratings, instrument connection size shall be as per piping material specifications as applicable.
5. The stand pipe connections to the equipment will be 3".
6. The type of flange shall be in accordance to piping material specifications (PMS).
7. Threaded connections shall be avoided in sour service.
8. For GRP pipes Instrument side flange shall be metallic.
9. Flange material shall be governed by the process service.
10. Threaded/ Welded connections shall be avoided in Lethal service
11. Instrument Impulse tubing shall be 12 mm O.D, , 0.89 mm minimum wall thickness, SS-316L. However, selection of materials shall be chosen based on process condition. Material for sour service shall comply with applicable COMPANY & NACE standards MR0175/ ISO 15156. For lethal service and pipe class rating of 1500# and above, hard pipe (instead of impulse tubing) shall be used for hook-up of transmitters.
12. The Thermowell connection Size for line shall be 1 ½" NB OE 2" NB depending on the piping material specification for the line. Refer Piping design and construction standard (E1150-BD-2000-P-0002) and Piping Material specification (E1150-TS-2000-P-0001) for details.
13. Diaphragm seals are required for level instruments in lethal, severely dirty, corrosive, hazardous fluids, or fouling service. Pressure instruments for measurement in non-clean applications including slurry, dirty, highly viscous fluid will use diaphragm seal type transmitters with flushing ring.

11.0 ELECTRICAL-INSTRUMENTATION INTERFACE

Substation Automation Systems with Intelligent MCCs using IPCMS will be implemented for the Island Process facilities by electrical discipline.

The Start/Stop commands from the BPCS to the IPCMS and the Motor status signals to the BPCS from the IPCMS shall be communicated using redundant MODBUS TCP/IP protocol.

Status signals from the Substation Control & Monitoring System (SCMS) and the Load Management, Load Shedding (LMLS) system and the Transient Disturbance Monitoring (TDM) system to the BPCS shall be communicated using redundant MODBUS TCP/IP protocol.

All electrical interfaces to the SIS system shall be hardwired. The ESD signals from the SIS shall use volt free contacts powered by the receiving system.

Interposing Relays shall be used (as necessary) to segregate MCC voltages (greater than 24 V DC/AC) from the BPCS. ~~and SIS I/O equipment which shall use 24 V DC~~.

All interface signals from SIS to MCC shall be through interposing relays.

Any relays used for Safety Instrumented Functions (SIFs) shall be certified with the applicable SIL rating.

New interposing relay panels shall be provided, or existing interposing relay panels shall be modified by MAC as per ICSS adequacy study report. Refer MAC Scope of work (E1150-SW-2000-J-0001) and Specifications for ICSS (E1150-TS-2000-J-0034) for details.

The communication links shall be monitored and failure shall be alarmed in BPCS using watch dog logic.

New EAMS shall be provided for existing and new facilities in AGI,ETI, UAI and ASI. The existing Plant Resource manager (PRM) will be integrated with new EAMS to fetch asset health status and display in PRM Client. Refer MAC Scope of work (E1150-SW-2000-J-0001) for further details on EAMS integration with existing ICSS and PRM.

12.0 HVAC-INSTRUMENTATION INTERFACE

The HVAC control system for all the buildings shall be interlocked with the smoke / fire and gas detection system to shut down the HVAC system upon receipt of a signal from the smoke/ fire and gas detection system.

Flammable HC gas and toxic gas (H2S) detectors will be provided at the Air Lock and HVAC air inlets of all the buildings irrespective of manned or unmanned.

Motorised fire & Gas Dampers shall be provided at fresh air intakes, outlets and rooms which are protected by clean agent maintaining concentrations. These dampers shall be closed and building HVAC will be shut down upon confirmed Fire or confirmed gas detection.

HVAC Control Panel shall be PLC based, with redundant controller for automatic operation. HVAC Control panels operation status shall be linked to BPCS, as required and shall have hardwired interface with the Fire & Gas System panels and motor control centres. Motorised fire & Gas dampers shall be shut down from HVAC control panel.

Existing philosophy shall be followed in all aspects related to interface and integration with ICSS.

Critical signals interchanged between the HVAC systems and the SIS and F&G systems shall be hardwired using volt free contacts in the outputs of both systems. The rest of signals interchanged with BPCS for normal operation & monitoring shall be communicated using redundant MODBUS TCP/IP communication.

Any relays used for Safety Instrumented Functions (SIFs) shall be certified with the applicable SIL rating.

The communication links shall be monitored and failure shall be alarmed in BPCS using watch dog logic. Refer HVAC Design Basis (Doc. No. E1150-BD-2000-H-0001) for further details.

13.0 INSTRUMENT SIGNAL TYPES AND SEGREGATION PHILOSOPHY

13.1 INSTRUMENT SIGNAL TYPES

SMART field instruments shall be used for the Island facilities.

The BPCS shall use Foundation Fieldbus instrumentation. Instruments with HART protocol shall be used where FF compatible instruments are not available (e.g. specialty instruments like analyzers or package instruments connected to package control systems).

As much as possible, HVAC instruments shall also be 'Smart' instruments with HART protocol, however conventional instruments can be used when equivalent HART instruments are not available.

If a special type of instrument/signals are mandatory required for Package Units, the same shall be highlighted clearly and aligned with control system supplier.

The SIS and FGS shall use 24 V DC, 4 to 20mA analog inputs with superimposed HART protocol.

BPCS/SIS Digital Input signals shall be 24 V DC volt free contacts with the BPCS/SIS supplying the 24 V interrogation voltage.

BPCS/SIS Digital Output signals shall be 24 V DC powered from the BPCS/SIS system.

Digital Output signals to other systems shall be solid state or volt free contact type (depending on the electrical load size) and the interrogation voltage shall be 24 V DC supplied by the other systems.

The Pneumatic signals shall be 3-15 psig.

A Hydraulic Safety Shutdown System (HSSS) shall be provided at each Island to control the hydraulically actuated Well Head Safety Valves.

The wireless transmitters (VR Sensors) installed (by drilling contractor) in the wellheads to monitor pressure and temperature shall use wireless network for communication with ICSS.

Wireless device shall be provided for critical local gauges in field which are difficult to access. These devices shall use wireless network for communication with ICSS.

13.2 SIGNAL SEGREGATION PHILOSOPHY

High Power Trunk (HPT) with Isolating Device Couplers (Intrinsically safe)" and FISCO Field Devices shall be used for FF Signals. This will provide high power (non-IS) power on the trunks, intrinsically safe (or energy limited) outputs on the spurs and H1 host controller and fieldbus power supply redundancy.

High Power Trunk (HPT) can use FF field instruments that are FISCO certified and utilize cables that meet the specified parameters for the interconnection of the equipment.

According to the FF specification (ISA S50.02) the maximum allowed length of a Fieldbus segment is limited to 1900 m. This total segment length is computed by adding the length of the main trunk line and all the spurs that extend from it.

Total Segment Length = Trunk + All Spurs

In order to eliminate the need to calculate the physical loading of each segment and to reduce the validation

requirement, the following limits shall apply for this project:

- Trunk cable length ≤ 1500 meters
- Spur cable length ≤ 100 meters.

FF Segment device allocation for each Standard Size FF barrier junction box shall be governed by following factors while maintaining 20% installed spares in each FF junction box:

- FF Barrier Junction Box size
- Number of FF Control Loops in one JB and FF loop Criticality of each loop

For Further details on FF Segment design ~~shall comply with~~ the Project "Specification for Foundation Fieldbus Design" (Doc. No. E1150-TS-2000-J-0033).

Non-FF signals segregation shall comply with the following segregation philosophy:

- Signal Destination (BPCS, SIS, FGS, UCP, LCP etc.)
- Signal Type (AI / AO / DI / DO)
- Type of Protection (Intrinsically Safe / Non Intrinsically Safe)
- Instrument power supply (Voltage, AC/DC, etc.)

Analog input (AI) signals and Analog output (AO) signals may be connected to the same field mounted Junction box and run in the same Multi-conductor Cable.

24 V DC Digital Input (DI) signals and Digital Output (DO) signals may be connected to the same field mounted Junction box, but have to run in different Multi-conductor Cable. The DI's & DO's shall be segregated in different terminal rows labelled appropriately.

Proper segregation shall be provided in cable trays. According to API RP 552 "Wiring with low energy/voltage should not be mixed with wiring carrying AC signals, DC pulses or any power. Wiring with 4-20 mA DC signals should be separated from 120 VAC to solenoids, 120 VAC alarms and power wiring, and power signals".

14.0 EMI / RFI NOISE IMMUNITY

The design of all electrical/instrument equipment and installations shall meet the appropriate emission and immunity specifications for the intended operational environment, meeting the emission (IEC 61000-6-4) and immunity (IEC 61000-6-2) requirements for an industrial environment.

15.0 UTILITIES

15.1 POWER SUPPLIES

On the Islands the Control Systems namely BPCS, SIS, FGS and Package Control System etc. located in the Island Control Room shall be powered from a 230V AC ± 10%, 50 Hz ± 5%, unearthed, solid state, parallel, redundant, UPS System.

The UPS shall provide a battery back-up for the control systems as per the Project "HSE Philosophy" (Doc. No. E1150-BD-2000-N-0001).

The field instruments, devices and circuits shall be powered by the respective control systems.

The field solenoid valves shall also be energized by 24 V DC power supply from the respective control system.

The externally powered field instruments shall be powered through respective power distribution boards.

The F&G field detectors shall be powered by F&G System using 24 V DC power supplies.

The following power supply feeders shall be made available to the Control Systems and Package UCPs:

- 2 x 230 VAC, 50Hz UPS supplies (A and B) (unearthed).
- 1 x 230 VAC, 50Hz from non UPS Utility power supply (earthed) (for lighting, sockets etc.).
- The Control System VENDOR shall further convert and distribute these power supplies as necessary (including 230V AC to 24V DC stabilized power supply units) for cabinet internal distribution of the 24 VDC (for the electronic modules, field instruments, F & G detectors, solenoid valves, lamps, etc.).
- The UPS power & 24 VDC power shall be monitored at each control system package UCP and it shall be alarmed in BPCS as a common alarm through serial link.

The stabilized power supply units (PSUs) shall be redundant and shall be wired in parallel with protection diodes. There shall be no common single point of failure between the power supply and the backup unit. Each PSU shall be capable of meeting the 140% load, which includes 20 % for engineering growth and 20 % spare, in order to be tolerant of a single power supply unit failure. Failure of the power supply units shall be alarmed in the BPCS. Each power supply shall have a failure alarm contact which shall be connected to the BPCS.

15.2 HYDRAULIC SUPPLIES

Hydraulic fluid shall be used as actuating medium for the Wellhead actuated safety valves such as the Down Hole Safety Valves (DHSV), Master Valves (MV), Wing Valves (WV), Master Surface Annulus Safety Valves (MSAS) and Choke Valves. The Wellhead control panel shall be provided with Hydraulic power units. The Hydraulic power units shall be part of main driven equipment systems, pressurized by electrically driven pumps. Standby accumulator pack and associated emergency panel shall be part of the Hydraulic power unit.

Hydraulic fluid shall be SHELL IRUS Fluid C for all hydraulic actuated On-Off and ESD valves on Islands other than well head actuated valves. Whereas Castrol Hyping AWH15 or ADNOC Lube ISO 46 shall be used for valves operated by HSSS of well pad area. The use of Synthetic oil is not acceptable.

15.3 PNEUMATIC SUPPLIES

The Instrument air supplies shall be as follows:

Design Pressure	175 psig
Maximum Pressure	130 psig
Normal pressure	109 psig
Minimum pressure	58 psig
Dew Point	Minus 40 °C

The valve actuators and the pneumatically powered valve accessories shall be sized using the above minimum pressure but also shall be suitable for the above design pressure. Control Valve Actuators should be designed to operate on a range of 3 to 15 psig.

16.0 SELECTION OF INSTRUMENTATION

16.1 GENERAL

Instruments and Systems shall comply with the following design criteria, as a minimum:

All instruments, control system including valves, actuators and accessories shall be purchased from reputed manufacturers on the COMPANY approved VENDOR list with proven track record of installation in similar Oil & Gas facilities and shall be standardized with the same manufacturer throughout the Islands as far as practical. Latest instrument models shall be provided.

Obsolescence of models of ICSS components that are part of project scope of work, Detectors and Sensors shall be critically verified during technical review and evaluation. Project material shall have at least 30 years of support available from the start of operation.

Adequacy of the existing systems hardware, software, licenses, and its compatibility with any new added hardware, software, licenses part of 1 MMBPD project shall be verified as part of adequacy checks of the existing systems through existing system OEM.

BPCS Instruments shall not be used for SIS duties and vice versa. In case a particular process variable needs to be used both for control and protection functions, two separate transmitters shall be provided. This is also applicable for Packages Units.

All instruments (including valves and actuators) used in Safety applications (SIFs) shall be SIL certified by TUV or equivalent. All necessary data required for SIL verification shall be obtained from the relevant VENDORS.

The BPCS shall be Foundation Fieldbus compatible. The SIS and FGS systems shall be HART compatible.

For Packages monitored and controlled by the BPCS, the package Instruments shall be FF compatible.

The make and model of the Instrumentation and Control items supplied by the Package VENDOR shall be same as that of the main plant, as far as practically possible. Any deviation from approved PVL for the packages shall be subject to COMPANY approval.

Switches shall not be used and Transmitters shall be used wherever practicable (as distinct from switches). Use of switches shall be subject to COMPANY approval.

Transmitter calibrated ranges shall be selected so that Alarm and Trip points are above 10% and below 90 % of the calibrated range.

A minimum of two Hand-Held HART and two Hand-Held FF communicators/calibrators suitable for the area classification shall be provided for each transmitter Manufacturer complete with all accessories (batteries, carrying case, leads, clips, etc.) for each Island.

All transmitters shall have an integral local indicator displaying the measured process variable (s) in Engineering Units. A separate loop powered/BPCS driven indicator shall be supplied (if specified on the Instrument Data Sheet) for applications requiring indication near the associated manually manipulated control device (e.g. control valve, damper, etc.).

All level instruments installed in the same Vessel (Level Gauge, BPCS Level and ESD Level) shall cover the same range.

Level measurements shall be indicated in both mm and percentage for both BPCS and SIS.

Primary level transmitter selection shall be GWR. Other types of transmitters can be used if required (with prior approval from the COMPANY).

Magneto restrictive type level transmitter shall not be used.

Diaphragm seals are required for Differential Pressure level instruments in lethal, severely dirty, corrosive, hazardous fluids, or fouling service.

Primary level transmitter selection for SIS system shall be GWR Type. GWR is not suitable for applications where the presence of emulsion is expected.

Instruments shall not be shared for high-high and low-low trips. Separate instruments shall be designated for high-high and low-low trips.

For electronic transmitters installed in open spaces or on top modules, transient surge protectors shall be provided to protect against lightning.

All Control Valves connected to the BPCS shall be provided with FF compatible Smart Valve Positioners.

Partial stroke testing (PST) facilities shall be provided for all Shutdown and Blowdown valves and other SIS final elements to enable the performance of diagnostic testing without the need for full stroking of the device. Test results shall be made available to AMS.

Actuated On-Off Valves for the following services shall be equipped with Partial stroke testing facilities.

- Shutdown valves and Isolation valves on the main Plant/Facility Inlet and Outlet lines.

- Process unit and critical Utility unit Inlet and Outlet shutdown valves, the tripping of which may lead to a complete facility shutdown or to shutdown of a key process unit.
- Blow down applications and any Actuated On-Off valve on a SIF duty.
- PST and SOV test option shall be applied for all valves including BDVs with size 3" and above, regardless the assigned SIL rating for that valve.
- Valves including BDVs with sizes less than 3" shall not be provided with PST and SOV test.

All Field Switch devices (e.g. Pressure Switches), wherever used, shall have two Single Pole Double Throw (SPDT) contacts (2A, 24V DC).

Field instruments and/or devices shall have dedicated tappings and process isolation valves.

The first Isolation Valve on each tapping point shall be provided by Piping as per the Project Piping Material Specification.

Pressure transmitters and pressure gauges shall have a 2-valve Instrument manifold for instrument isolation.

All pressure indicators associated with X-mas trees shall be provided with overrange protectors.

Differential pressure transmitters (Flow, Level and DP) shall have a 5-valve Instrument manifold for instrument isolation.

Instrument manifolds shall be integral and connected directly to the transmitter. For hard pipe hookup, the manifolds shall be provided with flange adapter/kidney flange with the nipple welded for process and vent connection.

Pressure instruments for measurement in non-clean applications including slurry, dirty, highly viscous fluid will use diaphragm seal type transmitters with flushing ring.

Instrument air take off points shall be provided with isolation valves and spare ones shall be plugged. Instrument air shall be supplied through SS316L piping as per pipe class A51E of piping material specifications.

Instrument Process Wetted part materials shall be suitable for the process fluid operating and design conditions.

Valve body and trim materials shall be suitable for the process fluid operating and design conditions. Trim Material shall be SS316L (as a minimum) or as required for the application (as per the associated Project Specifications).

All the electronic instruments shall have two ISO M20 cable entries to accommodate certified (Ex “d”) cable glands. Adapters shall not be used to convert NPT cable entries to Metric Parallel cable entries. Spare cable entries shall be plugged with certified SS316L plugs.

Instruments with flying leads are not acceptable and all leads shall be terminated on terminal blocks in an integral junction box with terminals to connect the incoming field cables.

All temperature gauges and elements shall be provided with Thermo-wells.

The housing material of all the instruments shall be suitable for marine installation. As a minimum, Die-Cast Aluminium with epoxy coating and painted. SS304 material shall not be used for any instrument housing. All parts shall be painted appropriately for installation in a highly corrosive, humid salt laden marine environment.

All field Junction Boxes shall be provided with 20% Spare cable entries. All spare cable entries shall be fitted with certified blank plugs.

Sunshades shall be provided for all outdoor electronic / electric instruments exposed to direct sunlight (i.e. not sheltered). The material of construction for sunshades shall be GRP.

Instruments shall withstand the maximum design conditions stated on the associated datasheet, as a minimum. Instruments exposed to vacuum shall have under range protection to full vacuum.

Instruments which require hydro testing shall be tested with a hydrostatic test pressure of 1.5 times the design pressure as specified in the Piping Material Specification.

Installation and hook-up of all instruments and devices shall be as per project specific documents, drawings and CONTRACTOR / COMPANY standard practices.

Field Instruments shall preferably be installed close coupled to minimize piping, tubing and fittings. However, if instruments are not easily accessible and readable from grade or platform when using close coupled methodology, then the instruments shall be mounted on 2" stand pipes/supports. Where Instrument impulse lines are laid at inaccessible levels or locations where scaffolding would be required for access for maintenance (e.g. to fix tubing leaks) or if impulse lines will be above 3 meters of distance, piping shall be used instead of tubing.

When mounting on 2” pipes, the mounting height of Field Instruments shall be 1.2 m to the center line of the instrument from platform or grade level.

Instruments shall be easily accessible and readable from grade or platform.

Instrument Stand pipes shall be fabricated from 2” Schedule 10S SS 316/316L. The stands shall be of welded and bolted construction and painted after welding. Stand Base Plates shall be fabricated from SS 316L of at least 5 mm thickness and shall be suitable for either welding to metallic structure or bolting to ground. Bolting shall be through Teflon inserts at least 3 mm thick to avoid dissimilar metal contact. The Painting shall follow the Project Specification for External and Internal Coating (Doc. No. E1150-TS-2000-W-0004).

Minimum instrument accuracies shall be as indicated below, unless otherwise stated on the Data Sheets:

Local Gauges	± 1% of full-scale range
Electronic Transmitter	±0.25 % of full scale range or better

Over range protections for field instruments shall be at least 130% of full scale or the design whichever is higher.

The Process wetted parts/Trim Material shall be SS316L as a minimum. Instrument materials of construction shall be suitable for the process fluid and conditions and shall be selected based on the applicable Pipe Class detailed under the Project Piping Material Specification document (Doc. No. E1150-TS-2000-P-0001) and the Specification for Instrument ~~Bulk Material and~~ Material Selection (Doc. No. E1150-TS-2000-J-0010).

For lethal service and pipe class rating of 1500# and above, hard pipe (instead of impulse tubing) shall be used for hook-up of transmitters. Threaded/ welded connections shall be avoided in lethal service,

When piping is used as an impulse line, pipe shall be minimum SS316L or higher grade based on service / piping class and instrument material selection specification (Doc. No. E1150-TS-2000-J-0010). The Rating , end connection and material shall be as per relevant pipe class. The compatibility of impulse piping with material specification shall be maintained to avoid dissimilar material contact. Insulating gaskets and bolting sleeves shall be considered as applicable. Supply of nuts, bolts, gaskets and other required bulk material for impulse piping shall be by Piping.

All Field Instruments, except in-line instruments, shall be provided with the capability of being tested and calibrated In-Situ.

Redundant cables for system security such as communication cables or power feeders or systems with multiple sensors on voting system particularly Fire and Gas systems shall be run in distinctly separate routes and through segregated junction / termination boxes, where feasible.

The PBU Phase of the project is to be implemented using Modular philosophy of design and construction. Consistency is to be maintained in all the Modules for engineering and design of Instrumentation & Controls, Instruments Manufacturer & Model and Installation & Testing requirements.

Wireless device shall be provided for critical local gauges which are difficult to access (physically or for safety reasons) and those that require regular monitoring. These devices shall be able to transfer all the readings electronically. These wireless devices are connected to BPCS through Wireless Gateway. The Wireless Gateway connects WirelessHART networks and communicates to the BPCS via modbus TCP/IP

16.2 PRESSURE INSTRUMENTS

The primary sensing shall be diaphragm with low displacement electronic type sensor – capacitance cell for Pressure Transmitters. Transmitters shall be designed, engineered and manufactured based on API RP 552: Transmission systems.

Accuracy of the transmitters shall be ± 0.25% of full scale range or better. Over range protection shall be at least 30 % above the specified range limits without calibration shift.

The sensing element for Pressure gauge shall be bourdon tube, bellows or diaphragm type as specified in respective instrument datasheet. Pressure gauges shall be Industrial solid front safety pattern type, designed to ASME B40.100 or to BS-EN-837-1.

The accuracy of the gauges shall be to Class 1A ASME / Class 1 EN-837-1. Primary elements shall withstand the specified overpressure for at least 30 minutes without having their elastic characteristics adversely affected (at the specified process design temperature).

The detailed requirements for Pressure Instruments are stated in the associated Project Specifications:

Specification for Pressure and Differential Pressure Transmitters : E1150-TS-2000-J-0028

Specification for Pressure Gauges : E1150-TS-2000-J-0026

And the associated Project Instrument Data Sheets.

16.3 TEMPERATURE INSTRUMENTS

RTDs shall be used for narrow span or differential span high accuracy measurements from -392 °F up to 1202°F.

RTD accuracy class shall be Class A (as per IEC 60751) only with Pt-100 (Platinum Resistance at 32 °F: 100 Ohms) element.

RTD element shall be in duplex configuration. However, only single RTD element shall be connected to the Transmitter.

Thermocouple shall be duplex., Mineral insulated and metal sheathed . Sheaths shall ne of austenitic stainless steel and preferably of SS 316L.

Thermocouple element shall be selected based on temperature ranges. K type Thermocouple shall be used for temperature measurement above 1202 °F while R type thermocouple shall be used for temperature measurement above 1382 °F.

Temperature transmitter shall be head mount type with spring loaded nipple-nipple arrangement. Temperature Transmitters shall meet the requirements of API RP 551: Process Measurement Instrumentation

The transmitter output shall be linear with measured temperature. Reference accuracy shall be better than +/- 1 Deg. F for ranges up to 400ºC (752 ºF) and +/- 1.0 % of range for higher temperature for temperature transmitters.

The detailed requirements for Temperature Instruments are stated in the associated Project Specifications:

Specification for Temperature Instruments with Therm : E1150-TS-2000-J-0029

And the associated Project Instrument Data Sheets.

16.4 FLOW INSTRUMENTS

The Flow meter technology shall be selected based on the application, required size, pressure rating, pressure drop, accuracy, available straight meter run, rangeability, multi-phase, bi-directional flow, etc.

The manufacturer's installation requirements shall be followed as a minimum.

The detailed requirements for Flow Instruments are stated in the associated Project Specifications:

Specification for Differential Pressure Flow Elements : E1150-TS-2000-J-0004

Specification for Vortex Shedding Flow Meters	:	E1150-TS-2000-J-0021
Specification for Variable Area Flow Meters	:	E1150-TS-2000-J-0022
Specification for Electromagnetic Flow Meters	:	E1150-TS-2000-J-0023
Specification for Multiphase Flowmeters	:	E1150-TS-2000-J-0014

And the associated Project Instrument Data Sheets.

16.5 LEVEL INSTRUMENTS

The level transmitter type shall be selected based on appropriate services.

Radar Type: Primary level transmitter selection shall be GWR. Shutdown applications (i.e. for high high, low low trip applications) and Control and Monitoring applications. All level transmitters used for SIS system shall be GWR type. Other types of transmitters can be used if required with prior approval from the COMPANY.

DP Type: D/P types can be considered in clean non-viscous services Control and Monitoring applications (i.e. for open and closed loop control and monitoring applications). DP types shall not be used in dirty or foam services, and GWR shall be used instead regardless SIS or BPCS.

Displacer Type: Interface level measurement and special applications where DP type is not suitable.

The detailed requirements for Level Instruments are stated in the associated Project Specifications:

Specification for Level Transmitters (Radar / Displacer	:	E1150-TS-2000-J-0027
Specification for Pressure and Differential Pressure Transmitters	:	E1150-TS-2000-J-0028
Specification for Level Gauges	:	E1150-TS-2000-J-0025

And the associated Project Instrument Data Sheets.

16.6 CHOKE VALVES

All the Choke Valves shall be designed and constructed in accordance with API 6A, latest edition. Material of construction shall conform to Product Specification Level 3 (PSL-3) and Performance Requirements (PR 2) of API 6A, with the added requirement that any welding (with the exception of weld overlay) is not permitted. Valve shall be fire tested to API 6FA.

All the Choke Valves shall be sized or sizing shall be traceable to ISA 75.01.01 using applicable correction factors for piping geometry, recovery factor, valve style modifier etc., for the offered valve model.

Wellhead Choke valve sizing shall be based on multi-phase service.

The detailed requirements for Choke Valves are stated in the Project Specifications for Choke Valves (Doc. No. E1150-TS-2000-J-0001) and the associated Project Instrument Data Sheets.

16.7 CONTROL VALVES

Globe body valve shall be the first choice for valves up to 12" size. Cage guided valves shall only be used in clean service. They shall be avoided for highly viscous fluids or services and where solids are likely to be present or coking may occur.

As a minimum all Control Valves shall be offered with valve seat leakage to Class IV as per IEC 60534-4.

TSO shall mean Class VI leakage (bubble-tight shutoff) and shall be provided only when specified in the Data Sheet.

Control Valves used in the minimum recirculation line at the discharge of the pumps and flare Control Valves shall have leakage rate of Class V.

The detailed requirements for Control Valves are stated in the Project Specifications for Control Valves (Doc. No. E1150-TS-2000-J-0006) , Piping Specification for Gate, Globe, Check and Needle Valves (E1150-TS-2000-P-0016) and the associated Project Instrument Data Sheets.

16.8 ACTUATED ON-OFF VALVES

Actuated On-Off valves shall be designed to be Fail-Safe (unless otherwise stated on the associated P&IDs and Instrument Valve Data Sheets) and the Actuator shall be the Fail-Safe spring return type (unless otherwise specified on the associated Instrument Valve Data Sheets).

Actuated On-Off valves used for safety applications shall be suitable for the Safety Integrity Level (SIL) specified on the associated Instrument Valve Data Sheet.

The actuator shall be selected based on stroking time specified in the associated Instrument Valve Data Sheet. Valve VENDOR shall be responsible for the mechanical compatibility between the valve and actuator. Actuator shall be supplied with all the necessary accessories such as solenoid valves, quick exhaust vent valve etc., as per the requirements of this specification and associated Instrument Valve Data Sheets.

The detailed requirements for Actuated on-off Valves are stated in the Project Specifications for Actuated On-Off Valves (Doc. No. E1150-TS-2000-J-0002) , Piping Specification for Ball Valves and IDBB Valves (E1150-TS-2000-P-0015) and the associated Project Instrument Data Sheets.

16.9 SAFETY RELIEF VALVES

Sizing, Selection and installation of safety relief valves shall be as per API Std 520.

The orifice designations, materials, area, end connection sizes and rating shall be as per API Std. 526 for Flanged Steel valves.

Seat tightness requirements and testing shall be as per API Std. 527.

API Std 521 shall be used as a general guideline for examining the causes of overpressure and determining individual relieving rates.

All Safety-Relief valves other than Thermal Relief valves shall have flanged end connections and ratings shall be as per ASME B 16.5. Rating and Facing shall be provided as specified on the associated Instrument data sheet.

The detailed requirements for Safety Relief Valves are stated in the Project Specifications for Safety Relief Valves (Doc. No. E1150-TS-2000-J-0003) and the associated Project Instrument Data Sheets.

16.10 CONTROL PANELS AND AUXILLARY CABINETS

All Outdoor Cabinets shall have a certified Ingress Protection of IP 65 as a minimum.

All Indoor Cabinets shall have a certified Ingress protection of IP 54 as a minimum.

The detailed requirements for Control Panels and Auxillary Cabinets are stated in the Project Specifications for ~~Instrumen~~t System Cabinet ~~and Auxillary console~~ (Doc. No. E1150-TS-2000-J-0040) and Specification for Auxiliary Console (Doc. No. E1150-TS-2000-J-0051) and the associated Project documents and drawings.

16.11 HYDRAULIC SAFETY SHUTDOWN SYSTEM

Each HSSS shall be Electro-hydraulic System and as a minimum shall include the following:

A Well Head Control Panel containing the hydraulic control systems for the associated hydraulically actuated Well Head Valves: Master Valve (MV), Modular Surface Actuated Safety Check Valve (M-SASV),Wing Valve (WV),Down Hole Safety Valve (DHSV), Choke Valves.

Well Head Valves Hydraulic control and shutdown circuitry shall be linked to the associated Island Safety Instrumented System (SIS).

The detailed requirements for Hydraulic Safety Shutdown System are stated in the Project Specifications for Hydraulic Safety Shutdown System (Doc. No. E1150-TS-2000-J-0013) and the associated Project documents.

16.12 ANALYZERS

The detailed requirements for Analyzers are stated in the associated Project Specifications:

Specification for Moisture Analyzers	:	E1150-TS-2000-J-0042
Specification for Basic Sediment & Water (BS&W) Analyzers	:	E1150-TS-2000-J-0044
Specification for Dissolved Oxygen Analyzers	:	E1150-TS-2000-J-0045
Specification for Turbidity Analyzers	:	E1150-TS-2000-J-0046

And the associated Project Instrument Data Sheets.

17.0 MODULARIZATION CONCEPT

Due to the offshore nature of the WORK on artificial islands, there are limitations to the number of personnel that can be accommodated and to the size of laydown areas available. Hence the project is being executed with modular philosophy, to the possible extent. This Modularized Facilities includes Pre-Assembled (Pipe) Racks (PAR's), Pre-Assembled Manifold Modules (PAM"s), Pre-Assembled Process Units (PAU's) and building modules such as local control room (LCR), local equipment room (LER), Modular technical room (MTR) etc.. All the above mentioned modules will be pre-fabricated, complete with installation, cabling and testing of all the instruments/cabinets, at the respective module VENDOR's yard. These modules will then be shipped at site for installation.

All the structure, piping, equipment, instruments, and cabling shall be designed to maximize completion and installation in the module fabrication yard and pre-installation of field cables on island prior to module installation at SITE. Junction boxes shall be provided on each module to maximize cable pulling on the module and for simple connection upon module delivery to site.

18.0 MAIN AUTOMATION CONTRACTOR (MAC)

The Control, Monitoring and Safety Shutdown Systems, field instrumentation such as pressure transmitters, DP transmitters, DP/Radar/Displacer type level transmitters, temperature element & transmitter etc., and Fire & Gas detectors for the Island Process facilities will be implemented utilizing the concept of Main Automation Contractor (MAC). Yokogawa, Abu Dhabi is the pre-selected MAC VENDOR for the project and will execute the implementation of these items.

The MAC Scope shall include but not limited to:

- Supply for FF Filed instruments, FF Junction boxes, HART Field instruments ,F&G Detectors etc.
- Supply of New ICSS System for the project Signals as per outcome of ICSS Adequacy report Approved by COMPANY/ CONTRACTOR.
- Modification/ Extension of existing ICSS System for Project Signals as per outcome of ICSS Adequacy report Approved by COMPANY/ CONTRACTOR.
- Integration of New supplied and existing modified / extended ICSS System with overall Plant ICSS System, Cyber Security System, AMS, ALMS, High end Solutions, Plant historian System, IPCMS, LMLS, SCMS.
- Wireless network design for new wellheads VR Transmitters, wireless field devices and integration of same with existing wireless networks.
- FAT, IFAT, SAT, ISAT and Trainings

Refer MAC Scope of work (E1150-SW-2000-J-0001) for details.

19.0 CONTROL, MONITORING AND SHUTDOWN SYSTEMS FOR THE ISLANDS

The environmental islands (AGI,ETI,UAI, ASI) in Upper Zakum (UZ) offshore field is equipped with Yokogawa CENTUM VP R5 and ProSafe-RS R3 systems.

The Al Ghallan / Central Island is provided with the following existing Control/Technical Rooms:

- **IFCC**: Centralized monitoring and control centre for all of the new Island facilities as well as for the existing platform facilities.

- **LCR-1**: For Oil and Gas Operation & Control (Technical Room for Separators, Vapour Recovery Unit, etc.).

- **LCR-2**: For Power Generation and Water Injection Plant Operation & Control (Technical Room for Power Generation Plant), chemical storage, Electro Chlorination Package, Nitrogen Package, Emergency Diesel Generator, Sea Water Intake System, Fire Water Pump Package, Service Water Filtration Package, Cooling Water Filtration Package, Instrument Air Compressors, Utilities

- Nine ~~Five~~ **Module Technical Rooms (MTR)**: One for each (3) LP Booster Compressors and one for each (2) Lift Gas Compressors,~~.~~one for the GDUs of both Lift gas Compressors, One for the GDU for export gas, one for Water injection Plant and one for the Fuel gas Plant.

- **WIP MTR**: Water Injection Plant.

- Two **LERs:** For Well head Units

Ettouk / North, Assefiya/ South and Umm Al Anbar / West Islands are provided with a dedicated LCR and Two LERs as below:

- LCR: For Operation & Control (Technical Room for Separators, Utilities, Instrument Air Compressors, etc.)

- Two LERs: For Well head Units

Umm Al Anbar/ West Island is also provided with a MTR for the Sulphate Reduction Plant (SRP)

IFCC in Al Ghallan / Central Island will be manned 24 hours a day, 365 days a year and will eventually control the entire Upper Zakum field. ~~However, initially provision has been made to control the Islands as well from the FCC.~~

Island Process Areas and Units are assigned to the respective Operator Consoles but reassignment to other consoles/workstations through an Operator 'request-release-transfer' dialogue is possible.

A new LER (LER-3) in Al Ghallan / Central Island shall be built as part of this project to control additional Well Head Units. Also new MTR will be required in Al Ghallan / Central Island (MTR-20) for ~~some of the~~ Produced Water Treatment Package (CPAU20) and Water Injection Plant (CPAU21) packages included in the scope. New facilities shall be in line with existing systems.

The new LER (LER-3) shall be designed similar to existing LER's. LER-3 and its associated facilities shall be sized for 4 rows- Rows 10, 12 14 and 16 (total 92 number of wells with Spare). New PAM (CPAM-16,17,18) will be installed on Al Ghallan/Central island to cater to Row 14 and 16 additional wells (total 48 number of wells) with space reserved for future PAM on rows 10 and 12. LER-3 shall accommodate new ICSS cabinets supplied by MAC for controlling all wells associated with new PAM for rows 14 and 16 and shall have spare space designed to accommodate future wells for future PAM on rows 10 and 12.

In case existing spare cards / slots are utilized in 1 MMBD Project, same shall be replenished before commissioning. The operation/maintenance approval shall be required for utilizing existing spares

20.0 DESIGN REQUIREMENTS FOR CONTROL AND MONITORING SYSTEM

All field cables will be brought to the marshalling panel as per segregation philosophy and then grouped in FTA card terminals in marshalling panels to group and segregate with reference to system cabinet grouping. FTA cards will be connected to IO cards located in System cabinets through PreFab cables. This arrangement shall be demonstrated and approved by COMPANY during prototype design of cabinets.

For 1 MMBD expansion project existing control system spares can be utilized only upon written COMPANY Approval.

The Main Automation contractor (MAC) shall perform the adequacy checks on existing system (hardware & software, network loading, inter domain communication, inter FGS communication, server capacity, licenses, obsoleteness and Lifetime, High End solutions Capacity, etc.) to include the new PROJECT signals. An adequacy report shall be submitted. The adequacy report shall include a section indicating the presently available spares, the spares planned to be utilized for 1 MMBD PROJECT upon COMPANY Approval, spares planned to be utilized by OTHER CONTRACTORS, and the available spares after the PROJECT for future use.

If existing spares are allocated for this PROJECT, CONTRACTOR shall ensure that additional spares are provided in line with COMPANY spares philosophy.

Latest Yokogawa ICSS version shall be provided for the new ICSS supplied for this project.

20.1 PACKAGE CONTROL SYSTEM

The various process / utility packages used in the islands are classified as follows based on the type of the package:

- Package Type A
- Package Type B
- Package Type C
- Package Type D

The detailed Package design and control philosophy as well as package allocation as per above types shall be in accordance with “Specification for Package Units Instrumentation & Control” (Doc. No. E1150-TS-2000-J-0011).

20.1.1. Package Type A

Type A Packages shall be fully implemented, monitored, operated and controlled from the Island BPCS, SIS and FGS, with no package control systems.

Function of the local panel, if any, shall be limited to local indicators and emergency push buttons without any logic units/devices installed in the field.

In this type of Package, all the instruments and accessories within the package skid shall be supplied, installed, wired and terminated in the junction boxes mounted on the skid or local panel by the Package VENDOR.

Multi pair/triad cables between the Package VENDOR supplied local panels/ junction boxes and the Island BPCS, SIS & FGS located in Local Control Room/Module Technical Room shall be by the Contractor.

The Package VENDOR shall provide all the required information, detailed functional description, cause & effect diagrams etc. to implement their package control, monitoring and shutdown functions in the Island BPCS, SIS and FGS.

20.1.2. Package Type B

Type B Packages shall be fully implemented, monitored, operated and controlled from the Island BPCS, SIS and FGS.

However, control systems required to perform package related special functions (e.g. AntiSurge Control, Load Sharing, Master Pressure Control and Machine Monitoring etc.) shall be standalone and dedicated systems.

All these standalone systems shall be interfaced via redundant Modbus RTU TCP/IP (preferred) or Modbus RS485 or redundant OPC communications to the Island BPCS for monitoring/control and hardwired or connected via the Vnet/IP control and safety network to the SIS (for trip and other SIS signals) and FGS.

In this type of Package, all the instruments and accessories within the package skid shall be supplied, installed, wired and terminated in the junction boxes mounted on the skid by the Package VENDOR.

Multi pair/triad cables between the Package VENDOR supplied junction boxes and the Island BPCS, SIS, FGS & Control Systems like Compressor Control System, Machine Monitoring System etc., located in Local Control Room/Module Technical Room shall be by the Contractor.

The Package VENDOR shall provide all the required information and documentation (Detailed Functional Specifications, control logic (in the form of Instrument Function Diagrams) and narratives, Cause and Effect diagrams, P & I Diagrams, etc.) required to implement their package control, monitoring and shutdown functions in the Island BPCS, SIS and FGS to the CONTRACTOR and the COMPANY for review and approval.

20.1.3. Package Type C

Type C Packages shall be fully implemented in the Package Unit Control Panel (UCP) with serial/hardwired link to the Island BPCS, hardwired link to the SIS and FGS. These Packages shall be monitored and operated from the Island BPCS.

Except for the GTG, the F&G detectors are connected to plant F&G System located in LER/LCR/MTR as applicable.

For the GTG package, GT enclosure detectors are connected to VENDOR supplied UCP and GTG Module F&G detectors are connected to plant F&G system.

Function of the local panel, if any, shall be limited to local indicators and emergency push buttons without any logic units/devices installed in the field.

In this type of Package, all the instruments and accessories within the package skid shall be supplied, installed, wired and terminated in the junction boxes mounted on the skid or local panel by the Package Vendor.

Multi pair/triad cables between the Package VENDOR supplied local panels/ junction boxes and the Unit Control Panel located in the Local Control Room/Module Technical Room shall be by the Contractor.

20.1.4. Package type D

Type D Packages shall be fully operated by Local Control Panel in the field, with serial/hardwired link to the Island BPCS, hardwired link to SIS and FGS only few hardwired interface (for repeat signals etc.) to the Island BPCS, SIS and FGS.

In this type of Package, all the instruments and accessories within the package skid shall be supplied, installed, wired and terminated in the Local Control Panel.

Multi pair/triad cables between the Local Control Panel and the Island BPCS, SIS & FGS located in the Local Control Room/Module Technical Room shall be by the Contractor.

The below table provides the list of the packages with Type for the “1 MMBD Expansion Phase 1 - Surface Facilities” project.

S. No.	Package Description	Interface Type	Remarks
Package Type A			
1	Chemical Injection Package in AGI	Not Applicable	
2	Chemical Injection Package in ETI	Not Applicable	
3	Produced Water Treatment Package in AGI	Not Applicable	
4	Produced Water Treatment Package in ETI	Not Applicable	
5	HP Water Injection Pumps, Produced Water Disposal Pumps, Crude Oil Transfer Pumps	Not Applicable (Refer Remark)	RMMS Cabinet is by Package Vendor and interface with ICSS.
6	Water Injection Package in AGI	Not Applicable	
7	Modification in Chemical injection Package in UAI	Not Applicable	
8	Modification in Chemical injection Package in ASI	Not Applicable	
9	Clean Agent System in AGI	Not Applicable	
Package Type B			
	Not Applicable		
Package Type C			
	Not Applicable		
Package Type D			
	Not Applicable		

The following packages are provided as standalone systems, with hardwired inter-trips to the Island BPCS, SIS and Fire and Gas System.

- Cathodic Protection System
- Electric Overhead Travelling Crane

Refer to "Specifications for Instrument Interface Requirements with Existing Facilities" (Doc. No. E1150-TS-2000-J-0009) for detailed requirements.

21.0 INTERFACE OF ISLAND BPCS/SIS/FGS TO OTHER THIRD-PARTY SYSTEMS

All non-BPCS systems (i.e. SIS, FGS, Package Control System etc.) on each Island shall be interfaced to the BPCS as shown below:

- The Island SIS and FGS systems shall be interfaced to the BPCS on each Island to monitor and display various parameters related to SIS and FGS action via redundant Ethernet links or proprietary protocol, which shall preferably be TUV approved.
- Any shutdown/trip commands shall be hard-wired or shall be through TUV approved Safety Networks.
- The Package control systems shall be interfaced to the BPCS on each Island using redundant OPC and/or Modbus RTU over RS 485 or TCP/IP link to enable suitable control and monitoring of the package equipment from the Island Control Room.
- Any shutdown/trip commands shall be hard-wired or shall be through TUV approved Safety Networks.
- The Down Hole Monitoring system (by others) shall be interfaced to the BPCS on each Island using redundant Modbus RTU over RS 485 or TCP/IP link.
- The Wireless transmitters (VR Sensors) and wireless field devices shall be interfaced to the wireless Hub/ Gateway and the Wireless Gateway shall be further interfaced to the Host (BPCS or Server Asset management system)

All third party Safety Systems (SIS and FGS) on each Island shall be interfaced with the Island Safety Systems as shown below:

- The Drilling Safety Systems shall be interfaced with the Island Safety Systems using hardwired link.

The interface requirements and the existing systems adequacy are detailed in the following documents:

- The interface requirements with existing systems (BPCS, SIS, FGS, AMS) will be described in the Specification for Instrument Interface Requirements with existing facilities (E1150-TS-2000.J-0009)
- The interface requirements with existing RMMS will be described in the Specification for Rotating Machine Monitoring System (E1150-TS-2000-J-0038).

- For all links/interfaces with packages, refer to ICSS Overall System Architecture (A0-2000-J-4015) and Overall ICSS Interface Block Diagram (E1150-A3-2000-J-4027). Also, islands interconnection and electrical systems are represented in the same architecture.

- All of these new interfaces are represented in Overall ICSS Architecture (A0-2000-J-4015) and Overall ICSS Interface Block Diagram (E1150-A3-2000-J-4027).

- The adequacies of existing systems will be performed and described in the respective Adequacy Reports. Adequacy study of existing systems shall be by respective System OEM only.

21.1 INTERFACE WITH WELL MONITORING SYSTEM

Down Hole Gauge Monitoring System (DHGMS) and Smart Completion surface equipment will be not part of Scope, however full provision (field and room footprints, essential and not essential power, communication with control system, wiring, etc.) to install and integrate the Surface Equipment required for DHGMS and Smart Completion shall be considered in the scope.

A. Downhole Gauges

1. Each well will have Downhole Gauge Monitoring System (supplied by Drilling Contractor) from one of the four following manufacturers: Weatherford, Schlumberger, Halliburton or Baker GE.

2. Drilling Contractor will install the Downhole Gauge and terminate the surface cable in a junction box mounted on surface near the drill-pit.

3. Drilling Contractor will supply the cable from this JB to the new Local Equipment Room (LER3) at AGI/CI and a free standing cabinet to house the data acquisition system (800x800x2100 mm) to be also mounted in the new LER3.

4. MMBD EPC Contractor shall:

    a) Provide redundant UPS Power supply and, if required, conventional power supply to the Drilling cabinet.
    b) Lay and connect the field cables between Downhole JB and LER3
    c) By means of the MAC (Yokogawa), integrate the Downhole Gauge system signals (both hardwired and communicated) into the ICSS.
    d) Consider 4 cabinets inside the LER3 (One each from every DHG vendor)

B. DTS (Downhole temperature distribution Sensor) and DAS (Downhole acoustic sensor).

1. Each well will have DTS / DAS

2. Drilling Contractor will install the DTS / DAS and terminate the FO cable in a splitter box mounted on surface near the drill-pit.

3. Drilling Contractor will supply the FO cable from this box to LER3 and 2 free standing IP 65 cabinets (800x800x2100 mm) to be mounted in the new LER – LER3 on .

4. 1 MMBD EPC Contractor shall

    a) Arrange a redundant UPS Power supply to these cabinets and terminate.
    b) Lay and terminate the FO cables between DTS / DAS and LER3
    c) Arrange MAC (Yokogawa) to configure the tags and commission.
    d) Consider 2 cabinets inside the LER3. (Supplied by Drilling Contractor or DTS/DAS vendor(

C. **ICVs:** There are no ICVs considered in UZ750 wells, but the discussions are ongoing on the subject. Assuming that ICVs will be implemented on the new wells, let us consider following in the 1 MMBD design.

1. Each well will have a set of ICVs

2. Drilling Contractor will install the ICVs and bring the necessary cables and hydraulic tubes on surface near the drill-pit.

3. Drilling will supply the cable from this box to LER3

4. Drilling will supply 1 Hydraulic panel per well (To be optimized during detail design phase) to be mounted in the field near the well and provide the logic to be implemented in ICSS in LER 3 .

5. 1 MMDB EPC Contractor shall

    a) Arrange a redundant UPS Power supply to these cabinets and terminate.
    b) Lay and terminate the cables between wellhead and LER3
    c) Arrange MAC (Yokogawa) to implement the configuration and commissioning.

D. Consider 1 Exd hydraulic cabinet suitable for zone 2 per well to be mounted under the PAM in the field. (Supplied by Drilling Contractor) **M-SAS / Annulus P&T / Wellhead P&T**

1. 1 MMBD project design will follow existing design.

E. **VR Senor and Transmitters**

1. Each Wellhead will have wireless transmitters (VR Sensors) installed in well head to monitor the pressure and temperature.

2. These Wireless transmitters will be supplied by drilling contractor along with the wellheads.

3. Similar wireless transmitters are installed in existing wellheads and an independent wireless network has been developed at each well Cluster for communication of these existing wireless transmitters with the ICSS.

4. New Wireless network , identical to the existing wireless network shall be designed for new wells added as part of this project by EPC CONTRACTOR along with MAC. New Wireless network shall also be integrated with overall existing ICSS in UZ field.

5. The Wireless network shall have two integration levels:

    a) The first level is a network between the field devices (VR-PT). Those devices will report to a hub known as the gateway.
    b) The second level is the integration between the gateway and the host for the information. Host can be a BPCS, and/or server for asset management. The system will be able to transfer the information between the field devices and the host system.

6. All wireless devices, repeater/routers, gateways, and space between them shall reside within ADNOC OFFSHORE premises. Wireless signals shall not propagate outside plant facilities. Wireless devices shall conform and comply with the Safety related Information Transmission Channel frequency regulations. Necessary approval shall be obtained where required by the Wireless Vendor.

7. The design shall not pose any security violation to the control system or any ADNOC OFFSHORE networks. Refer Specification for Wireless Network for Field Instruments (E1150-TS-2000-J-0007) for further details.

22.0 HIGH END SOLUTIONS

Existing High end solutions and network management system hardware and software shall be extended, with the involvement of MAC, to accommodate the new scope of 1MMBD project. The High End solutions comprise at least the following systems:

- Alarm Management System (ALMS)
- Asset Management System (AMS) (including interface with MAXIMO)
- Plant Resource Manager (PRM)
- Operator Training System (OTS)
- Procedural Automation (Exapilot)
- Plant Information Management System (PIMS)
- Plant & Enterprise Historian
- i-Field / DOF (Digital Oil Field) + MDPro
- Network Management System
- Network Security Solution
- Remote plant monitoring

Electrical systems shall have separate dedicated asset management system which shall be interfaced with ICSS asset management system via OPC protocol, refer to the Specification for Asset Management System (E1150-TS-2000-J-0035) and Specification for Integrated Control and Safety System (ICSS) (E1150-TS-2000-J-0034).

23.0 EARTHING AND BONDING

Electrical systems shall be connected to ground for the protection of personnel and equipment from fault currents and to minimize electrical interference in signal transmission circuits.

All Instrument and Control equipment including Junction Boxes, cable armours, cable screens and installation materials shall be earthed. Refer Earthing Typical drawings for details.

The following Earthing Systems shall be used:

1. **Safety Earth / Dirty Earth (SE):**

This is a protective earth used for protection of personnel. Equipment cabinets, cable armour, metal frames etc. shall be connected. Safety Earth cable shall have Green with Yellow stripes outer sheath, Instrument Earth cable shall have Green coloured outer sheath.

2. **Clean Earth / Instrument Earth (INE):**

2.1. Non-Intrinsically safe (NIS) Earth

- This is an insulated protective earth used for voltage references of electronic system. Cable shields / screens of Non-IS devices shall be connected.
- Safety Earth (SE) and Instrument Earth (INE) shall be segregated and never be combined into one earth bossbus . The distance between Safety Earth (SE) and Instrument Earth (INE) shall be 1 Metre, as a minimum.
- Earthing conductors used shall be stranded and insulated, 600/1000 V grade to BS6883.

2.2. Intrinsically Safe (IS) Earth

- In addition, a separate Intrinsic Safety earth (ISE) shall also be provided where I.S devices are used. I.S Instrument Earth (ISE) cable shall have Blue coloured outer sheath.

24.0 SPARES

Each multi-pair/core cable run shall have a spare capacity of at least 30% subject to a minimum of 2 pairs or 4 cores.

Each Junction Box shall be designed to accommodate all cable terminations and have a further minimum 20% additional spare terminals and with 20%spare cable entries, subject to a minimum of 4 terminals/entries.

Main and sub – Instrument Air header take-off spares are as listed:

- Main header: At least two per process area.
- Sub-header pipe sizes shall be as follows:
    - Up to 5 users (4 users + 1 spare): ½”
    - Up to 10 users (8 users pilots + 2 spares): 3/4”
    - Up to 25 users (21 users + 4 spares): 1”

The guideline for spares for maintenance requirements (2 years operation) of various items is as follows:

Gauges: At least one of each type and range for each island. Accessories shall have at least one of each type per Island.

Transmitters: At least two transmitters of each type and ranges used for each Island. Accessories shall have at least one of each type per Island.

Control valves: Spare trims for critical and high erosive service valves. Accessories shall be at least one of each type. At least one Actuator (for spring & diaphragm type only) of each type in use per Island. If required, spare trim shall be provided to meet the turndown of control valve to cover the entire controllable range.

Panels and System Cabinets:

- 20% pre-wired I/O spares for each type of I/O's and 20% uninstalled spare space for expandability (Including all necessary spare gland entries and space in trunking for utilizing the 20% spares and the 20% uninstalled expandability) after commissioning.
- Power Supply Unit to include 40 % wired spares after commissioning.
- CPU, Memory and network utilization: a maximum of 50% loading after commissioning.
- Spares for consumables shall be at least 20% of annual requirements.
- All the multicore / multipair cables shall be terminated at both ends of the cable e.g. Junction box and Marshalling rack; Junction box and sensor. No spare core / wire shall be left loose / hanging at either ends.

25.0 SURFACE PROTECTIVE COATING / PAINTING

Painting shall comply with Specification for External and Internal Coating (Doc. No. E1150-TS-2000-W-0004).

Painting shall be to the manufacturer's standard for items not addressed in Specification for External and Internal Coating (Doc. No. E1150-TS-2000-W-0004) or undefined within this specification and the associated Instrument data sheets.

The VENDOR shall furnish his standard painting procedure as a part of his bid documentation for CONTRACTOR review and approval.

Colour and finish can be to the manufacturer's standard but this shall require prior approval from the CONTRACTOR/COMPANY.

All Stainless steel parts exposed to environment shall also be painted to safeguard against chloride corrosion.

Painting / Coating shall not foul threaded connections or jeopardize the proper operation of moving parts.

All parts shall be painted for highly corrosive, humid salt laden marine environment.

VENDOR to maintain highest standards of painting procedure to maintain high quality painting at each stage of the process to ensure durability of paint in harsh marine environment.

26.0 INSTRUMENTS NAMPELATES

All field instruments and control items shall be provided with SS316L nameplates by the Manufacturer. Also, tag number engraved on the SS316L plate shall be fixed permanently to the instrument support.

Name plate information shall be engraved with the following general details, as applicable, and any other details as specified in the associated specifications and data sheets:

- Tag number.
- Manufacturer's Name.
- Model Number.
- Serial Number.
- Material of Construction.
- Body Size.
- Pressure Rating.
- Temperature Rating.
- Calibration Range.
- Electrical Protection Type.
- Hazardous Area Certification.
- Supply Voltage.
- Etc.

Name plates shall be permanently fixed to the body of the instruments using SS316L screws or rivets. Labels with adhesive are forbidden.

The letter height shall be minimum 2 mm and location of the plate shall permit easy readout in all possible installed positions.

In order to prevent corrosion, name plates in SS316L shall be covered by a transparent protective film.

For Junction Boxes / Enclosures, additional Nameplate shall be provided on the inside portion of the cover.

27.0 REMOTE I/O TECHNOLOGY STUDY

~~It was studied the applicability in Central Island (CI) of field mounted remote I/O's (RIOs) for the control of wells instead of centralized cabinets installed in a LER (Local Equipment Room).~~

~~Existing philosophy was followed for FEED, however in this study the use of NIO addressable remote IO cabinets in LER3 from MAC already took place as part of the FEED SOW, refer to FEED Remote I/O Technology Study Report (E1150-SR-2000-J-0004).~~

~~EPC contractor / ENGINEERING SUBCONTRACTOR shall re-verify the same with MAC/Company operation and maintenance involvement and conclude implementation of the same.~~

A Remote I/O Technology Study (by MAC) has been performed during FEED (refer E1150-SR-2000-J-0004 Remote IO Technology Study Report) about the feasibility of using N-IO technology instead of the existing

FIO technology for the new LER-3 in AGI/Central Island (CI). The FEED study was concluded with two feasible options out of four options assessed.

The MAC shall revisit the study and develop / re-evaluate the outcomes by considering two options concluded in FEED. Cabinet sizing shall be performed by MAC considering New LER #3 & MTR-20 I/Os provided as part of attachment 1 & 2.

The MAC Shall provide an optional quote with NIO system Remote IO design for new LER-3 and MTR-20. High level CAPEX / OPEX savings, other cost-benefits and advantages shall be covered as part of this optional quote. Additional BoM required for the integration of NIO systems with existing ICSS network, if any shall also be included the optional quote.

28.0 TRAINING

The necessary training to maintain and troubleshoot the Instruments and Control systems shall be provided to various categories of instrument and control personnel. Training requirements shall be as per the respective Scope of work / Specification and Material requisition documents.

29.0 DOCUMENTATION

All documentation shall be submitted in accordance with the requirements of the material requisition and purchase order. All documents, drawings, dossiers (including third party certificates), shall be in the English language.

EPC CONTRACTOR / MAC shall collect all required existing documentation (As-built) and verify the same with at actual site details. In case as-built drawings are not available or not matching with the actual existing arrangements, then all engineering design shall be based on actual site survey data / findings.

Any affected existing documentation shall be updated to include project requirements and issued for COMPANY review and approval upto as As-built by EPC CONTRACTOR/ MAC.