طرح نگهداشت و افزایش تولید 27 مخزن

SPECIFICATION FOR CONTROL SYSTEM

نگهداشت و افزایش تولید میدان نفتی بینک

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IDC: Inter-Discipline Check
IFC: Issued For Comment
IFA: Issued For Approval
AFD: Approved For Design
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IFI: Issued For Information
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REVISION RECORD SHEET

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1.0 INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields CLIENT (NISOC)
PROJECT:	Binak Oilfield Development – General Facilities
EPD/EPC CONTRACTOR (GC):	Petro Iran Development CLIENT (PEDCO)
EPC CONTRACTOR:	Joint Venture of : Hirgan Energy – Design & Inspection(D&I) Companies
VENDOR:	The firm or person who will fabricate the equipment or material.
EXECUTOR:	Executor is the party which carries out all or part of construction and/or commissioning for the project.
THIRD PARTY INSPECTOR (TPI):	The firm appointed by EPD/EPC CONTRACTOR (GC) and approved by CLIENT (in writing) for the inspection of goods.
SHALL:	Is used where a provision is mandatory.
SHOULD:	Is used where a provision is advisory only.
WILL:	Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR.
MAY:	Is used where a provision is completely discretionary.

2.0 SCOPE

The purpose of this specification is to define the main requirements for the design, manufacturing, testing and documentation of the plant control system of Binak oilfield (Compressor station/ Extension of manifold and Gas-condensate Pipeline as project work packages). Any deviation from the present specification at any stage of the project shall be subject to CONTRACTOR for approval.

3.0 NORMATIVE REFERENCES

3.1 LOCAL CODES AND STANDARDS

IPS

- IPS-C-IN-100 Construction and Inspection Standard for General Instrument Field Inspection, Calibration and Testing Of Instrument and Instrument System
- IPS-C-IN-190 Installation and Construction Standard for Transmission Systems
- IPS-E-IN-180 Engineering Standard for Instrument Electrical Power Supply and Distribution Systems
- IPS-E-IN-190 Engineering Standard for Transmission Systems
- IPS-G-IN-220 Engineering and Installation Standard for Control Centers
- IPS-G-IN-250 Engineering & Construction Standard for Distributed Control System (DCS)
- IPS-G-IN-260 Engineering and Installation Standard for Indicating Lights, Alarms and Protective Systems
- IPS-G-IN-290 Engineering and Construction Standard for Programmable Logic Controllers (PLC)
- IPS-M-IN-190 Material and Equipment Standard for Transmission Systems
- IPS-M-IN-220 Material Standard for Control Panels and System Cabinets
- IPS-M-IN-250 Materials and Equipment Standard for Distributed Control System (DCS)
- IPS-M-IN-260 Material and Equipment Standard for Alarm and Protective Systems
- IPS-M-IN-290 Material and Equipment Standard for Programmable Logic Controllers (PLC)

3.2 INTERNATIONAL CODES AND STANDARDS

IEC

- IEC 60068/2 Basic Environmental Testing Procedures for Electronic Components and Electronic Equipment
- IEC 60073 Basic & safety principles for Human Machine Interface
- IEC 60079 Electrical apparatus for explosive gas atmospheres
- IEC 60092-375 General Instrument, control and communication cables
- IEC 60332 Tests on electric cables under fire condition

- IEC 60529 Degrees of protection provided by enclosures (IP Code)
- IEC 60605 Equipment Reliability Testing

- IEC 60794 Optical fiber cables
- IEC 60801 Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment
- IEC 61000 Electromagnetic compatibility for Industrial process measurement and control equipment
- IEC 61131 Programmable controllers
- IEC 61508 Functional safety of electrical/electronic/programmable electronic safety related systems.
- IEC 61511 Safety Instrumented systems for the process Industry

EN

- EN 50014 Electrical apparatus for potentially explosive atmospheres - Flameproof enclosure 'd'
- EN 50020 Electrical apparatus for potentially explosive atmospheres Intrinsic safety 'i'.
- EN 50081-2 Electromagnetic compatibility(EMC)
- EN 50082-2 Electromagnetic compatibility. Generic immunity standard

ISA

- ISA S5.1 Instrument symbols and Identifications
- ISA S5.2 Binary logic diagrams for process operations
- ISA S5.3 Graphic symbols for distributed control/shared display Instrumentation, logic and computer system
- ISA S5.4 Instrument loop diagrams
- ISA S5.5 Graphic symbols for process displays
- ISA S 18.1 Annunciator sequences and specifications

ISO

- ISO 9001/2 international standard that specifies requirements for a quality management system (QMS)
- ISO 7498-1 Information technology — Open Systems Interconnection — Basic Reference
- ISO 8348 Information technology — Open Systems Interconnection — Network Service Definition
- ISO 8473 Information technology — Protocol for providing the connectionless-mode network service
- ISO 8802/2 Information technology — Telecommunications and information exchange between systems — Local and

metropolitan area networks — Specific requirements

- ISO 8802/4 — Information processing systems — Local area networks
- ISO 8072 — Information technology — Open systems interconnection — Transport service definition
- ISO 8073 — Information processing systems — Open Systems Interconnection — Connection oriented transport protocol specification

IEEE

- IEEE 488 — Digital Interface for Programmable Instrumentation
- IEEE 472 — Surge Protection Criteria
- IEEE 802.1~6 — Local Area Network
- IEEE C62 — Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

VDE

- VDE 0100 — Instrument symbols and Identifications
- VDE 0165 — Explosive atmospheres

Vendor shall state the additional Codes and Standards if necessary. The latest published issue or amendment shall apply unless otherwise stated.

3.3 THE REFERENCE DOCUMENTS

D03

BK- GENRL-PEDCO-000-IN-SP-0012	Specification For F&G system
BK- GENRL-PEDCO-000-IN-SP-0003	Specification For ESD System
BK- PPL-PEDCO-320-IN-BD-0001	Block Diagram Config. For Control/ESD/F&G Sys.
BK- GCS-PEDCO-120-IN-BD-0001	Control/ESD/F&G Sys. Block Diagram Configuration.
BK- W007S-PEDCO-110-IN-BD-0001	Block Diagram Config. For Control/ESD/F&G Sys. - Extension of Binak B/C Manifold.
BK-GENRL-PEDCO-000-PR-BD-0001	Process Basis of Design
BK- GENRL-PEDCO-000-IN-SP-0001	Specification For Instrumentation
BK- GENRL-PEDCO-000-SA-SP-0002	Spec. For Hazardous Area Classification
BK- GENRL-PEDCO-000-PL-SP-0001	Piping & Pipeline Material Specification
BK-SSGRL-PEDCO-110-IN-DC-0002	Instrument & Control System Design Criteria
BK-PPL-PEDCO-320-IN-DC-0002	Instrument & Control System Design Criteria
BK-GCS-PEDCO-120-IN-DC-0002	Instrument & Control System Design Criteria
BK-SSGRL-PEDCO-110-PR-PI-0001	Symbol & Legend For PFD and P&ID
BK-W018S-PEDCO-110-PR-PI-0001	P&ID - W018S
BK-W028-PEDCO-110-PR-PI-0001	P&ID - W028
BK-W046S-PEDCO-110-PR-PI-0001	P&ID - W0046S
BK-W046S-PEDCO-110-PR-PI-0002	P&ID for Diesel Oil Drum- W0046S
BK-W046S-PEDCO-110-PR-PI-0003	P&ID for Potable Water Tank - W0046S

BK-W035-PEDCO-110-PR-PI-0001	P&ID - W035
BK-W008N-PEDCO-110-PR-PI-0001	P&ID - W008N
BK-W007S-PEDCO-110-PR-PI-0001	P&ID - Extension of Binak B/C Manifold
BK-W007S-PEDCO-110-PR-PI-0002	P&ID - W007S
BK-W007S-PEDCO-110-PR-PI-0003	P&ID for Diesel Oil Drum- W007S
BK-W007S-PEDCO-110-PR-PI-0004	P&ID for Potable Water Tank - W007S
BK-BK14-PEDCO-110-PR-PI-0001	P&ID for Diesel Oil Drum- BK14
BK-BK14-PEDCO-110-PR-PI-0002	P&ID for Potable Water Tank - BK14
BK-BK12-PEDCO-110-PR-PI-0001	P&ID for Diesel Oil Drum- BK12
BK-BK12-PEDCO-110-PR-PI-0002	P&ID for Potable Water Tank - BK12
BK-BK15-PEDCO-110-PR-PI-0001	P&ID for Diesel Oil Drum- BK15
BK-BK15-PEDCO-110-PR-PI-0002	P&ID for Potable Water Tank - BK15
BK-BK05-PEDCO-110-PR-PI-0001	P&ID for Diesel Oil Drum- BK05
BK-BK05-PEDCO-110-PR-PI-0002	P&ID for Potable Water Tank - BK05
BK-PPL-PEDCO-320-PR-PI-0003	Symbol & Legend For PFD and P&ID
BK-PPL-PEDCO-320-PR-PI-0001	P&ID - Gas Pipeline (to Siahmakan G.I. Station)
BK-PPL-PEDCO-320-PR-PI-0002	P&ID - Condensate Pipeline (to Binak PU)
BK-GCS-PEDCO-120-PR-PI-0001	Symbol & Legend For PFD and P&ID
BK-GCS-PEDCO-120-PR-PI-0002	P&ID- Gas Compression Inlet Gas Pipeline (Binak)
BK-GCS-PEDCO-120-PR-PI-0003	P&ID- Gas Compression Inlet Gas Pipeline (Golkhari)
BK-GCS-PEDCO-120-PR-PI-0004	P&ID - Slug Catcher System
BK-GCS-PEDCO-120-PR-PI-0005	P&ID - Gas Compression Inlet Knock Out Drum
BK-GCS-PEDCO-120-PR-PI-0006	P&ID - 1st Stage Gas Compression Suction Drums
BK-GCS-PEDCO-120-PR-PI-0007	P&ID - 1st Stage Gas Compression Compressors
BK-GCS-PEDCO-120-PR-PI-0008	P&ID - 1st Stage Gas Compression Air Coolers
BK-GCS-PEDCO-120-PR-PI-0009	P&ID - 2nd Stage Gas Compression Suction Drums
BK-GCS-PEDCO-120-PR-PI-0010	P&ID - 2nd Stage Gas Compression Compressors
BK-GCS-PEDCO-120-PR-PI-0011	P&ID - 2nd Stage Gas Compression Air Coolers
BK-GCS-PEDCO-120-PR-PI-0012	P&ID - 2nd Stage Gas Compression Discharge Drum
BK-GCS-PEDCO-120-PR-PI-0013	P&ID - Gas Compression Dehydration Package
BK-GCS-PEDCO-120-PR-PI-0014	P&ID - Lean Glycol Storage Tank
BK-GCS-PEDCO-120-PR-PI-0015	P&ID - Instrument & Plant Air System
BK-GCS-PEDCO-120-PR-PI-0016	P&ID - Nitrogen Generation System
BK-GCS-PEDCO-120-PR-PI-0017	P&ID - Close Drain System
BK-GCS-PEDCO-120-PR-PI-0018	P&ID - Corrosion Inhibitor Package
BK-GCS-PEDCO-120-PR-PI-0019	P&ID - Methanol Injection Package
BK-GCS-PEDCO-120-PR-PI-0020	P&ID - LP Flare System
BK-GCS-PEDCO-120-PR-PI-0021	P&ID - Oily Water Sewer
BK-GCS-PEDCO-120-PR-PI-0022	P&ID - Fuel Gas System
BK-GCS-PEDCO-120-PR-PI-0023	P&ID - Diesel Oil System
BK-GCS-PEDCO-120-PR-PI-0024	P&ID - Potable Water System
BK-GCS-PEDCO-120-PR-PI-0025	P&ID - Glycol Sump Drum
BK-GCS-PEDCO-120-PR-PF-0001	Process Flow Diagram (PFD)

3.4 ENVIRONMENTAL DATA

Refer to "Process Basis of Design; Doc. No.BK-GNRAL-PEDCO-000-PR-BD-0001.

3.5 UNITS OF MEASUREMENTS

IS unit of measurements is used in the whole documents unless noted otherwise.

4.0 ABBRAVIATIONS

The following abbreviations are commonly used in this document:

NISOC : National Iranian South Oil CLIENT
AFC : Approved For Construction
AFD : Approved For Design
AC : Alternative Current
AMS : Asset Management System
CCR : Central Control Room
CD : Compact Disc
CD-RW : Compact Disc-Re Writable
CPU : Central Processing Unit
CRC : Cyclic Redundancy Check
D/A : Digital/Analog
DC : Direct Current
DVD : Digital Video Disc
DCS : Distributed Control System
EMC : Electromagnetic Compatibility
EMI : Electromagnetic Interference
ESD : Emergency Shut Down System
EWS : Engineer Work Station
FAT : Factory Acceptance Test
F&G : Fire and Gas
FGS : Fire and Gas System
HART : Highway Accessible Remote Transducer
HIPS : High Integrity Protection Systems
HMI : Human Machine Interface
HVAC : Heating, Ventilation, Air Conditioning
IEC : International Electrotechnical Commission
I/O : Input / Output
IPCS : Integrated Plant Control/Safety System
IS : Intrinsically Safe
ITR : Instrument Technical Room
KV : Sequence On/Off Valve
LCD : Liquid Crystal Display
LED : Light-Emitting Diode monitor
LV : Low Voltage
MCC : Motor Control Center

MMI	:	Man Machine Interface
MOS	:	Maintenance Override Switch
MTTR	:	Mean Time To Repair
MTU	:	Master Terminal Unit
MV	:	Medium Voltage
NIS	:	Non Intrinsically Safe
OCD	:	Operator Control Desk
OCS	:	Operator Control Station
OLE	:	Object Linking & Embedding
OPC	:	OLE for Process Control
OWS	:	Operator Work Station
PB	:	Push Button
PC	:	Personal Computer
PCS	:	Process Control System
PDCS	:	Power Distribution Control System
PDP	:	Power Distribution Panel
PID	:	Proportional–Integral–Derivative Controller
P&ID	:	Piping and Instrument Diagram
PLC	:	Programmable Logic Controller
PMS	:	Power Management System
POS	:	Process Override Switch
RFI	:	Radio Frequency Interference
ROM	:	Read Only Memory
RS-	:	Recommended Standard (422, 232, 485, etc.)
RTU	:	Remote terminal Unit
SAT	:	Site Acceptance Test
SIL	:	Safety Integrated Level
SIT	:	Systems Integration Testing
SOE	:	Sequence of Event
SPDT	:	Single Pole Double throw
TMR	:	Triple Modular Redundant
UCP	:	Unit Control Panel
UHF	:	Ultra High Frequency
UPS	:	Uninterruptible Power Supply
USB	:	Universal Serial Bus (USB)
VDU	:	Visual Display Unit

5.0 ORDER OF PRECEDENCE

In case of any conflict between the contents of this document or any discrepancy between this document and other project documents or reference standards, this issue must be reported to the CLIENT. The final decision in this situation will be made by CLIENT.

6.0 TECHNICAL REQUIREMENTS

6.1 GENERAL

6.1.1 Environmental Condition

For detail of site condition refer to “Process Basis of Design” Doc. No. “BK-GNRAL-PEDCO-000-PR-BD-0001”

6.1.1.1 Normal Conditions

CCR and ITRs will be equipped with HVAC system.

The VENDOR shall state, for all equipment supplied, the heat dissipation to be taken into account for the HVAC design.

6.1.1.2 Tropical service

All instruments shall be suitable to utilize in tropical condition and must completely meet and comply with the environmental conditions of the site. In tropical condition all printed circuit cards shall be protected against corrosion and humidity by means of appropriate varnish coating and gold plated contacts on connectors (even for those located within control and technical rooms).

6.1.1.3 Abnormal Conditions

VENDOR shall state the temperature and relative humidity limits of the equipment supplied in operating conditions and storage.

6.1.2 Ingress Protection

Instrument and Panel enclosure's "degree of protection" shall be in accordance with IEC 60529. For enclosures containing electronic components or coils (solenoid valves) the minimum degree of protection shall be IP 65. Large size outdoor local panels, for which IP 65 may not be applicable, shall be pressurized.

Minimum ingress protection for all indoor panels shall be IP 54.

6.1.3 Interference Protection

The Control System equipment shall guarantee an EMC for an electromagnetic environmental of level 2 as per the IEC61000-4-3 and IEC61000 4-4.

All instruments and microprocessor based system shall meet the following Radio Frequency Immunity (RFI) requirements that shall be tested at the acceptance test stage. Basic reference standard is IEC 60801 (part 3) for design and manufacturing considerations.

6.1.4 Hazardous Protection

Gas group and ignition level (temp class) will be in accordance with area classification according to IEC and CENELEC.

Classification of hazardous area shall be defined in accordance with API 500 & 505, while zone definition shall be based on IEC 60079.

All electrical or electronic instrumentation equipment shall conform to electrical area classifications.

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~~In case EExi apparatus is not available in the manufacturer's standard products, type EExd can be selected as an alternative for Zone 1 and 2 installations.~~

Industrial type non classified instruments could be utilized in non hazardous safe area.

All electrical apparatus in hazardous area shall be certified to CENELEC for the European countries or the recognized authority in the manufacturer country i.e.:

PTB	:	For Germany
BASEEFA	:	For England
LCIE	:	For France
CESI	:	For Italy
CSA	:	For Canada
INIEX	:	For Belgium
F.M.	:	For USA
U.L.	:	For USA
J.I.S.	:	For Japan

6.1.5 Language

All documents and drawings produced by vendor to satisfy the requirements of this specification shall be in English language. Operating, maintenance and commissioning manual shall also be prepared in English language.

6.2 SCOPE OF WORK/SUPPLY

The VENDOR shall be responsible for supply of the following as minimum in accordance with the criteria defined within this specification:

- Engineering of the systems
- Documentation
- Development of the Operator Control Stations, graphics, alarm management, other operator interfaces, Stand-alone system for this scope of work
- All system hardware, including I/O modules, processor units, power supplies, system racks and system cables, work station, Printers as defined by this specification.
- 2 operator work station with dual 32" LED/LCD monitor & keyboard and the operating software which resides the Control Room (CR) of the Control Building.
- One engineering Workstation for Configuration along with 32" LED/LCD monitor & keyboard and the operating software which resides in the Engineering Room of the Control Building.
- One industrial laptop computer with the latest technology shall be considered for maintenance purposes. All required hardware and software with licenses shall be included.
- Printer and control room furniture as per Block Diagram Config. For Control/ESD/F&G Sys.
- Wall mounted Large screen display
- All DC power supplies for the system cabinets, IS isolators (if any) and field I/O
- Power Distribution Panels (PDP) for AC power supplies distribution to all system panels (including ESD, DCS, F&G, other shutdown systems, package UCP, ~~TGS~~), OCDs and other peripheral equipment of the IPCS
- DCS System cabinets to house the required hardware, terminals, power supplies, ferrules, panel wiring
- DCS marshalling cabinets, including IS isolators (if any), terminals, power supplies, ferrules, panel wiring
- All interconnection cables between the marshalling cabinets and system cabinets and all system internal power wiring cables. This excludes all fields cabling between the field devices and the marshalling cabinets and power cabling from site power supply to the Power Distribution Cabinet.
- All cabling between PDP and other equipment supplied under this document, OCDs, panels in IPCS (including ESD/FGS Panels)

- All system interface modem pairs (DCS and Interface system) including fiber optic drivers where required
- All necessary software and firmware complete with licenses. This shall include, FAT, SAT and SIT
- Provision management of the fiber optic backbone and firewall protection for interfaces with 3rd parties
- Backbone for redundant DCS communication network. Interface gateways to ESD and F&G systems within each ITR via dual redundant communication networks
- Interface gateways between the DCS and all 3rd Party package Unit Control Panels communications interface modules
- System configuration
- Design, verification of after sales services, including, but not limited to Commissioning, Training, Spares Special Tools.

The main components of the DCS will be:

- Operator Control Station, Engineering workstation for supervisory, control, configuration, maintenance and troubleshooting purpose, printers etc. completed with mounting consoles/desks, hardwired pushbutton consoles to be installed in Control Room
- Data storage units
- Process control units (PCUs)
- Input/output modules
- External system interface units
- Hard copy devices and printer
- Operating workstation
- Engineering and system configuration workstations
- Marshalling system, PDP cabinets, Fiber-optic, communications interface cabinets
- Maintenance laptop to be used in ITR
- AMS (Asset Management System) server as per vendor design
- Historical Data Storage Server

The system shall be composed of manufacturer's standard hardware, system software and firmware that can be configured to meet the stated requirements. Equipment supplied as part of the system shall be the latest version currently available at the time of placement of order. All hardware, firmware and software supplied with the system, which has to be registered, shall have been field-proven with referenced applications on Plant.

Software design shall ensure that future revisions or updates of the system operating software will not affect the successful operating of the system.

Documents and parameters necessary for DCS design and configuration shall be prepared by CONTACTOR and approved by CLIENT. Therefore the VENDOR shall implement the DCS construction and configuration in accordance with the above.

Note: All equipment related devices and software must have a valid license (Original License) and purchased from the original manufacturer.

6.2.1 Functional Design Specification (FDS)

The DCS systems shall be supplied in accordance with the Functional Design Specification (FDS), which will be developed by the VENDOR after award of Purchase Order. The Functional Design Specification will be based on this specification, and approved by the CONTRACTOR prior to start of procurement of materials.

The Functional Design Specification shall include as a minimum:

- Detailed planning network showing all hardware/software production and test facilities
- Complete Bill of Materials
- Interface details, including connections
- I/O allocation rules
- Configuration/programming details
- Graphic display details
- Performance calculations
- Availability/reliability analysis
- System constraints and limitations
- Electrical Load/Heat Release Calculations
- Physical dimensions of the cabinets and console
- Details of the components within the scope of supply
- Details of the Operator Interfaces

6.2.2 System Integration

The selected DCS shall be part of IPCS.

Moreover, an adequate integration level of information and communication among the various facilities equipped with DCS shall be provided.

A satisfactory functional integration between the DCS and the ESD/F&G system shall be provided. The DCS, ESD/F&G systems will be referred to hereafter as IPCS.

IPCS shall be fully integrated. It means that the IPCS hardware and firmware (DCS/ESD/F&G and Package PLC) should be provided, that they are with adequate features and characteristics to fit with the requirements relevant to the assigned tasks. However they can be by different manufacturers than the DCS manufacturer. Nevertheless the DCS supplier will preferably be the front-end of the Control System.

The following characteristics shall be provided:

- The configuration of IPCS (application software) shall be done through the Plant Operator Control station.
- The IPCS diagnostic messages shall be automatically detected by the DCS and presented to the DCS diagnostic messages. Moreover, IPCS Block diagram shall be shown in HMI dynamically and any failure shall be highlighted. No application software should be provided to configure the automation system diagnostic messages.
- The DCS alarm management system will handle the process alarms coming from the automation systems and the DCS control processors (including time stamping),provided that the same features are associated with, and no difference occurs for both.
- The clock of DCS and automation systems is synchronized with the same source within the system. A synchronization message configured at application program level is not required. Time shall be synchronized throughout DCS.

6.2.3 Sizing

The quantity of hardware and software necessary to safety monitor and control the plant shall be in accordance to the detail design developed by CONTACTOR and approved by CLIENT.

The base IPCS I/O list for the PLANT is indicated in IO list documents.

6.2.4 Spare Capacity

6.2.4.1 Operator consoles and communication system

The operator stations performance and memory capacity shall be adequate to allow an increase of 30% in the size of the configured database, without requiring addition, modification or upgrade whilst complying with the stated performance criteria.

Similarly, the communication system shall be capable of handling the above specified expansion.

6.2.4.2 Controller, I/O Modules and Marshalling Cabinet

The number of controllers, I/O cards of each type shall be defined so that 20% installed spare (*Hot spare*) shall be available *after* FAT completion.

That is to say that additional CPU, cards, power supply, racks, etc. in system cabinets and marshalling shall not require for adding 20% of signals of each type. In addition, the CPU idle time shall be sufficient to allow good operation of the system (including the 30% of spares).

Provided marshalling cabinets shall allow the connection all the installed field cables. Minimum 20% free space in cabinets shall be considered for future addition/modification.

6.2.4.3 Serial link

It shall be possible to add 20% points on each serial link without any hardware addition.

6.2.5 Electronic Signal Types

According to IPS-M-IN-250, the process interface modules shall be capable of interfacing with the following types of input signals from field sensors, transmitters and digital systems.

a) 4-20 mA from transmitters.(Resistance measurements from RTD sensors or any other analog signal types shall be converted to standard 4-20 mA via Smart/Hart Transmitter in field)

b) 0-24 V DC from different electronic sensors

c) Millivolt with cold-junction temperature compensation for thermocouples (if any).

d) Direct digital signal from smart transmitters. (If any)

e) Communications signals with various systems via Mod-Bus link

6.3 Functional Requirements

Control, process interlocks and monitoring of the Plant shall be executed from the PCS/DCS that includes the following main functions:

- Provide DCS VDUs operator interface for remote control, operation and monitoring.
- Provide the display for all process and auxiliary variables with recorded traces (real time and historical trend)
- Alarm, event, change log and status display and reporting Regulatory control and monitoring
- Sequential and control functions
- Data acquisition, recording, reporting, archiving and trending functions
- Automatic diagnostics
- Communication with other systems

The DCS control system shall allow on-line expansion/modification without interruption and/or interference to current plant operation.

Measurements and control outputs from/to the field instrumentation shall be connected to the geographically distributed DCS processors and I/O modules located in ITRs. Redundant data highway cables shall link the CCR DCS network with the system electronics in the ITRs.

6.3.1 User Access Procedures

The access procedure shall include a minimum of four levels of access: view only, operator, supervisor and engineer.

- View Only Level: This level does not need a password for Log On and via this level the user could only monitor the whole plant. User of this level is not authorized to take any action over the plant. This level is only for monitoring.
- Operator Level: This "operation" level shall include the normal CCR operator functions (Auto/Man command, set point change, alarm acknowledgment, ...) for a dedicated process area
- Supervisory Level: This operating mode allows maintenance personnel to perform parameter tunings (PID actions, timer modification, alarms acknowledgement, setting of maintenance inhibits etc.)
- Engineering Level: This level aims at providing system network maintenance functions and developing & testing software configuration. This "supervisor and configuration" level shall also include all operator and maintenance functions.
- Individual passwords shall be considered for operator, supervisory and engineering levels.

6.3.2 Redundancy Requirements

The following requirements shall be applied to those parts of the system supplied in a redundant (hardware and software) configuration:

- Imposed switchovers shall have no effect on system operation
- Redundant equipment shall be continuously monitored for error diagnostics
- Automatic switchover to back up equipment shall take place on detection of failure of the primary equipment. The switchovers shall have no effect on system operation.
- Failure of main and back up equipment shall be alarmed as a system alarm.
- Current operating parameters shall be continuously updated and synchronized on backup equipment.
- Switchback to repaired equipment shall be by manual command.

The following redundancy criteria shall be generally adopted:

- Analogue I/O used for control loop shall be redundant with hot-back-up
- Digital I/O used for interlocks and control sequences shall be redundant with hot-back-up
- Processor shall be redundant with hot-back-up
- Data communication bus shall be redundant with hot-back-up
- Power feeders and power supply units shall be redundant.

- Operator Control Station shall be redundant. Hard disk for work station shall be of RAID type.
- Control, Monitoring network and Gateway shall be redundant.

6.3.3 System Design Availability

The system should be designed for the maximum reliability and highest tolerance to hardware malfunctions, software and operator miss-keying. Any fault shall have its effect localized from that part of the system.

The DCS System and Subsystems shall be designed to minimize the system failure in order to safe start-up, normal & emergency shutdown, safe continuous, accurate and efficient operation with minimum maintenance (required to work on a continuous 24 hours every day, 7 days per week basis). The following figures are related to the control and logic from system Input Cards to system Output Cards:

- Control and monitoring 99.9% with MTTR of 4 hours.

So the system shall be fault tolerant to achieve the availability measures mentioned herein and the system shall utilize the following failure recovery measures to exceed 99.99% availability minimally.

Reliability and availability prediction shall be provided by the Vendor for each system unit and for the overall system.

The Vendor shall specify the source of reliability data used (component manufacturer's databases or other available component databases).

All calculations shall be based on the actual system configuration.

The main task shall be to identify faults that will affect the system function. Any assumption made by the Vendor shall be detailed explicitly in the bid.

This availability shall be evaluated as:

Availability % = [(MTTF) / (MTTF + MTTR)] × 100

Where,

A = Availability

MTTF = Mean Time to Fail

MTTR= Mean Time to Repair

6.3.4 Time Management and Synchronization

According to IPS-M-IN-250, some additional design considerations for controller include the following:

- The controller real-time clock shall be synchronized to a common system clock and have resolution capable of supporting required time tagging of events;
- The controller should be capable of scanning and updating the I/O, executing logic and analog functions, and supporting communication interfaces to achieve required performance (typically, logic functions- ten times per second and analog functions-four times per second);

6.3.5 Man/Machine Interface

6.3.5.1 Interface in CCR (Operator / Engineer / Manager)

“Control System Block Diagram” in each site shall be referred for quantity and variety of stations and consoles. All mentioned stations and consoles shall be supplied by IPCS Vendor unless otherwise specified in Material Requisition document.

6.3.5.2 Maintenance interface in ITR/CCR

A laptop shall be provided in ITR for pre-commissioning, and maintenance operations including monitoring/configuration/troubleshooting etc.

IPCS equipment located in the ITR and field devices shall be equipped with HART functionality and relevant software in DCS to remotely configure the transmitters from Maintenance Station as well as provision of remote HART calibrator from marshalling cabinets.

6.3.5.3 MMI (Man Machine Interface) capacity performances

Vendor shall provide the capacity and performance figures with respect to following items:

- Maximum number of colors available
- Maximum number of process displays (mimics) for each console
- Maximum number of dynamic points (e.g. Tags, Flags, Variables, Dynamic text, etc.) for each process display
- Maximum screens refresh rate with maximum number of dynamic points configured
- Maximum number of tags that can be assigned at each console
- The following are the minimum requirements to be considered:
- Operator Control Station shall be capable to handle at least 10,000 tags

- Tag number shall have a minimum of 16 free-format alphanumerical characters
- The display builds time, time between display call-up and full availability of the same, cannot be more than 5 seconds including graphic that contains at least 50 dynamic points
- The display updating time, time between the modification of signals at I/O cards and serial interface module level and the relevant value or status updating on the current display, shall not be more than 2 seconds.
- The actuation of operator action/command, time between the operator command at keyboard and the relevant actuation at I/O cards and serial interface module level, shall not be more than 1 second.

6.3.6 Hardware Requirements

6.3.6.1 Minimum requirements for Operator/Engineering workstation

Each station in an operator console shall be fully independent of others and shall be stand-alone type, with its own electronic circuits and dedicated peripherals, CPU and memory. An operator station shall be industrial fan less type and minimally contain the following devices:

- Industrial LED monitor , min. 32” , antiglare , low radiation , non-capacitive , min. 16 distinct colors
- 32/64 bits CPU, 8 GB RAM, with 72 hours battery back-up
- Redundant power supply
- Industrial grade keyboard , spill or dust proof membrane, (programmable type) , with mouse & sounders , c/w manufacturer’s standard layout
- Communication interface to dual communication link
- Software , documentation and CDs
- System restore CDs
- System memory capacity shall be redundant (if technically available) 1 TB minimum and shall be raid type. Each operating console must include a hard disk with capacity sufficient for database, graphics displays, etc. Reporting and historical data trending for all the inputs connected to the system up to one month at least at 1 sec interval for controlling loops and 5 sec interval for non-controlling loops.
- CD-RW/DVD-ROM drive
- Video Card
- Connection for external parallel devices (2 min.)
- Connection for external serial devices (2 min.)
- Connection for USB devices (2 min.)
- IEEE 802.3 port (NT-certified Ethernet adapter card)

- Touch screens are not allowed
- Removable media drives
- All work stations shall be industrial fan less type computer

6.3.6.2 VDU Monitor

The VDU monitor in OCDs shall be a high-resolution color TFT LCD capable of displaying mixed alphanumeric/graphic information.

6.3.6.3 Large screen VDU

The large screen display may be provided in the CCR to display critical graphics, alarm pages, trend pages, and PLANT status, generated by the DCS. The large screen display shall be equipped with a signal selector switch panel, which shall be interfaced with the DCS operator displays. This shall enable the user to select any display that is shown on any operator workstation. The large screen display shall not be less than 62 inches, Measured diagonally from corner to corner, across the actual display area. The screen shall be based on plasma or LCD technology.

6.3.6.4 Keyboard

Keyboard access shall be provided for each VDU. Each OCS shall provide full interface capability to the process control and monitoring as well as to the loop configuration and system check.

The operator keyboard shall be sealed membrane type with alarm annunciator LED's, purpose built for DCS. An easy to use cursor device like trackball mouse shall be included. These devices, when used, must not be capable by pointing to a target to initiate directly a control function: a confirmation is needed such as "enter" key.

The keyboard shall enable the user to perform operating, tuning, and configuring functions with dedicated and/or variable function keys.

6.3.6.5 Desk Furniture

As well as the basic desk furniture to be supplied with each OCS, furniture as follows shall be provided to comply with the OCD design requirements:

- Desk wedge units to arrange the furniture in arcs,
- Flat top desk units to provide a flat work surface,

Blank stations are identical in size and appearance to operator station, without control equipment.

The final lay out and console color shall be submitted to CLIENT approval.

6.3.7 Monitoring and Control Functions

The control system shall provide the operator with means for easy control of any process control operating function. The operator shall be able to initiate, stop sequences and programs, adjust controller set points, transfer from one mode to another, start/stop motors, open/close valves etc.

The operator accesses this functionality by means of a keyboard and a pointing device. Security "passwords" shall be provided to prevent unauthorized modification.

Operational displays shall be provided to present terminal data in a user friendly and structured form.

These displays enable the operator to select and view process variables, alarms, trends, status and graphic information. The system should be capable of displaying both real time and historical trends in graphical form for one or more analogue or digital variables at any operator console. The graphic animation rules will be given by Contractor and shall be confirmed by CLIENT.

A structured hierarchy of displays shall be used.

ESD hierarchy diagram shall be shown in HMI dynamically.

ESD Status shall be appeared by dynamic diamond on top of relevant object in HMI graphic pages.

MOS and POS shall be provided within HMI with protected access. Vendor shall prepare HMI graphic pages for activating of maintenance override and process override.

Uniformity for third party HMI pages shall be considered by IPCS vendor, so these pages will be finalized after completion of third party design.

The operator shall be able to select any display directly or with a sequential selection of higher order menu-type displays (not more than two or three strokes or clicks).

Screen target, soft keys and multiple window displays shall be provided and other facilities for quick cursor positioning and option selection.

Facilities shall be provided to enable selected parameter changes to be performed by the operator in a simple logical procedure from the keyboard. The operator shall be provided with visual confirmation of all such parameter changes.

The Vendor scope shall include the minimum following displays:

- Overview displays

- Area and Group Graphic Displays
- Group displays
- Loop detail Display
- Real time trend Displays
- Alarm summary displays
- System status Displays
- ESD/F&G Displays
- ESD Hierarchy Diagram (Dynamically)
- Third Party (Packages) HMI Pages

The configuration database of all OCS's shall be common to enable OCS to monitor any area of the plant. However, in normal operation, each group of OCD shall only be used for control and monitoring of its assigned area, in particular regarding manual control and alarm acknowledgment. Re-assignment of OCS's shall be possible on line via key lock or password. Control access from other consoles should also be selectively inhibited by configuration, password or key lock.

Each OCS shall have identical capability and be interchangeable for all functions, including interactive graphics.

6.3.8 Process Interface Units

The I/O racks with relevant termination units and the marshalling cabinets will constitute the process interface units.

Manufacturer shall fully describe the Central Processing Unit (CPU) and proposed I/O architecture.

Field I/O's shall be grouped and assigned to CPU's using the following guidelines:

- Communication between CPU's across the DCS communication network (peer to peer communication) shall be minimized
- CPU assignment should be designed in accordance with the process area segregation. This means that basically each process area cannot be controlled by different CPU's Field I/O
- Where inputs have 2 independent sensors for redundancy or 3 independent sensors for 2OO3 voting as defined by the P&ID, the inputs shall be connected with adequate methodology in order to achieve maximum reliability. As a minimum, where multiple sensors are used, a failure of one field input shall not disable any other input and repair must be possible on-line, without impacting other inputs.

Hardware layout within the I/O racks is subject to specific CLIENT approval. The CPU's microprocessors shall be based on 32 or more bits.

The control loop processing time, which includes the input scan rate, the loop processing at microprocessor level and the output scan rate, shall not be more than 0.5 seconds (throughput time).

CPU's shall be capable of combining continues and sequential functions. Moreover the CPU's shall be able to do discrete control functions to implement industry standard binary logic functionality.

All control unit configurations shall reside at control unit level in non-volatile RAM memory so that configuration shall not require reloading from a disk in the event of failed card or upon power up. Any failure in the communication system shall initiate alarm not effect control unit functions.

CPU system software programs shall reside in non-volatile *FLASH* memory. Volatile "Random Access Memories" (RAM) can be used for running application program. Read Only Memories are considered as non-volatile memories. System Basic Software shall be held in Read Only Memories (ROM). *Any* volatile memories shall be backed up with a backup battery which lasts for at least 72 hours.

All CPUs shall be equipped with power supply monitoring for the automatic activation of safety subroutines to deal with power cuts or returns.

Each CPU shall be automatically and permanently self-tested and/or controlled by watchdog to ensure that it is not out of service.

Each CPU shall also be equipped with dedicated LED's to indicate malfunctioning and/or confirm proper operation.

No processor shall be loaded at more than *60%* of its processing capacity in the worst case.

The I/O cards shall be capable of being-removed and inserted into the DCS system rack under power, without affecting any other cards in the rack.

The I/O cards shall have fault diagnostics and status indications.

Manufacturer shall clearly state the standards and capabilities provided by the proposed system.

6.3.8.1 Analogue inputs

The analogue input modules shall accept transmitter's Smart type working with HART protocol provided that the communication between them and the DCS shall be in analogue mode based on 4-20 mA at 24 V DC two wires.

The scan rate for analogue inputs that are part of control loops, shall not be more than 0.25 seconds. The scan rate for analogue inputs not involved in control loops shall not be more than 1 second.

All analogue input cards shall have an individual power regulator to provide isolated power for transmitters.

As a standard, all analogue input points shall be individually either optically or galvanic isolated.

The system shall provide out of calibrated range alarms for all inputs. All calibration constants of the input cards shall be handled using software without the need of any potentiometers on the input cards.

Failure on input cards shall be alarmed on each card and to the Operator Control Station. Analogue to digital conversion shall be as minimum of 16 bits (A/D conversion will be preferred point to point).

Each analogue input card cannot have more than 16 inputs.

6.3.8.2 Analogue outputs

Analogue output cards shall have an individual D/A converter for each analogue output. The scan rate (output update) for analogue outputs that are part of control loops, shall not be more than 0.25 seconds.

The analogue output accuracy shall be better than +/- 0.1% of span and the linearity shall be better than +/- 0.025%.

The analogue output cards shall hold the outputs in their last position upon failure; this failure mode shall be user-selectable upon control unit stops or communication break.

All analogue output cards shall have an individual power regulator to provide isolated power for loop outputs.

As standard, all analogue output points, when used, shall be individually either optically or galvanic isolated. The DCS shall perform an integrity check on the entire output loop.

The system shall provide out of calibrated range indication for all analogue outputs. All calibration constants of the output cards shall be handled using software without the need of any potentiometers on the output cards.

Failure of output cards shall be alarmed on each card and to the Operator Control Station. Each analogue output card cannot have more than 8 outputs.

Selectable fail-safe position for each channel is required

6.3.8.3 Digital Inputs

The system shall accommodate both normally open and normally close contacts.

The input contacts, generally, will be free of voltage and ungrounded type, they shall be powered by the digital input modules using 24 V DC.

The scan rate for digital inputs that are part of sequential control loops shall not be more than 0.25 seconds.

The scan rate for digital inputs not involved in sequential control loops shall not be more than 0.5 seconds.

As standard, all digital inputs shall be individually optical isolated. Card circuits shall be isolated channel to channel and channel to ground.

Each input point shall be individually protected against over-current.

Each digital input card shall be individually fused and equipped with fuse and indication.

For interface signals (status) between DCS and MCC, interface isolator relay shall be considered. Interposing relays shall be installed in marshalling cabinets.

Digital input card circuits shall be isolated channels to channel and channel to ground. Each digital input card cannot have more than 32 inputs.

6.3.8.4 Digital Outputs

Output cards shall normally be solid state able to drive field on/off valves and relays. Where necessary due to load requirements, relay outputs shall be used.

Solid state outputs shall be 24 V DC and be capable providing at least 300 mA to the external coil.

For all digital outputs in DCS, interface isolator relay shall be considered. relays shall be installed in marshalling cabinet.

The digital output cards shall drive the outputs to OFF state (fail safe position); this failure mode shall be user-selectable upon control unit stops or communication break.

The scan rate (output update) for digital outputs that are part of sequential control loops, shall not be more than 0.25 seconds.

The scan rate (output update) for digital outputs not involved in sequential control loops, shall not be more than 0.5 seconds.

Each output shall be individually protected against over current.

Each digital output channel on card shall be individually fused and equipped with fuse and indication. Digital output card circuits shall be isolated channels to channel and channel to ground.

Each digital output card cannot have more than 32 outputs.

Digital output circuits shall be provided with protection for the switching of inductive loads.

In case of relays included in the DCS supply, the same shall comply with the following requirement (as minimum):

- Maintained latching contact
- Normally open/normally closed outputs (selectable fail-safe position for each channel is required)
- Relays shall be suitable for inductive field devices with 24V DC coil, as per solenoid valves
- Relay contacts shall be SPDT available free of voltage, 2 Ampere at 24V DC.

6.3.9 Communication System

6.3.9.1 Internal communication

The DCS communication network shall provide high-speed, reliable, secure and error-free communications between all devices resident on the control system network and be in a redundant configuration with automatic switchover.

The network type, protocol and performances shall be defined by Control System Vendor to meet the functional requirements and shall be approved by CLIENT.

DCS communication subsystem shall be designed for loading not more than 60% of the engineered system under worst case conditions. The Vendor shall provide the calculated load communication network and justify its design.

The communication subsystem protocol shall include codes such as CRC (Cyclic Redundancy Check), parity error, overrun error etc. in order to detect errors and take protective action to assure a high degree of transmission reliability. Diagnostic shall be continues and failure alarms shall take priority.

No single node point failure shall disable the communication network. Extensive error checking shall be provided to ensure that accepted messages contain the same information that was sent, and that neither noise nor hardware failure has caused erroneous data to be incorporated in the message received. Self-diagnostic shall provide system status to the operator and alarm any fault and take appropriate protective action.

The control system Operator Control Station will be used as operator's window towards the ESD/F&G system providing but not limited to, the following functions, which shall be implemented by both the DCS and the ESD/F&G system as far as their respective required activities are concerned:

- Alarms and logging for shutdown invocation and reset action
- OCS (PC) custom graphics
- Safety commands from control centers
- Measurements
- ESD/F&G system status reporting

The ESD/F&G signals shall be exchanged mainly using the communication redundant network with DCS system. In addition signals that can affect either the main functionality of the ESD/F&G system or the integrity of the information exchanged shall be interfaced by means of hardwired connections.

The co-ordination activities among the communications between DCS and the ESD/F&G systems shall be in the Manufacture scope of work.

6.3.9.2 External communication to sub-systems

The DCS shall have capability for redundant interface and data conversion for an efficient interchange of information between the system's communication network and other PLC based systems (e.g. electrical power diesel/generator control system).

Communication scan rate (overall time for read and write) shall be 2 seconds maximum. By means the above interfaces, the DCS consoles shall include the information from other Supplier's process subsystems.

Where serial ports are required to connect the subsystem with the communication network the DCS shall able to drive RS-232 or RS-422 or RS-485 serial ports.

The communication protocol shall be selected in order of preference in accordance with the following subject to EPC Contractor approval:

- MODBUS TCP/IP
- MODBUS RTU
- OPC

In addition, since redundant serial ports are required, each of these ports shall have redundant cables and connectors. So that if there is a serial communication failure, a switch over to the back-up serial line will occur.

Supply of Interconnection cables between DCS and other third parties are in IPCS scope of work.

6.3.10 Power Requirements

AC/ DC power provided for the system shall be from dual redundant UPS 110 VAC 50 Hz feeder.

The control system power supply units shall be dual redundant and shall be sized to include the 25% equipped spares. In other words, each power supply unit shall be sized so that it will carry no more than the 75% of capacity under maximum load condition. In case of failure in each power supply there should not be any degradation in system power. The capacity power supply sets shall not also be less than 130% of maximum consumption of panels.

Daisy chain power distribution shall be avoided.

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AC power for lighting fixtures, fan and maintenance sockets shall be provided from 230 VAC Non UPS sources.

All other voltages (such as 24 Volt DC, etc.) required by the control system shall be derived from within the cabinet by the use of suitable internal power supplies and distribution.

6.3.11 Cabinets and Cabling

6.3.11.1 Marshalling Cabinets

Field cables should be terminated in cabinets.

In addition to DCS cabinets, the Vendor may have to supply equipped marshalling cabinets to receive all field cabling and wiring from the DCS, EEx"i" galvanic isolation barriers and/or interposing relays where necessary and to supply interconnecting cables between the I/O cabinets and marshalling.

The marshalling cabinets shall be preferably dedicated to particular units except for small units.

The marshalling cabinets shall be sized and set out to accommodate the "cross wiring" technique, in which:

- Field wiring terminates on terminal strips located on one side of each cabinet. The terminals will include protections and features to easily isolate the signal from the plant without disconnecting wire. Terminal boards drawings shall be given by the Contractor.
- System wiring from the DCS terminates on separate terminal strips located opposite the Field Wiring terminal strips. (Alternatively, if the Vendors I/O termination assemblies are small and can perform connection via plug terminated system cables to the controllers, then these I/O termination assemblies may be mounted in the marshalling cabinets themselves.)
- Bulk 24 V DC power feeders are wired to separate terminal strips, and are used as required.
- Cross wiring is installed as required to connect field devices to galvanic isolation barrier and 24V DC power supply.

6.3.11.2 Cabinet Mechanical Requirements

The cabinets shall have the following characteristics:

- Standard size of cabinet or frames (e.g. DxWxH: 800x800x2000), + 100 mm plinth,
- Key lock system with the same key for all cabinets,
- Internal door pocket for drawings,
- IP 54 of IEC 60529, as the minimum

- Standard type with eyelets, painted according to IPS and CLIENT Approval,
- Modular structure accessible from one or both sides,
- General earth for metallic parts,
- Separated and isolated earth for electronic circuits,
- Fans with filters as required, along with failure detection or natural draught,
- Cable entry from bottom, with supporting bar and sealing plate,
- All cables and wires shall be installed in cable duct or on cable tray
- All cables and wires shall be installed using explosion proof glands.
- Outside standard color *RAL 7035*.

6.3.11.3 Cabinet Equipment

The cabinet design should allow full and easy access to all components, connections, terminations and assemblies by installation, maintenance and repair personnel. All cabinets supplied by Vendor shall be fully equipped/wired (frames and racks, terminal strips and rail, wire markers and ferrules, etc.) and shall be ready to be installed on site.

The high temperature inside of cabinets shall be detected and one common alarm for all cabinets shall be wired to the DCS system and shown on DCS graphic display.

6.3.11.4 Termination Panels

The termination panels shall meet the following requirements:

- All terminals shall be screw terminals,
- Analogue termination panels shall have provisions for internal power access from the termination panel and external power access. Wiring options should be configurable via jumpers which can be changed back to other positions without requiring soldering or replacement components and without disturbing the other loops,
- Termination panels shall have provision for redundant power supplies to drive field transmitters and optional binary relays; separate circuits for redundant I/O power supplies shall be available on each termination panel,
- Power wiring to termination panels shall be through parallel wiring to each termination unit (2 feeders by cabinets 110 VAC UPS). Daisy chaining of power wiring is acceptable,
- Input shall be fuse protected.
- A circuit breaker for each power supply is required.
- Partitions shall be included between terminals for different voltage and when required by regulations (EExi separation),
- All field protections shall be located in the marshalling cabinets,
- All terminals for field cables shall be "knife switch" type terminals.

6.3.11.4.1 Cabling

The cabling includes the wiring of all links internal to the equipment provided by the Vendor. The cabinets shall be entirely wired from the field terminals to the Control system hardware.

Segregation of cables shall be in accordance with voltage and level of redundancy.

Sufficient room shall be left inside the cabinets for good access to the spare terminals.

All cables shall be adequately supported and secured to prevent dislocations at the connectors.

6.3.12 Grounding, Lightning Protection and Noise Immunity

Vendor shall fully describe the preferred method for grounding power, signals and signals shields in the system proposal. In particular, the Vendor shall indicate the effect of equipment installation in different locations on the grounding design.

The conductive part of instrumentation equipment installed in the ER and CR building shall be connected to a specific earth loop which is connected to the main earth loop through existing earth dispatchers.

Moreover, the screens of instrument cables shall be connected to the instrument earth. This is the electrical reference point for all instrumentation electronic signals. These screens shall be grounded at only one end (control room side).

In order to avoid electronic noise and interference, the instrument earth shall be provided as two separate and independent earthing systems for I.S. & N.I.S. signals and remain totally isolated from the electrical protective earth. The impedance of the instrument earth shall be less than 0.5 ohm.

Three separate and independent reference earths shall be provided for electrical earth, instrument IS earth and instrument NIS earth.

Vendor shall describe his philosophy for powering transmitters and insuring good noise immunity. Specifically, the Vendor shall point out the general philosophy on isolated signal reference and galvanic insulation.

The Vendor shall state the performance in terms of common Mode Voltage rejection, normal Mode Voltage rejection, and maximal over voltage protection, maximum common mode voltage, and maximum permanent voltage.

Vendor shall describe how the system will be protected against lightning.

Vendor shall clearly detail all of the requirements which need to be followed by others to insure maximum efficiency for the lightning protection.

Noise immunity equipment shall be immune to spurious action or damage due to RFI in accordance with IEC 60801. Hand held personal radio equipment of 5W nominal output may be in operation near the equipment with the cabinet doors in the open position.

Standard limitation for acoustic noise of the devices shall be considered by vendor during design.

6.3.13 System Software

The Manufacturer shall provide the configuration software, referred to hereinafter as application program, suitable to monitor and control the Plant at the maximum extent possible of efficiency and safety.

Comprehensive system diagnostic shall be provided to detect problems and let the operator know where the problem is located. A diagnostic message shall be shown to the DCS operator in case of system malfunction and shall be able to identify:

- The device's location (address) in the control system
- The type of device
- The diagnostic code
- The diagnostic description

On-line diagnostic software and off-line diagnostic software shall be included as minimum. The diagnostic software shall be resident in the system ready to be activated on request.

The basic software of the operating system shall be oriented toward real time applications for the process control and supervision, support multitasking and multiprocessors functions, manage the communication network through interface task and guarantee the support for the management of the peripheral units.

6.3.13.1 Control function blocks

Control blocks shall be able to perform automatic mode switching based on external or internal inputs. Mode switching shall include:

- Auto/manual switching
- Local/remote set-point switching

All control structures that require loop switching; including cascade loops shall support bump less transfer and shall be configured in the same CPU.

Standard software algorithms shall be available to perform regulatory control functions. The standard functions shall include as a minimum the following:

- Inputs: linear, square root extraction, type E-J and K thermocouple characterization, RTD characterization, time-based filtering, digital input tantalization, pulse input to frequency conversion, flow measurement compensation algorithms.
- Computational: addition/subtraction, logic functions AND OR NOT, ramp generator, integrate, differentiate, dead time, high/low select, multiply or divide, time average, signal selection switch.
- Control: controls PID/PI/PD and proportional only, external feedback, auto manual with bias control, ramp, on/off control, discrepancy alarm, interlocking.
- Outputs: linear, non-linear, linear with high low limits

Input filtering and signal conditioning shall be performed before alarming checks and any control calculation.

The valve split-range, where specified, shall be accomplished in the DCS, providing two 4-20 mA standard outputs with possibility of reverse action.

Wherever required a totalizer, the flow rate shall be compensated.

All flow measurements that are included in mass balance reports shall be compensated.

6.3.13.2 Data Base Configuration

This section addresses the capabilities required for system software configuration.

The program shall provide the data base structures to be used to implement the required control and data acquisition functions.

The main functions required through the program will be:

- implementing a database
- modifying the database
- updating the database
- generating reports about a database

6.3.13.3 Archived information

The system shall be able to perform the following functions for at least ***one year period***:

- Historical trends

- Reporting function
- Recording function

The Vendor shall indicate how the system does it and the limitation regarding numbers and scan rates.

6.3.14 Alarm and Event Management

The system shall sequence the alarm according to ISA standard code S 18.1 "Annunciation sequences and specifications".

Standards shall be available in the standard library of Operating Control Station (OCS). All ESD/F&G alarms and valves status shall be time stamped and logged by the DCS system.

Process alarms shall be managed by the DCS and grouped based on user selectable priority levels. The first priority shall be assigned to the emergency alarms coming from ESD/F&G system.

The system shall have the capability and shall be configured in order to suppress nuisance alarms created by:

- Start-up or shut down conditions scheduled for a process unit or single equipment or machine
- Equipment not in service or not running and ready for back-up
- Sensor under maintenance. Alarms at the Operator Station

Alarm and event shall be automatically detected and recorded by the system and processed to notify the operator through VDU display, audible alarm and logging printer. These alarms and events shall at least include the following information:

- Operator actions affecting the process (e.g. start/stop of motors, set-point changes).
- Engineering actions changing the control performance of the process.
- Sequence of event records.
- System Events and failures.

Different priority levels shall be provided for each alarm point. Selection of alarm priority level shall be performed as part of the system database configuration.

All alarms generated by other systems (ESD/F&G, packages) which are transferred to DCS without their time stamps are stamped by the DCS system.

An alarm summary display shall be provided to show the operator a listing of alarms status. Alarm shall be stamped, with 1 second discrimination time maximum and shall appear in chronological order. Alarm priority level shall be indicated by a coloured text corresponding

to a priority level. Alarm summary shall indicate the tag number and the description of each abnormal condition in addition to "acknowledge/ or not" status field.

6.3.14.1 Alarm types

Alarms presented to the operator via the DCS shall be divided into classes such as process alarms, ESD/F&G alarms, telecommunication alarms and system status alarms.

Process alarms are generated by deviations from normal operating conditions or by undesired events.

Alarms may also be generated by external devices such as subsystem, PLC etc. Each alarm is attached to one alarm priority and to one process unit.

6.3.14.2 Masking the alarms

Three level of alarm priority (minimum) shall be distinguished by colour coding and sound toning.

Adequate facilities shall be provided to mask unnecessary alarms coming from idle or stand by equipment. Alarm masking capabilities shall be incorporated in the DCS and shall be standard feature.

Alarm masking shall be active if the equipment is not in use (signal from DCS) and if the alarm masking is enabled (signal from the operator). An interlock shall provide to preclude equipment restart if alarm masking is not removed.

6.3.14.3 Alarm identification and acknowledgement

The DCS shall allow quick identification of the priority level of an alarm and a way to easily call up the graphic, the group or the alarm summary display to acknowledge that alarm. Sequence of key touches should be such that the operator is able to identify clearly the loop in alarm. The possibility to inhibit alarm on each Operator Control Station shall be protected by access control.

Alarms shall be presented at the OCSs. Alarm acknowledgement on OCS shall be done through a unique keystroke in one OCD, which shall be assigned to alarm and acknowledgement to other OCS's assigned to the relevant process area.

6.3.14.4 Alarm messages

The alarm message shall be unique to each loop and shall indicate the type of alarm (low, high, deviation, failure etc.) and the priority.

6.3.14.5 Alarm stamping

Time and date stamping shall be implemented at the level of DCS and subsystems PLC (ESD, F&G and UCP, etc.) only the alarm status shall be transmitted to PCS via data link communication. When discrimination time on PCS is not sufficient to allow correct sequencing of transmitted events and alarms, fire alarm shall be detected at the level of subsystems and transmitted with " first out " status to PCS for display and print out.

6.3.14.6 Alarm logging

The DCS will be supplied with a free format report generator able to compose a report using any tagged data in the system. This generator must provide elementary calculations as well as access to historical data with some statistical functions.

Data collection facility should be as a minimum contain the following for each event:

- Tag/ID Number.
- Tag Description.
- Time and Date of Event.
- Event Value/State.
- Type of Event.

7.0 PANEL CONSTRUCTION

The cabinets will be freestanding rigid, self-supporting and floor lying. Generally they shall be constructed and assembled of modules with the following dimensions:

- For front/rear accessibility: W x D x H = 800 x 800 x 2100 mm
- For only front accessibility: W x D x H = 800 x 600 x 2100 mm

(Including the base frame of 100 mm)

The supporting structure and the front plate will be carefully reinforced in order to support instruments and devices mounted thereon, and in order to prevent buckling or distortion during shipment, handling or erection.

The cabinets will be provided with:

- key lock and handle (all doors will be provided with the same lock and key combination)
- fan for air circulation with filter (when heat dissipation is required);
- rubber gaskets;
- pocket for drawings.

The cabinets will be accomplished with:

- mounting frame for floor anchor;
- eyebolts for lifting and transport.
- Gland plate with suitable hole size for cable entry at the bottom side of panel as per IPS

Cable inlet will be from the bottom of the cabinet; the bottom of cabinets shall be closed by means of sliding bottom plates. A fastening rail for incoming cables shall be provided in the bottom frame.

Generally in the front side will be installed all electronic equipment, in the rear side will be installed all terminal strips for in/outgoing cables and cable tray channels.

Following detailed requirements shall be satisfied:

Panel structure shall be entirely self-supporting by the use of 50 mm structural angle iron frame. Framing and brackets shall be as necessary to achieve a rugged design and to insure a smooth, flat surface with a maximum deflection of 4 mm over total surface of panel after installation of all instruments and accessory equipment. Design and fabricate panel lengths from a smooth, continuous panel surface. Provide holes at panel joints complete with bolts, nuts, and washers for panel assembly, shop-assemble the entire unit and check for accurate alignment and surface matching.

- Provide removable end side plates.
- Bottom and rear of the panel shall be easily accessible.

For handling purposes, each shipping section shall be provided with removable lifting lugs designed for lifting without deforming the panel.

All burrs produced around cutouts or bolt hole drillings must be ground smooth.

The equipment installed inside the cabinet (e.g. racks, power supply, etc.) shall be completely wired to the terminal strips including the “spare”.

The “spare” provided will be 20% of spare terminals, of circuit breakers (No 1 minimum spare for each kind), of power supply capacity. Also, 40% spare shall be considered for wire-ways space (duct).

Other 20% of empty space in the cabinet will be provided as well.

7.1 LABELLING AND NAMEPLATES

Panels shall be clearly labeled with plant instrument numbers and duties at the front and rear.

Labels shall be transparent plastic material and engraved on reverse side. The engraving to be filled in either black or white depending on which is most legible. Provision shall be made in the panel mounted instruments, for insertion and removal of meter constant cards and control valve action.

The material for name-plates should normally be a laminated bicolor plastic, which when engraved;

the top layer is cut through allowing the letter to show in the second color.

Continuous panels for control of a number of process units, as in the case of integrated plant, shall have the panel sections clearly defined by arrow-headed lines and labeled with the plant designation at the top of the panel.

7.2 IDENTIFICATION

Each cabinet shall have a nameplate of corrosion resistant material fixed on to the front of the cabinet, with screws, and giving the following information:

- Name of purchaser,
- Serial number of the unit,
- Rating in watt,
- Voltage and frequency,
- Purchase order number,
- Year of manufacture.

Live parts of equipment and terminations carrying voltages above 50 volt shall be covered with a transparent insulation plate, bearing the warning text: DANGER.

All equipment, relays, sockets, wiring, terminals, etc. shall be clearly identified by nameplate in accordance with the relevant drawings included in the data sheet.

All equipment, relays, sockets, wiring, terminals, etc. shall be clearly identified by nameplate in accordance with the relevant drawings included in the data sheet.

These nameplates shall be properly fixed using a 2 component epoxy resin cement near to the equipment on non-removable parts of the cabinet.

8.0 TEST AND INSPECTIONS

8.1 FACTORY ACCEPTANCE TEST

Note: All tests, operations, and procedures itemized here are as a minimum and shall be finalized as per vendor final document approved by company.

The acceptance test in the Vendor's factory shall be made with the overall equipment in normal operation, except for any Marshalling cabinets which may be delivered on site prior to the acceptance test.

The Vendor shall submit the test procedure, which takes into account the requirements of this specification.

The inspection shall include the following stages:

a) Equipment inventory:

This stage will be used to check:

- That all equipment specified in the Contractor's documents (specification, requisition, etc.) is presented for inspection,
- The Vendor identification of cards, equipment, etc.,
- The good presentation of equipment (cards, racks, cabinets, wiring, cables, etc.),
- That the overall documentation has been submitted and matches the hardware delivered.

b) Test of the system

This stage shall be used for:

- The demonstration of all system functions (e.g. changing tuning constants, check of algorithm functions, etc.),
- The check of loop configurations for the validity of ranges, units, etc.,
- The 100% testing of complex loops (two or more variables linked together),
- The design and wiring for each typical kind of loops by simulating the electronic signal,
- The check of sequences and interlocks,
- The check of the accuracy and the operation of all I/O cards,
- The Configuration and the display of all inputs/outputs and internal variables (by override),
- The 100% check of displays pages available on operator stations,
- The test on the alarm system,
- The test on the correct functionality of the operator keyboard,
- The Test on the proper working of the printers,
- The test on the proper working of the trend recorders,
- The check of non-standard software (tested 100 %),
- The check of PLC and computer interfaces (tested 100 %),
- The check of standard software packages (100 %, functional check).
- The simulation of reloads,
- The simulation of Power failures and restarts,
- The check on the immunity to radio interference,
- The check of the failure diagnostic, automatic backup and recovery for all redundant devices,
- The demonstration of all system functions including service functions of supplied diagnostic equipment,
- The burn-in test certifications.

c) Integration and tests of connection to other systems

These tests shall be performed to validate the links with other systems, which will be incorporated into the final system network. They test shall include the good transfer of data with the selected transmission protocol, the configuration rules given by DCS Vendor (in DCS and in other equipment), the transfer and response time and the full transparency to the operator for the data exchanged by such links.

The functional tests between the DCS and the ESD will be fully tested during the FAT DCS.

The Vendor shall provide all of the necessary simulation tools for these tests, including sufficient quantities of marshalling cabinets to perform the tests and the validation.

Errors detected during these tests in the system programming and configuration shall be preferably corrected before the end of the factory acceptance tests. The Vendor shall correct the errors in the concerned drawings and documentation within a short period after FAT.

8.1.1. SITE ACCEPTANCE TESTS

Note: All tests, operations, and procedures itemized here are as a minimum and shall be finalized as per vendor final document approved by company.

The Site Acceptance tests (SAT) shall be the duplicate of the FAT but shall include the test on all of the interfaces between systems. The vendor shall submit the test procedure for SAT.

For a period of thirty days, the system behaviour and performances shall be monitored. The network load shall also be checked in the course of the SAT.

The SAT shall be divided into four main activities, as described below:

a) Individual System Functional Test

For each system, this test shall repeat all the FAT tests related to the system behaviour:

- System power-up
- Power failure
- Redundancy
- Hardware diagnostics
- Test of all other system basic functions…

This test shall demonstrate that the system has been received in good condition that it is installed correctly and can successfully be used for further site activities.

b) Logic Function Check

The logic function check shall start only after the completion of the "Individual System Functional" test.

For each system, all internal logic functions shall be tested by simulation from the marshalling cabinets (test shall be done to check the Cause and effect charts and logic diagrams). This test aims to certify that the logic functions operate according to the relevant documents in order to allow the loop test to proceed loop by loop.

c) Test of System Integration

Test of system integration shall start only after the "Individual system functional" test.

When all systems are interconnected, the test of system integration is performed to certify that links between different systems operate according to specification and that any redundant link switches-over if the link in service fails.

This test shall also demonstrate that the time synchronization function between the DCS and the other systems works according to specification.

d) Loop Test

Loop test shall start only after a successful "Test of system integration" and after the completion of the "Logic function check".

For each loop (hardware or software), the loop test shall be done with all systems connected and operating. The loop test shall allow the test from the end device to the DCS display with the presence of other portions of the system that are involved in the processing of the signal.

For Analogue signals, checking shall be performed for five points (0%, 25%, 50%, 75%, 100%) and for any alarm point. When a logic function is tied to a loop, the test shall insure that logic initiation is correct and that any inhibit function is operating correctly.

9.0 SPARE PARTS AND SPECIAL TOOLS

The VENDOR shall provide lists of recommended spare parts, which shall include the original part numbers with prices for commissioning, start-up and two years operation. All spare parts shall be identified individually.

Spare parts for commissioning and start-up; a qualified and complete list based on PROJECT SPARE PART SUPPLY PROCEDURE (Doc. No. E&D-QC-SP-1).

Spare parts for two years operation; a qualified and complete list based on PROJECT SPARE PART SUPPLY PROCEDURE (Doc. No. E&D-QC-SP-1).

The VENDOR shall be able to provide spares back up and support for the plant life of at least 20 years.

SPIR form shall be approved by CLIENT prior to procurement.

9.1 SPECIAL TOOLS

Special Tools (as option / if any; to be recommended by Vendor)

10.0 TRAINING

The Manufacturer shall prepare, develop and carry out a specialist training program to impart all necessary skills and knowledge to the operational and maintenance personnel such as to enable them to competently and safely operate and maintain facilities. Such training program shall be submitted to the CLIENT for review and approval at least 180 days prior the commencement of the training.

The training courses will be provided:

- Prior the plant pre-commissioning (At Manufacturer Training Center, using project system, or similar equipment, configured with a basic simulation of the plant controls and safety systems.)
- On the job training during the plant pre-commissioning

- The number of the attendees for each training courses shall be considered as per contract.

The training course will be organized for:

- Operators
- System engineers (including software design and system configuration)
- Maintenance engineers (including system configuration)

The Vendor shall provide detailed information on vendor factory and onsite training for plant personnel. The training program shall be based on the DCS manufacturer approved training courses and cover operation, maintenance and configuration topics.

An outline of the training course shall be submitted with the bid.

The training program shall cover all areas of delivered hardware and software.

The training shall be performed in English (documents and courses).

The proposed training shall match the revision level of the software and hardware delivered.

The vendor shall state the terms and conditions of training, as stated below:

- The duration of each course
- The minimum and maximum number of students per course
- The locations where the courses will be offered
- Any equipment requirement
- The transportation, loading and out-of-pocket costs which will be incurred by the purchaser.

The vendor shall provide suitable training location and all required educational facilities such as comprehensive documentation, course materials, technical notes, manuals, video cassettes, literature and other materials (as required) for the effective implementation of the training curriculum.

All such training materials shall become the property of the CLIENT. The vendor shall be required to update the course material documentation, technical notes and manuals in the event of changes due to revisions or modifications to the system as delivered.

The CLIENT shall approve the training location and proposal and reserves the right to apply changes in the program. The training shall include the following items:

- A detailed, comprehensive overview.
- Descriptions of the configuration programs and the configuration files, including the theory of operation.
- Descriptions of program and associated subsystem programs, to include theory of operation.

11.0 DOCUMENTATION

Final documentation list shall be issued by DCS SUPPLIER in coordination with ESD/FGS SUPPLIER for CONTARCTOR/CLIENT review and approval.

SUPPLIER shall include all software media containing the standard application software, configurations and any additional project specific software supplied under the project. Databases and other data structures created for the project shall also be delivered to the CONTRACTOR/CLIENT in machine-readable formats.

All documentation should be written in English language.

All vendor documents shall be handed over in native format (whenever required by CLIENT)

All licenses for the software and certification supplied shall be included in the deliverables.

With his bid the DCS SUPPLIER shall provide a detailed schedule for engineering, production, assembly, testing and shipping of the DCS systems. This shall identify all major milestones, including production of documentation, dates for receipt of critical data from CONTRACTOR, order

of long lead items, production of test procedures, integration requirements, FAT and integrated test dates. An indication of proposed manning levels shall also be provided in accordance with the proposed schedule by DCS SUPPLIER.

Comments made by CONTRACTOR on drawing submittal shall not relieve VENDOR or SUB-VENDORS of any responsibility in meeting the requirements of the specifications. Such comments shall not be construed as permission to deviate from requirements of the Purchase Order unless specific and mutual agreement is reached and confirmed in writing.

Revisions to drawing shall be identified with symbols adjacent to the alterations, a brief description in tabulate form of each revision shall be given, and if applicable, the authority and date of the revision shall be listed.

VENDOR shall prepare the relative study and detail engineering in accordance with current international standards.

The VENDOR shall provide the following documents as minimum (Document list need to be approved by EPC contractor/Main CLIENT):

- A listing of I/O configuration identifying each module, location and tag
- All index of the system's database including tag numbers, descriptions and initial values
- A complete narrative describing the operation as sequence of the logic and control system
- A fault finding / troubleshooting narrative for the complete system, recommended format is an "if-then:" condition diagram
- Installation, operation and maintenance/trouble shooting manuals

Engineering documents containing but not limited to:

- Architectural schematic of the system, with all subsystems, peripherals and addresses.
- Block diagram of the system with all cabinets and peripherals along with the interconnecting cables.
- Overall dimensional drawing of "each equipment" (cabinets, video monitor, printer, etc.) along with the requirements for equipment erection and installation.
- Layout and Front end of operator consoles.
- Layout of the different racks with indication or electronic cards location and schedule items.
- Cable list for all cables supplied by the Vendor for wiring the different cabinets and DCS equipment, with tag, length, type reference and routing of each cable.
- Internal cable drawings, which indicate blocks or connector wiring arrangement.
- Single line diagram of electrical supply for all devices of the system with indication for starts up and normal intensity.
- Grounding scheme of the different parts of the system to the central grounding point and indication of resistance grounding leg.
- Troubleshooting/loop diagrams.

- The vendor shall provide the cabling data. The cabling data include: Assembly and interconnecting wiring diagrams cabinets number, card number, channel (number, rack number, terminals number, multiplexer number, connector, cable, IS barrier, etc.)
- Functional specifications of every function detailing how they are performed through the system's resources. Approval of these documents is the basis of the work, and has to be done in the early stage of the job.
- All documentation, which permits the user to understand the software algorithms, to build his proper software control loops, to write and read parameters and to modify displays organization. Sufficient examples should be included in the documentation.
- Reference manuals for all software packages.
- Listing, or print out of the configuration for:

  - System data base,
  - Computer, Network and PLC gateways,
  - Parameters loaded in the different input/output cards,
  - All displays & reports available in the stations and printers, All test software used to test the communication with other equipment and/or for inspection,
  - Any Specific software.

- User and maintenance manuals for all equipment including configuration tools.
- Reports and certificates:

  - Copies of the Manufacturer test reports or certificates shall be available during the acceptance tests, including original manufacturer certificate.
  - Inspection and acceptance test reports shall be supplied.

- Certificates for intrinsic barriers and loop calculations relative to intrinsic safety loops. Certification shall be by the official national testing authority.
- Any drawing (not listed above), which may be needed for correct installation, start-up and maintenance of the System.
- All documents shall be supply in proper paper size (A4/A3), all drawing shall be supply on AutoCAD (DWG) format. All text files shall be supply on Microsoft Word (DOC) format, all table shall be supply on Microsoft Excel format. The vendor shall be supply both print copy and electronic copy of any document that explain in this section.
- Interface details between sub-systems
- Input/output terminations
- Power distribution block diagrams
- I/O module indexes
- Cabinet arrangement and dimensional drawings
- Cabinet Circuit Wiring Diagram
- Wiring Connection Detail Diagram (Excel Format)
- Two wire diagrams for all signal points acquired by the system

- Programming manuals
- Calculation of overall system availability / reliability including the failure mode and effect analysis
- List of sub-VENDOR & data sheets
- Grounding system
- FDS (Functional Design Specification)
- FAT Procedure
- SAT Procedure

12.0 SITE SERVICES

12.1 GENERAL

- The services required from the Supplier will cover two periods:
- System Pre-commissioning: assistance during system installation and preliminary tests (power on & system loading).
- System Commissioning and start up: assistance to the CLIENT performing units pre-commissioning, commissioning and startup by DCS.
- The period of “on site” activity, pre-commissioning, start-up and SAT, shall be quoted, all inclusive, on a basis of eight (8) hour per day and six (6) day per week; travel and living
- Must be included.
- Any period consumed for system fault or trouble shooting where the supplier is responsible, will not be computed as site services activity.
- Any additional period will be computed on a daily rate base.
- Daily rates for additional period shall be quoted.

a) System Pre-commissioning

- The Supplier shall include the necessary manpower in order to provide the following services:
- Interface for all problems concerning the system
- Check out that all facilities needed for the system are available (electrical power supply, air conditioning, suitable room, cable runs and trays, grounding etc.)
- Supervision of system internal cables installation
- “Power on” of the electrical power supply (for all equipment) and system loading.
- Test routines
- Repetition of the test made in Supplier’s staging area before shipment and SAT certificates filling.
- Loop check and functional test assistance.
- Preparation of a master copy for all documents of the supplies, which later will be used to prepare the “as built” documentation.

b) System Commissioning & start-up

c) After S.A.T., during commissioning, the Vendor will be available for configuration assistance, allowing CLIENT to modify on line the configuration of the system.
d) Commissioning services will consist in:
e) Loop check activity troubleshooting and assistance including configuration changes and display upgrading/modification.
f) Preparation of a master copy for all the documents included in the scope of supply, which will be later, used to prepare the “AS BUILT” documentation.
g) The on line configuration of the system may not be modified until successful completion of the acceptance test. If configuration changes are deemed necessary these should be agreed with the vendor.

13.0 GUARANTEE AND MAINTENANCE

13.1 GUARANTEE

The Vendor shall guarantee the satisfactory performance of the system in accordance with project material requisition. This guarantee shall be performed through a letter of acceptance. In addition, The Vendor shall guarantee the availability of all spare parts and replacement parts that are required by any equipment item supplied for 10 years of operational period.

13.1.1 Maintenance during guarantee

The guarantee period shall be eighteen (18) months from the date of delivery or twelve (12) months from the installation date of each equipment/packages at site. For the reason that the process units and facilities might be executed by different temporal schedule, SAT may be carried out unit by unit, consequently the period guarantee of the relevant hardware and software will be started after completion of each respected unit and facility.

During the guarantee period, the Supplier shall provide onsite service personnel, at request, for maintenance, fault detection, repair and/or replacement within 48 hours. The Supplier may utilize the recommended/start up spare parts supplied, to maintain the system. The Supplier shall replace all such spare parts used at no cost and in duly time.

13.1.2 Maintenance after guarantee

The Supplier’s proposal shall include details of all standard maintenance agreements available from the vendor that are suitable for the systems (hardware, firmware and software). The CLIENT shall be under no obligation to select all or some of the agreements detailed and shall be free to negotiate a unique maintenance agreement with the Supplier.

14.0 PACKING, SHIPPING AND STORAGE

The Supplier shall perform the most stringent level of maintenance and protection during staging and testing as recommended by the original equipment manufacturer for each piece of equipment, to assure “like new” condition when shipped.

The Supplier shall provide adequate packing to prevent contamination, mechanical damage, or deterioration of the items supplied, including spare parts, as defined in the following requirements:

Items not immediately packaged after manufacturing shall be suitably protected from contamination.

At the time of shipment, the equipment shall be clean inside and out and covered with a plastic membrane protecting from water, or any other suitable means not harmful to equipment.

All items shall be adequately boxed, crated, or otherwise protected to prevent loss, damage or pilferage in transit.

Each box shall contain a detailed packing list in addition to the normally attached external list.

Large and heavy equipment shall have the weight, center of gravity, and lifting points marked on the exterior covering.

Supplier shall furnish complete site preparation, shipping, and handling instructions to the Handles.

15.0 SHOCK AND VIBRATION CONSIDERATIONS

In construction, integration, arrangement, and installation of control system panels, The vendor shall meet all considerations related to Noise and Vibration according to IPS-G-SF-900, and use adequate isolation solution for the damping any shock and vibration by any internal/external cause.