ADNOC GROUP PROJECTS AND ENGINEERING

PROCESS CONTROL SYSTEM SPECIFICATION

Specification

AGES-SP-04-001

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GROUP PROJECTS & ENGINEERING / PT&CS DIRECTORATE

CUSTODIAN	Group Projects & Engineering / PT&CS
ADNOC	Specification applicable to ADNOC & ADNOC Group Companies

Group Projects & Engineering is the owner of this Specification and responsible for its custody, maintenance and periodic update.

In addition, Group Projects & Engineering is responsible for communication and distribution of any changes to this Specification and its version control.

This specification will be reviewed and updated in case of any changes affecting the activities described in this document.

1. INTER-RELATIONSHIPS AND STAKEHOLDERS

a) The following are inter-relationships for implementation of this Specification:

i. ADNOC Upstream and ADNOC Downstream Directorates and

ii. ADNOC Onshore, ADNOC Offshore, ADNOC Sour Gas, ADNOG Gas Processing. ADNOC LNG, ADNOC Refining, ADNOC Fertilisers, Borouge, Al Dhafra Petroleum, Al Yasat

b) The following are stakeholders for the purpose of this Specification:

ADNOC PT&CS Directorate.

c) This Specification has been approved by the ADNOC PT&CS is to be implemented by each ADNOC Group company included above subject to and in accordance with their Delegation of Authority and other governance-related processes in order to ensure compliance

d) Each ADNOC Group company must establish/nominate a Technical Authority responsible for compliance with this Specification.

DEFINED TERMS / ABBREVIATIONS / REFERENCE

"**ADNOC**" means Abu Dhabi National Oil Company.

"**ADNOC Group**" means ADNOC together with each company in which ADNOC, directly or indirectly, controls fifty percent (50%) or more of the share capital.

"**Approving Authority**" means the decision-making body or employee with the required authority to approve Policies & Procedures or any changes to it.

"**Business Line Directorates**" or "**BLD**" means a directorate of ADNOC which is responsible for one or more Group Companies reporting to, or operating within the same line of business as, such directorate.

"**Business Support Directorates and Functions**" or "**Non- BLD**" means all the ADNOC functions and the remaining directorates, which are not ADNOC Business Line Directorates.

"**CEO**" means chief executive officer.

"**Group Company**" means any company within the ADNOC Group other than ADNOC.

"Specification" means this Process Control System Specification.

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GENERAL

2. PURPOSE

The purpose of this specification is to supply a proprietary Process Control System (PCS), being part of the ICSS, which shall be a microprocessor-based control and data acquisition system, comprising multiple modules operating over a network. It defines the general requirements for all business units. The hardware and programming of all devices in the system shall be developed by the VENDOR using proprietary designs, which shall not be interconnected with other equipment without use of proven gateways.

This specification is intended to provide the minimum basic requirements and shall not relieve the VENDOR of his contractual obligations. Any deviation from this Specification shall be identified by VENDOR and shall require written approval from COMPANY.

The ICSS shall comprise a distributed system including PCS, ESD, F&G and BMS (if required).

3. SCOPE

The scope of this Standard covers the minimum requirements for the design, engineering, supply and commissioning of the Process Control System, which is part of ICSS. The scope of supply shall include, but is not limited to, the following equipment components and services.

4. DEFINED TERMS / ABBREVIATIONS / REFERENCES

Abbreviations	
ADNOC	Abu Dhabi National Oil Company
AMS	Alarm Management System
BMS	Burner Management System
BSI	British Standards Institute
CCR	Central Control Room
CPU	Central Processing Unit
DMZ	Demilitarised Zone
DVT	Design Validation Test
EMI	Electromagnetic Interference
ESD	Emergency Shutdown System
EWS	Engineering Workstation
FAT	Factory Acceptance Test
F&G	Fire and Gas System
FDS	Functional Design Specification
FLD	Functional Logic Diagrams
FS	Functional Specification
GPS	Global Positioning System

Abbreviations	
HART	Highway Addressable Remote Transducer
HMI	Human Machine Interface
IAMS	Instrument Asset Management System
ICSS	Integrated Control & Safety System
IEC	International Electrotechnical Commission
IES	Instrument Equipment Shelter
IEEE	Institute of Electrical and Electronics Engineers
IFAT	Integrated Factory Acceptance Test
I/O	Input/ Output
IP	Ingress Protection (rating)
IS	Intrinsically Safe
ISA	International Society of Automation
ISO	International Organisation for Standards
LAN	Local Area Network
LED	Light Emitting Diode
LSD	Large Screen Displays
MCB	Miniature Circuit Breaker
MTTR	Mean Time to Restore
NESA	New Standard of Information Security in the UAE
OWS	Operator Workstation
PAC	Plant Acceptance Certificate
PCS	Process Control System
OT	Operational Technology
OTS	Operational Technology Security
QMS	Quality Management System
RFI	Radio Frequency Interference
SAT	Site Acceptance Test
SER	Sequence of Events Recording
SIS	Safety Instrumented System
SNTP	Simple Network Time Protocol
SOE	Sequence Of Events
TCP/IP	Transmission Control Protocol / Internet Protocol
UPS	Uninterruptible Power Supply

Abbreviations	
VDRL	Vendor Data Requirement List

References
ADNOC Group Companies PCS documents part of PCS Purchase Order shall be referred for design and supply of equipment.

SECTION A

5. NORMATIVE REFERENCES

5.1 International Code(s) and Standards

The following codes and standards, to the extent specified herein, form a part of this specification. When an edition date is not indicated for a code or standard, the latest edition in force at the time of VENDOR'S proposal submitted shall apply.

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)	
IEEE 802.3	Local Area Network (LAN) protocols
IEEE STD 829	Standard for Software and System Test Documentation IEEE Computer Society Document
IEEE STD 830	Recommended Practice for Software Requirements Specifications
INTERNATIONAL SOCIETY OF AUTOMATION (ISA)	
ISA 71.04	Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants (2013)
BRITISH STANDARDS INSTITUTE (BSI)	
BS 7671	Requirements for electrical installations
BS ISO 80000-1	Quantities and Units Part-1: General
INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)	
IEC 60079	Explosive Atmospheres
IEC 60364	Low Voltage Electrical Installations
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
IEC 61000 Series	Electromagnetic Compatibility (EMC)
IEC 61131	Programmable Controllers
IEC 61326-1	Electrical equipment for measurement, control and laboratory use — EMC requirements Part 1: General requirements
IEC 61158	Digital data communications for measurement and control - Fieldbus specifications
IEC 61499	Function Blocks
IEC 61508	Functional safety of electrical, electronic and programmable electronic safety related systems.
IEC 61511	Functional safety - safety instrumentation systems for the process industry sector

IEC 61643	Low-voltage surge protection devices
IEC 62443	Industrial communication networks - Network and system security
IEC 62591	Industrial communication networks - Wireless communication network and communication profiles-Wireless/Hart.
IEC 62734	Industrial networks - Wireless communication network and communication profiles - ISA 100.11a

5.2 COMPANY Specifications

DOCUMENT NUMBER	TITLE
AGES-SP-04-004	Emergency Shutdown (SIS) System Specification
AGES-SP-04-003	Fire and Gas System Specification

6. REFERENCE DOCUMENTS

6.1 Standard Drawings

Not Applicable

6.2 Guidelines/Recommended practices

ENGINEERING EQUIPMENT AND MATERIALS USERS ASSOCIATION (EEMUA)	
Pub. 191	Alarm systems - a guide to design, management and procurement
Pub. 201	Control rooms: a guide to their specification, design, commissioning and operation
INTERNATIONAL ORGANISATION FOR STANDARDS (ISO)	
ISO 11604	Ergonomic Design of Control Centres – Part 7: Principles for the Evaluation of Control Centres
INTERNATIONAL SOCIETY OF AUTOMATION (ISA)	
ISA RP 60.3	Human Engineering for Control Centres

7. DOCUMENTS PRECEDENCE

The Codes and Standards referred to in this specification shall, unless stated otherwise, be the latest approved issue at the time of Purchase Order placement.

It shall be the VENDOR'S and CONTRACTORS'S responsibility to be, or to become, knowledgeable of the requirements of the referenced Codes and Standards.

The VENDOR/CONTRACTOR shall notify the COMPANY of any apparent conflict between this specification, the related data sheets, the Codes and Standards and any other specifications noted herein.

Resolution and/or interpretation precedence shall be obtained from the COMPANY in writing before proceeding with the design/manufacture.

In case of conflict, the order of document precedence shall be:

(1) UAE Statutory requirements

(2) ADNOC Codes of Practice

(3) Equipment datasheets and drawings

(4) Project Specifications and standard drawings

(5) Company Specifications

(6) National/International Standards

8. SPECIFICATION DEVIATION/CONCESSION CONTROL

Deviations from this specification are only acceptable where the VENDOR has listed in his quotation the requirements he cannot, or does not wish to comply with, and the COMPANY/CONTRACTOR has accepted in writing the deviations before the order is placed.

In the absence of a list of deviations, it will be assumed that the VENDOR complies fully with this specification.

Any technical deviations to the Purchase Order and its attachments including, but not limited to, the Data Sheets and Narrative Specifications shall be sought by the VENDOR only through Concession Request Format. Concession requests require CONTRACTOR'S and COMPANY'S review/approval, prior to the proposed technical changes being implemented. Technical changes implemented prior to COMPANY approval are subject to rejection.

9. PROCESS SAFETY REQUIREMENTS

Sr.No.	Description
1	All alarm and trip settings shall be within 10% to 90% of the relevant instrument ranges to ensure visibility of the success or failure of automatic or manual actions.
2	A main database of all alarms shall be created, including all associated data - ranges, set-points, response times, required operator actions (section 11.7.2)
3	Alarms on out-of-service equipment shall not be suppressed if the related hazard can arise while non-operational.
4	ICSS communication networks shall be divided into zones of appropriate security levels with adequate protection between zones. (section 11.4.2)

10. DESIGN CONSIDERATIONS /MINIMUM DESIGN REQUIREMENTS

10.1 Operation & Design Life

The PCS shall be designed for minimum life of 15 years (see section 20.2)

10.2 Environmental Requirements

Unless otherwise specified, PCS system cabinets, other than field local panels, shall be installed within a climate-controlled area.

The indoor installed PCS system shall be suitable for an air-conditioned environment to ISA S71.04, G3 classification.

Normal indoor operating conditions will be 22°C ± 2°C and 50% Relative Humidity.

Control layer equipment shall continue to operate in HVAC upset conditions during which the temperature in the indoor location of the installation can fall to 0ºC or rise to 60ºC, and the humidity can vary between 5% and 95% non-condensing. Control layer equipment shall be considered to include network switches used in the Control Network.

10.3 Electric Utility Data

Two separate power feeders from UPS and one feeder from Utility power supply shall be made available for use by the VENDOR for powering PCS system cabinets.

The Electrical power supply details are as follows:

(a) Nominal voltage - 240V AC,

(b) Single Phase, 50 Hz, earthed

(c) Steady state Voltage variation ± 10% nominal voltage

(d) Steady state Frequency variation ± 5 %

10.4 Seismic Requirements

The system shall be designed to operate in the presence of a sinusoidal vibration of 2g at 10 - 500 Hz and withstand a shock of 15g for 11 milliseconds.

10.5 Hazardous Area Protection

Unless otherwise specified, PCS system cabinets shall be installed within a general purpose, non-classified electrical area.

If equipment is located in hazardous area, the Hazardous area classification and method of protection shall comply with IEC 60079. PCS Equipment located in certified Hazardous Area enclosures shall comply with the maximum ambient conditions for continuous operation.

Instrumentation located in hazardous areas shall be certified to IEC Ex standards by a certifying body acceptable to COMPANY.

All equipment within the scope of supply shall be suitable for the area classification as defined within the requisition. The PCS equipment supplied shall be located in non-hazardous areas, however interconnecting system cabling may, in certain cases, pass through hazardous areas, and should be adequately designed and protected for this duty.

Field equipment connected to the PCS will typically be located in hazardous areas and will be certified to National or other Certifying Authorities.

Field equipment located in these hazardous areas shall in general be interfaced via galvanic isolation safety devices and will be certified in accordance with IEC 60079 by an acceptable approval body as Ex'ia' or EX'ib' with the exception of solenoid valves which will be certified Ex'd' or Ex'm'. Other protection standards for SOVs may be used where appropriate if specifically approved by COMPANY.

10.6 Ingress Protection

The degree of Ingress Protection (IP) for equipment enclosure shall comply with IEC 60529 and equipment data sheets. The equipment minimum IP rating shall be as follows:

(1) IP 42 for Indoor climate-controlled environments

(2) IP 65 for Outdoor field environments

10.7 Engineering Units

Reference shall be made to Project Engineering Design basis for Units of Measure.

SECTION B

11. TECHNICAL REQUIREMENTS

11.1 General Design

The PCS shall provide a control system based on the project I/O list and functional design specification.

The PCS system VENDOR shall have a proven track record over a minimum 20 years in providing design, engineering, Supply and Commissioning services for large scale Oil, Gas, Petrochemical and related process facilities.

The PCS system shall be engineered considering the full life cycle from design, installation, commissioning, start-up, operations and maintenance through to decommissioning.

11.2 Proven Technology

Only field proven hardware/technology should be used. Field proven should be defined as minimum 3 year of operation in the similar operating environment that the new system is deployed for control layer equipment and 1 year of proven service for Console equipment.

Only System Hardware and Software that is field proven shall be included in the VENDOR's scope of supply. Prototypes shall not be proposed. In instances where 'new' technologies may be considered beneficial to the project the VENDOR must present a case detailing benefits, time frames and a fall back scenario.

11.3 Standardization

The PCS shall be based on 'off the shelf' standard products of a field proven design. It shall have a high degree of availability, reliability and tolerance to faults and fulfil the projects requirements.

The system shall be designed in a modular fashion. The number of different parts shall be minimized and standardized in order to reduce spare parts holding. Standardization will also minimize the maintenance and Operator training requirements.

Standardization shall apply to all software and hardware components (operating system, communication network equipment).

11.4 Architecture

11.4.1 General

The Process Control System Network topology shall be 'Open System Architecture' which is Vendor-independent, based on official and/or popular standards that allow flexibility, functionality and interoperability, between various control functions/ systems on the same network

Network topology shall be addressed, but for current environment openness, is limited by security requirements, which must be discussed with COMPANY on a project by project basis.

The VENDOR shall produce a topology drawing showing the arrangement of operational segments and security zones and conduits in the proposed network. A preliminary version of this drawing shall be provided with VENDOR's proposal.

Where specified, the PCS architecture shall be designed to support an 'island' (local) mode of operation of equipment in each Instrument Equipment Shelter in case communication with the Central control Room is lost.

VENDOR shall include all equipment necessary to allow basic operation and historisation of the plant units under control by operators located within the IES in the PCS design.

11.4.2 Cybersecurity

PCS networks shall form the basis of networking for all elements of facility control and safety systems. The network shall be divided into zones with separate levels of security.

All communication between the ICSS zone and Enterprise zones shall be via a Demilitarized Zone (DMZ) and Firewalls.

In addition, the Safety Zone shall be separated from the Control Zone by an additional Firewall.

VENDOR shall provide details of their proposed 3rd party interfacing strategy and procedures, and alternatives available that give due cognizance to COMPANY's system security requirements.

All automation installations shall comply with COMPANY's OT Security policies and procedures.

Applied security should have the capability to allow remote performance monitoring by either Company Personnel or, third parties. The VENDOR shall implement UAE national Digital Security Authority requirements after discussing with COMPANY and in compliance with Company OT Security policy and procedures.

The PCS functionality shall provide for user configurable access security control via software password recognition to limit the access rights of personnel to the PCS system functionality. VENDOR shall describe the mechanisms available to achieve this, the logging facilities for access requests and how the access rights can be modified as necessary to suit commissioning and operational purposes.

A cyber security risk assessment as per IEC 62443-2-1 shall be performed by COMPANY/CONTRACTOR. VENDOR shall provide all required support for this assessment.

The cyber security risk assessment shall be performed as follows and shall be an iterative and continuous process:

(1) Define the risk analysis methodology (for example architecture based)

(2) Identify major items (organization, systems, subsystems, networks)

(3) Identification, evaluation of the threat scenarios with their impact and likelihood

(4) Reduce the risks by designing adequate countermeasures

(5) Summarize the results in a Risk Register.

The cyber security risk assessment findings and recommendations relating to PCS design and configuration shall be implemented by VENDOR.

VENDOR shall provide the necessary firewalls to control data transfer between the different ICSS zones.

11.5 Functional Specification (FS) and Functional Design Specification (FDS)

The Functional Specification shall be prepared by CONTRACTOR in consultation with COMPANY and shall form the basis for the VENDOR proposals and for the VENDOR to develop the PCS design in Detail. shall be written specifically for each project.

The FS shall provide the following information:

(1) This specification

(2) Number and spacing of IES;

(3) Number and type of I/O (Analogue, Digital, SOV, Fieldbus, 'Soft' serial, IS, Non-IS) and allocation to IES;

(4) Number of Control functions (Controllers, sequences, interlocks, batches, etc.) and allocation to IES;

(5) I/O Criticality ratings

(6) Requirements for 'island' operation.

(7) Identification of Security Levels for each zone of the system

(8) Interfaces to third-party packages;

(9) Interfaces to other networks;

(10) Historisation requirements;

(11) Trending requirements

(12) Number and location of OWS;

(13) Number and location of EWS;

(14) Estimated number of Operating Graphics;

(15) Number of Console groups;

(16) Requirement for Large Screen Displays;

(17) Number and type of additional Workstations (for example maintenance) required

(18) P&IDs (to support segregation assessment).

Based on the FS and additional supporting documentation, VENDOR shall develop the detailed design of the PCS and document it in the FDS.

The supporting information supplied to VENDOR to develop the FDS shall include:

(19) Control Narratives;

(20) Logic Descriptions;

(21) Sequence Narratives;

(22) Updated P&IDS;

(23) Operating Philosophies;

(24) Interface details for third-party packages;

(25) Interface details for complex instruments.

The FDS shall detail the project specific architecture, system layout, hardware, software and graphics structure. It shall be written in conjunction with COMPANY/CONTRACTOR by VENDOR, based on the Functional Specification, provided in the requisition, and the additional supporting documents.

The system design and build will not be approved until the FDS is approved by COMPANY.

Operator interface requirements shall be included in FDS.

The FDS shall provide a detailed inventory and description of the equipment, functional definition and equipment data, including, as a minimum:

(26) Number and nature of communication networks:

- (e) Identification of networks
- (f) Identification of network criticality & redundancy
- (g) Communication link capacities
- (h) Communication link loadings for all operational cases
- (i) Identification of security zones
- (j) Identification of conduits
- (k) Definition of security measures between zones
- (l) Definition of data flows to achieve FS requirements
- (m) Communication details of all network elements
  - (ii) Controllers
  - (iii) Gateways
  - (iv) Servers
  - (v) Switches
  - (vi) Firewalls
  - (vii) HMI stations
- (n) Network architecture
- (o) Details of Historisation
- (p) Details of DMZ/interface to Enterprise zone
- (q) Number and type of controllers
- (r) Allocation of controllers to IES/units
- (s) Allocation of I/O to controllers
- (t) Number of PCS cabinets
- (u) Allocation of I/O to cabinets

(v) General Arrangement (GA) of cabinets including, rack distribution and mounting, power distribution, terminations, trunking, cooling fans, temperature monitoring, cable entry arrangement and dimensional drawings

(v) Preliminary configuration database

(w) Function block definitions (Valve Control, Pump Control, etc.)

(x) Detailed descriptions of agreed graphics elements/standards

(y) HMI station details including GA and dimensional drawings

(z) Access control

11.6 Hardware

11.6.1 General

The hardware of all parts of the PCS shall be designed and configured to carry out the functions described in the FDS. Special consideration shall be given to:

(1) Environmental (temperature, humidity, vibration, etc.) and transport conditions;

(2) Design of the cooling requirements for equipment mounted in enclosures;

(3) Protection of the electronic components from static electricity and electromagnetic radiation; all hardware components of the PCS shall allow use of High Frequency radio communication in the vicinity of the installed equipment.

(4) Each PCS input/output shall be individually protected against electrical failure.

(5) All digital and analogue outputs shall have a configurable failure position (hold, on or off).

(6) Dedicated marshalling cabinets shall be used for each system (PCS, ESD, F&G etc.), if an ICSS system is required, with segregation of IS and Non-IS.

11.6.2 Functional Requirements

VENDOR is responsible for ensuring that all items of equipment and components provided (including equipment from sub-Suppliers) are suitable for the specified operating conditions.

VENDOR shall detail the equipment items proposed and their relationship to the operational functions defined tin the FS

Dual redundant Simple Network Time Protocol (SNTP) time servers each with their own Global Positioning System (GPS) aerial in the Central Control Building signal shall be provided by VENDOR for time synchronization of all servers, workstations, controllers and other device clocks connected to the Process Control Network, third party systems and the Plant-Wide Network.

For the purpose of establishing the Total Cost of Ownership over the design life of the equipment, the VENDOR shall provide the reliability and life cycle data as specified in the requisition.

11.6.3 EWS/OWS

A workstation shall consist of display screens, keyboard, and mouse that allows the operator to interact with the process control system. An operator's console shall consist of multiple independent operator stations. The PCS Operator Workstation (OWS) should be the primary operator interface to control and monitor the entire process and shall also be used to monitor and control the signals from all third party systems.

The OWS shall be the primary operator interface to control and monitor the entire process The OWS shall also be able to monitor and control signals from all third party systems.

The number of OWS will be determined by the size and complexity of the process being controlled and the number of operators assigned to the unit or process complex.

Within the HMI layer, each OWS shall have its own electronics or virtualized hardware and failure of any hardware shall not affect more than one operator station. Virtualisation should be considered for the entire HMI/console layer including EWS, OWS, servers & workstation, interface stations, gateways etc. Where systems are virtualised, the design shall ensure that failure of a single host platform cannot disrupt operator access to maintain control of the plant. Vendor shall demonstrate how design of OWS satisfies the requirements of ISO 11604 & ISA RP 60.3 respectively.

Wireless operator interfaces may be considered for remote locations provided that adequate consideration is given to reliability and security. Unless otherwise agreed by COMPANY, use of such access shall be limited to indication or information use. Wireless Operator Stations intended for outdoor use shall be classified for Zone 1 with a suitable electrical protection method.

A point detail display shall be provided for every hard and soft tag configured into the PCS system. All parameters applicable to each tag shall be available for display. Operating parameters shall be accessible by the operator. Engineering and tuning parameters shall available for change only under access password or key lock

VENDOR shall offer their standard trend display capability for COMPANY review

Separate engineering workstations shall be used to configure the subsystems of the process control system. When engineering workstations are used then the workstation will consist of electronics, storage media, display screen, keyboard, and printer to allow authorized personnel to configure, download, monitor, trend, document, modify, and verify software configuration.

All EWS workstations shall have the same functionality / features as the OWS, however they shall also have access to the application software, configuration and graphic builder software to allow maintenance and onsite modifications.

EWS shall be provided with the engineering functions to configure the PCS system, with password protection. EWS shall be configured in such a way that the operator functions and Engineering functions shall be performed with different login ID and passwords.

11.6.4 Power Supplies

The VENDOR shall incorporate an overall AC/DC power distribution, incorporating dual redundancy feeds to control equipment and single feeds to utility outlets.

Power supply to the PCS will be from 2 (dual redundant) UPS feeds. Each UPS feed will supply 240V AC, 50Hz power.

For each incoming power feed a double pole isolation switch shall be provided. Individual alarms will be generated for each of these when turned to the off position or on any fault.

System power supply located inside PCS cabinets shall be dual redundant and each shall be capable of supplying 100% system power if other fails. All power supplies, without considering redundancy shall include a spare capacity of 25 percent of the maximum load considering all spare I/O slots were filled.

The PCS shall support automatic switching between dual redundant power supplies for continuous service without risking transient voltage effects.

Power supplies shall be replaceable on-line without disrupting the process and without affecting functioning of PCS System. Distribution of all power levels to all system chassis and modules shall also be completely redundant as a minimum. This is to be inclusive of all voltage levels required for logic processors, all

chassis requirements, I/O modules and communication modules. This means that the failure of a power supply or incoming line shall not take out a leg of I/O or a main processor. The system shall withstand a 20 ms power outage without interrupting system operation. Cabinet power supplies shall have over-temperature protection, integral fuse protection, and status LEDs to indicate power supply faults.

Miniature circuit breakers (MCB) and fuses shall be employed to provide electrical protection and isolation for all powered components. The distribution circuit shall ensure that at no point of single MCB failure will result in other consequences or cascade effect. MCB fault contacts shall be wired in series to generate a common fault alarm. Selection of fuses and MCB ratings shall be carefully coordinated with upstream fuses / MCBs including UPS distribution, taking into account power up inrush currents.

Additionally, separate 24 VDC redundant power supply for powering field instruments shall be provided. The VENDOR shall be responsible for designing the 24 VDC power distribution with circuit protection for all system I/O. All 24VDC –ve terminals shall be connected to Instrument earth (floating earth is not allowed).

Failure of any power supply must be signalled via a dry normally open (N/O) contact which shall be wired in series to a common discrete input point for alarm indication for each self-contained suite of cabinet(s). Each power supply shall be provided with primary and secondary overload protection. The secondary overload shall be self- resetting or have a time overload delay to prevent an instantaneous fault from tripping the system off. Over voltage protection must be provided if it is necessary for the protection of the connected loads. All individual fuses shall be considered with fault LED indication and common fault alarm for monitoring by PCS. No hidden fault is allowed without remote common alarm.

The VENDOR shall wire cabinet lighting and utility outlets to a separate breaker which will be fed from a single phase 240 VAC 50 Hz utility non -UPS supply.

VENDOR shall provide the power consumption including inrush currents and crest factors for each cabinet to size incoming power feeders.

11.6.5 I/O Modules

These modules can be integral with the process control rack (for example communications, control processors mounted on the same back plane as the I/O modules) or mounted in separate modules/carriers

Distribution of I/O shall also be governed by Unit segregation and reduction of common-mode failure risk. Unless otherwise approved b COMPANY, control loops from different units shall be processed by different controllers and I/O channels shall be segregate so that failure of a single card/module only affects one unit. I/O module for primary and standby equipment items shall also be segregated.

I/O modules will be capable of handling the following I/O –

(1) analogue input;

(2) discrete input;

(3) discrete output;

(4) analogue output;

(5) frequency input;

(6) thermocouple input;

(7) RTD input

(8) Serial communications.

Serial I/O modules shall be able to communicate with various digital systems such as Fieldbus, HART or other serial data communications. Other I/O modules shall allow HART data to pass to the PCS.

The location and environment of the installation must be considered in selecting the modules. If the modules are to be located in remote locations, they must be have valid hazardous area certification for the full range of temperatures specified and be capable of continuous operation over the full range of all of the specified environmental conditions. Purging of I/O enclosures may be required to meet hazardous area requirements. The likelihood of EMI or RFI must be assessed and mitigated.

The power supplies to the I/O modules and the I/O channels must be identified and appropriately designed. Power for the modules from same source as the process control modules or one of equal reliability. Power supplies must be suitable for the area classification and ambient temperatures in which they will be installed.

If the I/O is remote from the control modules, the communications to the remote I/O must be evaluated for suitability. The impact of loss of communications must be assessed and the need for redundant and/or separately routed communications must be identified.

All I/O modules shall be remotely configurable and publish their entire configuration on request.

The I/O system design shall allow for removal of any failed module, whether redundant or non- redundant, without affecting the operation of any other modules and with no impact to the running plant beyond the loops related to the affected module. I/O modules shall be HART pass through and have the capability to connect to Asset Management System without a MUX/ Demux.

The PCS system shall be designed such that upon failure of the primary module/unit in service, the control shall be transferred to the backup module /unit and the changeover shall be bump less transfer and shall not result in loss of an operator's ability to view or manipulate real time data from the work station. The failure shall create an alarm to alert the operator. Automatic equalization between redundant modules shall be provided to ensure consistency and bump less switching in any case.

Different style input modules may be required for 2-wire and 4-wire devices depending on the manufacturer of the module to address power supply and isolation issues. Input modules shall be able to be configured to do filtering, characterization and other functions.

11.6.6 I/O Signals

Use of wireless or semi-wireless network for PCS field devices shall be considered for monitoring of instruments located a long distance from Control Centres. If there are instances where a number of devices are on a given unit that all need wireless communication, it will be simpler to use a wireless remote I/O device that gathers the data and sends it back using one wireless Ethernet radio rather than individual transmitters.

Wireless networks for field instrumentation shall be Wireless HART (IEC 62591) and/or ISA 100 (IEC 62734).

Wireless instruments shall support authentication and cryptography for enhanced security mechanisms.

11.6.7 De-Centralized Logic

As the base case the control will be done in the PCS controller located in a specified Control Room or Equipment Room. Vendor should indicate whether they can support control in the field and how well this will be integrated within the PCS in terms of engineering tools, operator graphics, backup controls, alarming etc.

If the VENDOR offers a De-Centralized Logic solution for all green field projects, the I/O’s shall comply with the requirements included in this specification.

De-Centralized Logic are considered as 'smart junction boxes'. They consist of I/O modules, power supplies, communication bus interface and field terminals enclosed in boxes or cubicles according to the number of field instruments and valves.

Maintenance facilities shall include:

(1) Replacement of I/O or power supply modules under power;

(2) Diagnostic data available at the PCS maintenance/Operator stations in the same way as for standard I/O's;

(3) When used, the I/O bus design shall be such that a loss of one I/O rack will not impact the other I/O racks: for instance, the de-energization of one I/O rack shall not impede the control and monitoring of the other I/O racks.

11.6.8 Cabinets

All cabinets will be vendor standard, but with the following details.

Two types of cabinet shall be provided:

(1) System cabinets including CPUs, I/O boards, communication boards, power supplies, switches, firewall, routers and Patch panels. Each Subsystem shall have dedicated cabinets, except for specific cases described in this specification.

(2) Marshalling cabinets equipped to receive all process and safety signals from and to the field, the electrical room, or other technical rooms or to receive signals from other systems such as package control systems.

Each Subsystems (PCS, ESD BMS and F&G) shall have dedicated cabinets.

PCS system and marshalling cabinets shall be rigid and self-supporting. Cabinets shall be constructed of sheet steel with a rigid internal steel frame. Cabinets shall be braced for shock and vibration normally encountered during transport and construction.

The cabinet's structure thickness shall be minimum 1.5 mm for cabinet steel plate sides, roof and bottom, and minimum 2 mm for doors and plinths.

The dimensions of the cabinets shall be 2000 mm (H) (excluding plinth) x 800mm (W) x 800 mm (D) (front access). If cabinets are permanently bolted to form sections, the length of these sections shall not exceed 2400 mm.

All cabinets shall have the same exterior and interior finish and colour. Cabinet colour shall be RAL 7035. Plinth colour shall be RAL 7022.

The cabinet Internal layout shall be designed to provide safe and unimpeded access to all electronic modules, power distribution, fuses, terminals and cables termination areas, cables and wiring routings and replacement of defective parts with the minimum amount of dismantling or removal of associated equipment.

All cabinets shall be bottom entry unless with approval from COMPANY.

IP42 shall be standard for all indoor cabinets.

Cabinets shall have redundant ventilation fans for heat removal. Alarms shall be provided for cabinet high temperature and fan failure. Cabinets shall be equipped with ventilation louvers with dust filters units. Inlet louvers shall be installed at the bottom of cabinet doors. Filter screens shall be readily accessible and easily removable.

Cabinet and inside equipment support shall be designed to dampen effects of external vibration.

Eyebolts shall be mounted on each cabinet to facilitate handling during unloading and permit transportation of the enclosure by crane.

All unused I/O module slots shall be fitted with removable cover plates.

Cabinet shall have lockable hinged doors. Hinges shall be the lift off type for example doors shall be easily removable from cabinet. All door locks shall be provided with the same lock and key combination. Keys shall be removable with the doors either locked or unlocked.

Internal lighting lamp at the top of the cabinet shall be controlled by a door switch or movement detector and incorporating a manual on/off/auto switch.

All PCS components shall be safe to personal and environment that shall comply with listed international electrical safety standards. All terminals containing voltages in excess of 50V shall be shrouded and labelled as hazardous.

Each Cabinet and all its major components shall be clearly labelled and identified with a Tag Number. Cabinet nameplates shall be by engraving on three-layer plastic. Material layers shall be white-black-white for PCS and shall be attached with stainless steel screws. Nameplate engraving shall be subject to COMPANY review and approval.

When available space inside the technical room is limited, combined marshalling/system cabinets may be considered. However, physical segregation between marshalling and systems sections, and easy access to any equipment/device/terminal requirements shall be fulfilled. Such arrangement shall be submitted to COMPANY for approval, as a cost saving.

Side mounting of components shall not be permitted, unless approved by COMPANY.

All cabinets shall have drawing/document folders located on front and rear doors.

All components shall be safe to personal and environment and shall comply with electrical safety standards.

Prefabricated system cables shall be provided to connect the system cabinets to the marshalling cabinets, if remote I/O is not used. All cabling, sockets, plugs and terminating blocks shall be arranged and positioned to facilitate easy access for testing, inspection and maintenance.

Terminals shall be Blue for Intrinsically Safe and grey for all others.

11.6.9 Earthing

There shall be three separate isolated Earthing Systems within the PCS cabinets as follows:

i. Safety Earth: Each cabinet shall have a M10 brass earth stud, complete with nuts and washers for dedicated safety earthing. All metal racks, internal panels, cable tray, doors and detachable panels shall be earth bonded together to this safety earth with a flexible copper braid strap of at least 10mm2 to ensure effective earthing.
ii. Instrument Earth: Each system and marshalling cabinet shall be provided with one 5mm x 15mm copper galvanically isolated instrument earth bus-bar across the full width of, and insulated from, the panel for earthing System electronics and electrostatic screens of field cables. In general, field instrument shields shall be grounded to instrument earth within the Marshalling Cabinet.
iii. Intrinsically Safety Earth – IS Earth: Marshalling cabinets with non-isolating IS barrier (for example Zenner barrier) circuits shall be supplied with an additional isolated IS earth bus-bar clearly labelled.

11.6.10 Wiring

Prefabricated system cables shall be provided to connect the system cabinets to the marshalling cabinets, if remote I/O is not used. All cabling, sockets, plugs and terminating blocks shall be arranged and positioned to facilitate easy access for testing, inspection and maintenance.

Unless otherwise specified in the requisition, or approved by COMPANY, the colour coding of wires within system cabinets shall be as follows:

(1) Power 24V DC positive / negative - RED / BLACK

(2) Power 110V/240V AC phase / neutral - BROWN / LIGHT BLUE

(3) Input and output signals - BLACK/WHITE or BLACK/ BLUE (to indicate intrinsically Safe signals)

(4) . Signal earth - GREEN

(5) . Intrinsically Safe Earth - GREEN/BLUE

All interconnecting cables shall be tagged at both ends with cable number and cabinet number. Wiring core shall be tagged at both ends (where applicable) with tag number using shrink sleeve type markers or equivalent.

Internal wiring shall be laid in PVC close slotted ducting (raceway) with a covering lid colour coded blue for Intrinsically Safe and Grey for non-Intrinsically Safe wiring. Ducting (raceways) shall have at least 40% spare capacity after commissioning.

Internal cabinet wiring, cables and wire ways shall be minimum flame retardant in accordance with IEC 60332.

All internal and external wiring shall be connected to terminals. Splices are not permitted in wiring. Terminal blocks shall be Push-in Spring type (cage clamp type) and non-hygroscopic type. Terminals shall be tinned and clearly identified. The size of the terminal blocks shall be consistent with the wire size. Terminal colour for Non-IS wiring shall be Grey and Intrinsic Safe wiring shall be Blue. Terminals utilized for voltages higher than 48 volts shall be protected against accidental contact with removable cover plates which carry high voltage warning labels. Terminal blocks shall be labelled and numbered.

All panel cabinet tagging for cabinets, racks, TBs, Distribution boards, Terminal blocks, shall be engraved tagging fixed in a permanent manner. Sticker or temporary tagging is not acceptable.

11.6.11 Availability/Redundancy/Reliability

Hardware redundancy shall be provided to meet the requirement that ‘no single PCS component fault, failure or replacement shall affect availability of the Process asset’. The systems shall contain diagnostic routines to alert the operator to any faults and failure.

The following components shall, as a minimum, be redundant:

(1) PCS networks, servers and communication equipment (such as switches, firewalls, routers, etc)

(2) PCS nodes: controllers, power supplies

(3) I/O modules for loops which provide a ‘critical’ control function, where a ‘critical’ Function is defined as a function that, if lost due to a fault, would adversely affect asset safety or cause a significant loss of production.

The goal of providing redundancy is to increase the overall availability. If, in the case of servers, if it can be shown that sufficient availability is achieved using non-redundant servers but with redundant powers supplies and disks (mirroring or raid) then this may be proposed.

The required availability of the PCS shall be at least 99.99% based on an MTTR of 8 hours.

11.7 Software

11.7.1 General

The VENDOR shall supply clarification of the standard system software with release of expected software updates for the coming 5 years. This shall be included in the bid. The migration path for future software upgrades shall be clearly specified by the VENDOR. Once any single piece of software has been signed-off by COMPANY the VENDOR shall not change any part of the system software without first consulting fixes and new features in the later version of software. The agreement on whether or not to install the later version and the timing thereof shall be with the agreement of COMPANY.

Operator interface shall be the latest proven version of VENDOR's windows based system.

The VENDOR shall provide as part of the system all system and application software (fully configured & documented) necessary to implement the functionality described in the FDS. The software shall be designed and programmed to facilitate maintenance, modification and future expansion of facilities and be of modular structure.

Standard Functions are developed to define the Hardware interface and Software requirements for individual instrument and equipment. These standard software blocks shall be used to develop the project specific requirements. COMPANY subsidiaries may use their own library of Standards Functions if already developed.

These Standard Functions are key requirements for the development of the Functional Specification which would then define how these functions are applied to specific process/utility and safety sub systems.

The Functional Specification shall be the basis of the development of the application software.

Applications software shall be designed, programmed and documented to facilitate maintenance, modification and future expansion. For this reason it shall be of a logical modular structure.

Special attention shall be paid to the functions split within the different controllers belonging to the same subsystem to minimise the consequences of:

(1) Any process shut-down when losing one controller (or a part of it);

(2) Too many data exchanges between controllers.

VENDOR shall be required to develop and implement a comprehensive Software Lifecycle Management Process. The process shall identify, and store with revision numbering, the master versions of software at all stages from the start of the project and VENDOR toolkit development, through modular code implementation and testing, integration testing, commissioning, and handover to the site support organization for the engineering support phase.

The PCS shall have communication between security zones which must meet cyber security requirements and support multiple local and remote operator stations including distributed server architecture over industry standard LAN/WAN.

If ICSS is by a single VENDOR is adopted, then communication between the subsystems shall be VENDOR's native system protocol.

The PCS shall provide a secured bi-directional flow of information between third party devices and the PCS.

The PCS communication with ESD and F&G should be seamless redundant communication utilizing the Ethernet (TCP/IP) protocol, if ICSS is adopted.

The PCS shall provide a secured bi-directional flow of information between third party devices and the PCS.

VENDOR shall assume total responsibility for the control of software up to the date of handover to COMPANY and the system shall be auditable by COMPANY. VENDOR shall provide details of their proposed Software Lifecycle Management Process and the tools that are proposed for deployment and use for this project.

The PCS shall have the capability of extensive historization and trending of data. Selection of the tag and sampling time for real time and historical trending shall be possible from operator keyboard. The PCS shall have the facility to record all data points on the system at one second resolution for one month and one minute average for 3 months. The system shall be capable of uploading all tags in 30 seconds or less to a central database system

Instrument configurable engineering databases shall be used as an engineering tool in designing the PCS system for example allocation of Input/output.

11.7.2 Alarm Management

Alarm Management software shall be provided to ensure that the operator is alerted to plant upsets in a clear manner without being overloaded during normal operation and even plant upset.

An Alarm Management System (AMS) shall be implemented in ICSS.

Alarm Management shall comply with the EEMUA Publication 191 and the ISA 18.2 requirements.

A database of all alarms on the ICSS and their variables, with ranges; setpoints, criticality, notifications and actions shall be developed, initially by VENDOR, and maintained throughout the system life.

Operator required actions for each alarm shall be available to console operators at all times.

Alarms on out-of-service equipment shall not be suppressed if any cause has been identified for the related hazard to arise while the equipment is non-operational.

The alarm management software for PCS system shall have the following AMS capabilities, as a minimum:

(aa) Alarm and event logging

(bb) Storage of alarms and events for retrieval

(cc) Sorting of alarms and events in chronological order

(dd) Sorting of alarms by priority

(ee) Providing statistical analysis of alarms and events

(ff) Alarm reports (shelved alarms, filtered alarms, masked alarms, statistics)

(gg) Alarm change management (alarm threshold modification, alarm priority change)

(hh) Printing and reporting.

(ii) First out alarm.

(jj) Alarm masking and dynamic suppression, including suppression between units.

The alarm and event history shall be periodically backed onto another central server for permanent storage.

Refer to ADNOC Group Company AMS specification for further details.

Vendor shall configure the alarm management defined in the FS documents and the software shall be suitable for further refinement by COMPANY operators. Training in the use of Alarm Management software shall be offered by VENDOR.

11.8 Maintainability

System maintainability requirements shall include the need to perform diagnostics and system maintenance functions, including software updates. This will topology requirements for data links and communications in order to facilitate this process. Additional control module redundancy may be necessary to meet system maintainability.

Provisions should be made for major maintenance or upgrades that can only be performed when the process is shut down. In large complexes, this means that equipment should be segregated so that processes areas that cannot or do not come down together do not share key equipment.

The control system hardware shall be located where it can be repaired and maintained. All modules shall be replaceable with the system powered and plant running. Modules shall have mechanical keying to prevent physical insertion and on-line activation of a module in an incorrect slot in the chassis. Shorting or grounding the field wires connected to any I/O module shall not damage the module itself.

The process control system shall incorporate comprehensive self-diagnostics so that all permanent and transient faults are identified, located, alarmed and reported. All diagnostics should be performed automatically on-line, without disturbing the process or reducing the reliability of the system.

Where specified in the FS, separate Maintenance Workstations shall be provided. These shall comprise identical hardware to the Operator stations but shall be located in a separate Maintenance Engineering location.

11.9 Reports

The PCS shall be provided with report generation and historisation tools that have been tested and certified for use with the rest of the process control system.

The capability for the creation of custom reports shall be such that all values, measured or calculated, within the system can be accessible for these custom reports.

The PCS shall incorporate an event logger which shall store messages for future reports and displays and should be provided with the capability to accumulate and store process information history. The PCS specification shall also be capable of storing user defined network data for a period of six months.

The PCS shall support management of change, including tracking user changes and providing hardcopies on demand of system configuration.

The PCS shall have file backup management application for routine backup to magnetic media storage on a scheduled basis.

An automatic archiving facility shall be included to archive the historical data and events on a removable media, which shall be in line with COMPANY procedure.

The OWS shall provide the operator with the means to initiate reports on demand or to schedule regular reports that have previously been configured.

The VENDOR shall supply a software package within the OWS to allow personnel to create or modify reports.

Printers shall be provided as part of the ICSS for log and report printing. Colour printers shall be supplied for Graphic printing.

11.10 Instrument Asset Management System (IAMS)

IAMS, which shall be included shall constantly monitor defined instrumentation/equipment parameters and automatically generate alarms and fault reports when specified thresholds are exceeded along with operator guidelines, which will improve plant operations.

The VENDOR shall supply an IAMS Server, plus network to store and display all diagnostic data transmitted from the field, to reduce equipment failure.

Provide configurable device scan rate capability, of 100ms or less. The scan times for third party devices shall be no more than 1sec. No system should be able to change parameters of process measurement without authorization due to security protection. It shall enable filtering of status messages from any field device to avoid nuisance alarms.' IAMS shall not prevent field devices from raising Process or Bad PV alarms on PCS.

The following shall also be included:

(1) Automatically build and maintain a database of installed devices.'

(2) Provide unlimited character tag device tag capability.'

(3) Provide automatic device foot-print comparison checks against device benchmark performance including as a minimum friction, spring rate, bench set, seat load, and torque.

(4) It shall be able to carry out partial stroke test and establish a valve signature.

(5) Generate equipment inspection requests.

(6) Maintain an equipment audit trail and operational history.

The IAMS shall provide a common field device interface and database for connectivity to all types of instrumentation, including all package instrumentation.

The IAMS shall automatically update maintenance records by tracking work orders.

11.11 Controllers

The controllers shall be inherent redundant architecture and shall demonstrate availability figure of greater than 99.99%.

The controllers shall have the following functions as a minimum:

(1) Configurable PID loops

(2) Alarming (PV, deviation and rate of change)

(3) Bump less transfer

(4) Output ramping and output limiting.

(5) Dead time compensation

(6) Internal cascade control

(7) Ratio Control, Gap control

(8) Rate of change calculation

(9) Totalizing and mass flow computation

(10) Step sequencing and interlocking

(11) Pulse control input

(12) Selectors overrides and flip flop commands

(13) Spilt-range controllers

The controllers shall be capable of scan rates of 100ms or faster. For logical processing of digital signals, the processing rate for each controller shall not be more than 0.2 second.

When an active controller fails another controller will automatically take control. An alarm will be displayed on the operator console to indicate that a controller has failed. The failed controller will be capable of being replaced on-line. The new controller should be configured automatically by the control system when it is installed.

Controllers shall be capable of executing both pre-defined configurable algorithms and user algorithms coded in a high level programming language, as defined in IEC-61131 part 3.

Controller loading shall not exceed 50% during peak load (Alarm flooding condition). Loading measurement shall include I/O addressing capability and processor CPU loading.

Controller shall have the capability to interface either directly (preferred) or via a gateway with the industrial standard protocols such as Modbus, Profibus, Foundation Fieldbus and other standard protocols, through a firewall.

Upon Failure of controller, it shall be possible to remove it and install a replacement on-line, without interrupting the system function. Also, an alarm shall be initiated on the Operator Interface Station.

11.12 HMI

11.12.1 General

The HMI for the PCS is provided by the OWS and shall consist of the following features as a minimum:

(1) VENDOR's standard displays such as alarm and event lists, system status displays and alarms.

(2) VENDOR's standard functions such as alarm annunciators, keypads, audible sounds

(3) Project specific graphics

All OWS's shall be able to access all graphics, however access to alarms, events, set points, mode change and state change controls shall be restricted to the operator and OWS(s) assigned responsibility for that specific plant. Alarms and events from one operating area shall not be visible in another operating area unless specifically enabled.

VENDOR shall detail the constraints for each OWS configuration with respect to the maximum number of tags / points, display call-up time etc. To assist in the assessment of capability, VENDOR shall also provide for typical display objects, the functionality they provide and the number of tags / points they use. Functions such as menu pick, pushbutton and navigation target shall be either removed or greyed out if unavailable; this is to avoid an operator being unsure as to whether the function is available or not or there is a fault.

It shall be possible to configure the system so that the HMI defaults to operator area overview and/or alarm list if not used for a period of time. For OWS terminals not in the Control Room, it shall be possible to configure them to default to view only mode if not used for a period of time.

Requirement for Large Screen Displays (LSDs) used for incident control and general overviews for operator and non-operator personnel shall be Project defined.

The PCS shall ensure a safe, reliable and efficient control and monitoring function for the facility. It shall also provide the 'backbone' of the ICSS communication network and thus allow the Operator to view and manage the entire facility from the HMI located in the control room (s).

11.12.2 Graphics

The PCS HMI will provide the operator with a single window to the process control and safety systems. The operator will have the capability to control and monitor the process, apply overrides to and monitor the status of the ESD and F&G systems and monitor the status of all of the major packages.

PCS custom graphic libraries, including all symbols, shapes and dynamic objects / elements shall be verified as fit for purpose and approved by COMPANY prior to commencement of project graphic bulk build process. Each element must be tested with the associated function block(s) and standard configurations for which it is to be used for the test to be valid.

In addition, graphic templates covering all project graphic types, shall be developed to satisfy Operations hierarchical display design requirements, and verified as fit for purpose by VENDOR (with respect to graphic performance) and approved by COMPANY prior to commencement of project graphic bulk build process.

Project specific graphics shall integrate all automation systems to provide a common 'look and feel' for operator monitoring, control, and diagnostics and shall be built using the graphic objects, templates and standards approved as part of the toolkit to ensure a consistent look and feel for operators and as an essential part of reducing the risk of misinterpretation or misoperation. Any new graphic requirements identified during the project shall go through the toolkit design process to ensure integrity is maintained. The project graphics shall consist of the following:

(kk) Project field overview graphics.

(ll) Process Control Schematic graphics:

- (i) Process overview graphics
- (ii) Process unit graphics
- (iii) Process detail graphics (P&ID)

(mm) F&G graphics

(nn) ESD graphics

(oo) Electrical System Graphics

(pp) HVAC graphics

(qq) Sequence graphics

A point detail display shall also be provided for every hard and soft tag configured in the PCS System. Maintenance displays that show the data communication links and system hardware status shall be available.

11.13 Design Data

One of the primary design sources will be Instrument configurable engineering databases which shall be utilized for two-way data exchange of design information between COMPANY and the VENDOR. As part of the FDS, VENDOR shall detail the proposed database exchange requirements; these include:

(1) Database verification - essential to this is the agreement of a primary key(s) which are used to link databases with PCS data.

(2) Data exchange management

(3) Database revision control, on the basis that the central Company database shall continue to be a live working database.

(4) Configuration auto-build rules and tools

(5) User Defined Fields

During the course of the project large amounts of data will transfer between Company and VENDOR to align the database and the PCS, maintaining control of this to allow updates and verification is seen as essential by COMPANY and will be jointly developed during the FDS phase.

12. ADDITIONAL SPECIFIC REQUIREMENTS

Not Applicable

SECTION C

13. SCOPE OF SUPPLY

Detailed engineering and design of the ESD system in accordance with all specifications, standards, datasheets and other statements of requirement include with or referenced in the requisition.

The VENDOR shall have single point responsibility for all aspects of the works, inclusive of all components sub-contracted or purchased from other parties. These shall include, but not be limited to:

(1) Total system engineering definition of the PCS in the form of a Functional Design Specification (FDS) based upon the Functional Specification (FS), datasheets and COMPANY specifications provided by CONTRACTOR. FDSs shall be written by the VENDOR and approved by COMPANY during the Design Phase to detail the VENDOR scope of work.

(2) the agreed FDS

(3) Control System Topology

(4) Design and supply of the PCS Operator Control Console, including the integration design and resulting facilities for all free issued materials to be mounted thereon

(5) Design and supply of the PCS System Cabinets

(6) Design and supply of the PCS Marshalling Cabinets

(7) Design and supply of the PCS Auxiliary Cabinets

(8) Design of the PCS communications network and supply of all communication equipment and cables up to but excluding communication bridges to domains outside the Process area

(9) all System Interconnecting cables

(10) Supply of operating system software and firmware.

(11) Supply of system configuration and application software including design and configuration of database, graphics and reports

(12) Supply of specialist integration services for third party equipment forming part of the PCS scope

(13) Supply of System test procedures, all necessary test equipment and personnel for all tests. Perform tests for witness by the Contractor’s representative

(14) Human Machine Interface

(15) Alarm processing and management

(16) Data communications

(17) Documentation

(18) Documentation and certification in accordance with the material requisition, this specification and the standards referenced herein.

(19) Special tools required installation, operation and maintenance of the equipment;

(20) Painting, Preservation and Packing;

(21) Insurance spares;

(22) Spares (commissioning and 2 year);

(23) Certified calculations shall form part of the scope of supply as follows:

(24) Design and supply of power distribution system within the PCS

(25) Sizing Calculations; Power Calculations; Commissioning; start-up and long term support.

(26) Heat loading calculations.

In addition to the above requirements, design, fabrication, configuration, testing and installation shall also be compliant with cyber-security requirements.

The PCS shall be configured so that a user at any level (from the PCS to the business network) can immediately ascertain the validity (quality) of real-time and historical process tag values. A tag's data quality shall be determined and set in the PCS module hosting the instrument data acquisition.

14. QUALITY CONTROL AND ASSURANCE

Equipment shall only be purchased from Vendors approved by COMPANY Category Management. This approval indicates that the VENDOR has an approved Quality management system and a proven track record in supply of this equipment type.

COMPANY/CONTRACTOR reserves the right to inspect materials and workmanship at all stages of manufacture and to witness any or all tests.

VENDOR shall comply to Criticality Rating for Equipment outlined in respective ADNOC Group Company's Quality System Specifications for requirements of production checks, shop inspection, testing and material certification.

The VENDOR shall provide equipment inspection and test reports as per approved Inspection and Test Plan by CONTRACTOR.

VENDOR shall submit a quality plan for approval by COMPANY.

15. MATERIAL & CERTIFICATIONS

Material certification is not applicable to PCS system equipment.

16. INSPECTION & TESTING REQUIREMENTS

16.1 General

The VENDOR shall be responsible for workmanship, testing and quality assurance of the material supplied.

Inspection and Testing will be carried out by VENDOR and it will be witnessed by the CONTRACTOR and COMPANY representatives at various stages and locations as follows:

(1) Pre-Factory Acceptance - conducted at the system assembly/manufacturer location.

(2) Factory Acceptance Test - may be conducted at the system assembly location as a standalone PCS

(3) Integrated Factory Acceptance Test – conducted following FAT at the PCS location.

(4) Site Installation Test- conducted at the job site once system is installed and powered up.

(5) Site Acceptance Test - conducted at the job site as a system operating test after commissioning.

VENDOR shall provide all test procedures to CONTRACTORS and COMPANY for review and approval at least two months prior to the proposed test schedule. Each formal acceptance test must be signed by a VENDOR, CONTRACTOR and COMPANY representative at the successful completion of the test(s).

16.2 Shop Inspection

CONTRACTOR'S representative will periodically visit the VENDOR'S shop facilities and inspect system progress from a hardware and software perspective.

16.3 Pre-Factory Acceptance Test

VENDOR shall detail all physical tests and inspections which will be performed in the Pre-FAT procedure. As a minimum these tests shall include complete physical inspection of all cabinetry, system components, wiring, labelling, etc. Additionally, the procedure shall list all internal VENDOR test/inspection records which can be provided to the CONTRACTOR during the Pre-FAT. As a minimum, project related QA inspections covering bought out components and internal inspections of assemblies are to be included.

The system equipment will be inspected by CONTRACTOR representative at the Pre- Factory Acceptance Test for satisfactory quality and workmanship. In addition, COMPANY or CONTRACTOR shall have the right to inspect the work in progress at any stage.

The VENDOR is responsible to maintain a punch list during the Pre-FAT. The Pre-FAT punch list shall list the problems discovered, include the date discovered, the name of the person reporting the problem, the date corrected, the name of the person who performed the correction, the date retested and accepted, and the name of the individual accepting the retest. This entire Pre-FAT punch list shall be given one System Log report number and maintained as part of the PCS system log. Unless otherwise agreed by COMPANY, all items on the Pre-FAT punch list shall be cleared before the commencement of FAT.

The entire Pre-Factory Acceptance Test (Pre-FAT) procedure must have been successfully exercised on the system by the VENDOR prior to the FAT.

16.4 Factory Acceptance Test

The FAT shall include the complete testing and acceptance of both hardware and software.

The VENDOR shall be required to submit FAT procedures for approval prior to FAT. These shall cover, but not be limited to:

(rr) Complete hardware testing including simulation of all input and output channels, testing of all system redundancy (CPU's, power supplies, I/O buses, I/O comm modules, highway communication modules, etc.), observation of fault reporting via hardware indicators and data transfers, and hot swap component replacement.

(ss) Complete simulation of all functional groups. This testing is to be inclusive of I/O simulation through the marshalling cabinets and system cables to ensure healthy HW and SW configuration for all I/O. Functional test shall be performed through software simulation for all tested I/O. Additionally, full redundancy testing of the communications interface shall be performed.

(tt) As the functions are checked, proper recording of SOE data shall be verified. Additionally, the SOE sorting and reporting capabilities shall be demonstrated and certified correct.

During FAT the system shall be made available to CONTRACTOR and COMPANY for sufficient periods to verify satisfactory performance.

COMPANY and CONTRACTOR'S representative will witness the entire FAT. The FAT procedure/checklist will be signed off by the VENDOR, CONTRACTOR and COMPANY representative at the successful conclusion of testing. A copy of the signed off FAT procedures/checklist and related printouts shall be

furnished to CONTRACTOR and COMPANY representative. Each punch point shall be categorised to define criticality and time frame for completion. This is applicable to all tests & punch lists.

All process inputs and outputs must be simulated during the FAT. The purpose of this simulation is to provide a facsimile of the production process, with all points of an individual loop or interconnected loops hooked up for test simultaneously.

All system programs must be complete and resident in the system prior to the start of FAT. All program listings must be free of pencilled (patched) corrections. The system software loaded must be the final version encompassing all required changes incorporated after VENDOR internal testing. Any changes which were made as a result of internal testing shall be documented as part of the PCS system log.

The VENDOR is responsible to maintain a punch list during the FAT. The FAT punch list shall list the problems discovered, include the date discovered, the name of the person reporting the problem, the date corrected, the name of the person who performed the correction, the date retested and accepted, and the name of the individual accepting the retest. This entire FAT punch list shall be given one System Log report number and maintained as part of the PCS system testing log.

Diagnostic programs which are tested during FAT shall be shipped to IFAT with system.

16.5 Integrated Factory Acceptance Test (IFAT)

Following FAT, IFAT shall follow and include testing of communication interfaces between FGS, ESD, PCS and third-party systems. Data transfer between FGS/ ESD/PCS shall be checked. FGS/ESD/third-party graphics implemented in PCS OWS shall be 100% tested.

IFAT testing procedure shall be furnished by VENDOR for CONTRACTOR and COMPANY approval.

16.6 Site Installation Test (SIT)

After the system has been installed on site and site QA as well as VENDOR inspection of the mechanical and electrical installation has been successfully completed, a Site Installation Test will be conducted by the VENDOR when directed by the CONTRACTOR.

SIT shall include as a minimum:

(uu) An audit and inspection of equipment as installed. A deficiency report shall be written, and appropriate action taken to rectify any problems.

(vv) All alarm status, analogue and pulse inputs, and controlled end devices shall be disconnected by means of isolating terminals.

(ww) Each system shall be powered up and system and application software will be loaded. System diagnostics shall be run and checked to ensure the system is error free.

(xx) Communications shall be established between all components of the system.

(yy) Redundancy testing of processor, power supply systems, I/O buses and communication modules shall be performed.

(zz) At least one point from every input/output module shall be verified by signal simulation/monitoring from the associated marshalling cabinet.

(aaa) A random sampling of data transfers between the PCS and other systems shall be performed to ensure proper operation of the data links.

(bbb) All MOS enable switches shall be checked for proper operation by exercising the enable switches, implementing PCS soft MOS functions, checking the ESD/FGS implements the MOS and then

observing the ESD/FGS clearing imposed soft MOS functions when the MOS enable switches are switched to the off position.

(ccc) Random sampling of SOE data shall be conducted.

Full details of all tests to be performed shall be defined in the SIT procedure.

The VENDOR is responsible to maintain a punch list during the SIT. The SIT punch list shall list the problems discovered, include the date discovered, the name of the person reporting the problem, the date corrected, the name of the person who performed the correction, the date retested and accepted, and the name of the individual accepting the retest. This entire SIT punch list shall be given one System Log report number and maintained as part of the PCS system test log.

COMPANY and CONTRACTOR representative will witness the entire SIT. The SIT procedure will be signed off by the VENDOR, CONTRACTOR and COMPANY representative at the successful conclusion of testing. A copy of the signed off SIT procedures and related printouts shall be furnished to CONTRACTOR and COMPANY representative.

Upon completion of the SIT, the system shall remain powered on and loop checks shall be conducted as loops are made ready. System status shall continue to be monitored and all detected faults and/or changes/modifications to system hardware and software shall be recorded in the System test log. During commissioning, loop checking shall include the whole loop, from the control room to the field device.

16.7 Site Acceptance Test (SAT)

After the system has been commissioned and put in service the Site Acceptance Test period commences. The purpose of the site acceptance test is to verify that all hardware and software is correctly installed and functioning according to the specifications in the real environment and verify integrated performance of the ICSS system.

The Site Acceptance Test will also be done to a previously approved procedure prepared by the VENDOR and approved by the CONTRACTOR. This procedure will detail the monitoring functions to be performed, the methods to be employed, and clearly stipulate the conditions which must be met for acceptance.

This test shall include monitoring the system data transfer and update times. SOE data capture and time synchronization between the PCS and other systems shall be verified. Transmission and display of correct first out alarm notifications as well as secondary alarms shall be observed. System diagnostics shall be routinely checked. The SAT procedure shall fully detail all acceptance test criteria. Duration of SAT shall not be less than 72 hours.

The VENDOR is responsible to maintain a punch list during the SAT. The SAT punch list shall list the problems discovered, include the date discovered, the name of the person reporting the problem, the date corrected, the name of the person who performed the correction, the date retested and accepted, and the name of the individual accepting the retest. This entire SAT punch list shall be given one System Log report number and maintained as part of the PCS system test log.

The SAT procedure will be signed off by the VENDOR, CONTRACTOR and COMPANY representative at the successful conclusion of testing. A copy of the signed off SAT procedures and related printouts shall be furnished to CONTRACTOR and COMPANY representative.

Successful completion and approval of the SAT will constitute system acceptance by the CONTRACTOR and COMPANY.

16.8 Certificates of Acceptance

At the satisfactory conclusion of the FAT, IFAT, SIT, and SAT a Certificate of Acceptance shall be provided by the VENDOR for signature by the CONTRACTOR and COMPANY.

Following documents as minimum shall be attached to Certificate of Acceptance dossier:

(ddd) Signed and Approved FAT, IFAT, SIT and SAT test reports

(eee) Electric Equipment Test Certificates

(fff) Hardware Test Certificates

(ggg) Software Test Certificates

(hhh) Approved As-Built Drawings

16.9 Services by the VENDOR

The VENDOR shall supply necessary manpower and specialist personnel and all necessary tools and equipment to support testing at Vendor's shop and at site as defined above sections.

17. SUBCONTRACTORS/SUBVENDORS

The list of SUB-CONTRACTORS must be approved by COMPANY.

VENDOR shall assume responsibility and overall guarantee for all supply and services provided by SUB-CONTRACTOR/SUBVENDOR.

The VENDOR shall transmit all relevant Purchase Order documents including specifications to his SUBCONTRACTORS.

It is the VENDOR'S responsibility to enforce all Purchase Order and Specification requirements on his SUBCONTRACTORS.

The VENDOR shall submit all relevant SUBCONTRACTOR drawings and engineering data to the CONTRACTOR.

Any subcontracted services or hardware must be approved by in writing by company. The term service includes design, fabrication, assembly and testing.

VENDOR shall obtain necessary warranties from SUBCONTRACTORS/ SUBVENDORS.

18. SPARE PARTS

18.1 Spare Parts

VENDOR shall include the provision of all commissioning spares in the bid. The VENDOR shall also include list of spares required for two years operation, FAT Spares and insurance spares along with price schedule for each item along with the bid.

VENDOR shall complete Spare Parts Interchangeability Record (SPIR) Form in COMPANYS approved formats. Parts data shall be supplemented with appropriate drawings / bulletins identifying each part in their respective position.

The VENDOR shall propose the minimum required number of different card types.

18.2 Spareage

The PCS shall be delivered with an installed spareage of 20% for each type of input and output and associated support hardware and adequate space within the cabinets to allow for installation of an additional 15% inputs and outputs and any additional support hardware. This spareage shall be utilised to accommodate additions due to design development after the delivery of the system. Prior to delivery

additional I/O shall be added as required by the Design Update Packages to maintain the 15% installed spareage target.

Processors, memory, software, communications and software shall be adequately sized to allow for the specified inputs and/or outputs (including all spareage detailed above) and associated controllers, algorithms, system functions and applications (logic and / or sequences) without any upgrade being required, accordingly processor loading and memory utilisation shall at no time exceed 60%.

Specified spare capacity should include only cabinet space and power supply capacity, unless specific pre-investment is approved.

The VENDOR shall propose the minimum required number of different card types.

Minimum 30% spare space shall be provided for future use.

19. PRESERVATION & SHIPMENT

19.1 Packing and Shipping

Preparation for shipment shall be in accordance with purchase order Preservation and Export Packing requirements. VENDOR shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to materials and application, and to provide equipment at the destination in ex-works condition when handled by commercial carriers. Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite. Preparation for shipment and packing will be subject to inspection and rejection by COMPANY'S/CONTRACTOR'S inspectors. All costs occasioned by such rejection shall be to the account of the VENDOR. Equipment shall be packed, securely anchored, and skid mounted when required. Bracing, supports, and rigging connections shall be provided to prevent damage during transit, lifting, or unloading. Separate, loose, and spare parts shall be completely boxed. Pieces of equipment and spare parts shall be identified by item number and service and marked with CONTRACTOR'S order number, tag number, and weight, both inside and outside of each individual package or container. A bill of material shall be enclosed in each package or container of parts. One complete set of the installation, operation, and maintenance instructions shall be packed in the boxes or crates with equipment. This is in addition to the number called for in the Purchase Order.

All kinds of regulatory / non-regulatory approvals and procedures required for shipping shall be in the scope of CONTRACTOR / VENDOR.

19.2 Preservation and Storage

Equipment and materials shall be protected to withstand ocean transit and extended period of storage at the jobsite for a minimum period of 18 months. Equipment shall be protected to safeguard against all adverse environments, such as humidity, moisture, rain, dust, dirt, sand, mud, salt air, salt spray, and seawater. All equipment and material shall be preserved, and export packed in accordance with project specifications.

The VENDOR shall provide preservation plan to protect and ensure the integrity of PCS equipment during the period that starts when the PCS equipment is prepared for the first shipment from the point of origin and ends at the completion of project commissioning and start-up. The plan shall identify protective measures to be implemented during each phase of the project, inclusive of maximum ambient conditions. The completion plan shall be submitted to COMPANY for review and comment no later than 90 days prior to the first shipment of PCS equipment from the factory.

20. COMMISSIONING

20.1 Installation

VENDOR shall provide supervision assistance for Installation and Commissioning of PCS System at site. Installation will be carried out by the CONTRACTOR with supervision assistance from the VENDOR. The VENDOR shall notify the CONTRACTOR of any special tools required for installation and supply these, if necessary, to the CONTRACTOR.

The VENDOR shall include the provision for all commissioning spares in its bid.

VENDOR shall be required to support COMPANY / CONTRACTOR by preparing detailed ICSS

Commissioning procedures, together with detailed plans covering all site based activities necessary to fully commission the ICSS.

The VENDOR shall identify any special requirements or recommendations for VENDOR support during commissioning and start-up of the equipment supplied.

20.2 Life Cycle / Long Term Support

VENDOR must provide assurances that system equipment will not be obsolete in the next 15 years. In the belief that portions of the system will eventually be withdrawn from sale, a firm commitment by the VENDOR that for his standard products there will be either repair capability or equivalent parts and/or products available for a minimum of 15 years from the withdrawal date is required.

The entire system shall be in 'Active life' for a minimum period of minimum 15 Years. VENDORs shall provide life cycle commitment including:

(iii) Start of Active life

(jjj) End of active life

(kkk) Start of limited support

(lll) End of limited support

(mmm) Start of Obsolescence

Active life: Denotes the system is active and available for sale for new projects and revamp projects, full support from R&D, continuous support in terms of upgrade, patch update, bug fixing etc.

Limited Support: Product has limited support with local maintenance and engineering support; bug fixing, continue to supply of spares (refurbished or new parts)

Obsolete: Out of sale and support is discontinued

Between active to support phase, vendor shall provide a minimum support period of 7 years for company to plan for a smooth upgrade or replacement.

20.3 Maintenance

During warranty period, VENDOR shall provide service personnel for periodic fault finding, repair and replacement of all faulty hardware, firmware and software.

During bidding stage, Vendor proposal shall include the details and costs of all standard maintenance services available after SAT. COMPANY shall be under no obligation to select all or any of the agreements detailed and shall be free to negotiate a unique maintenance agreement with the VENDOR.

21. TRAINING

21.1 General

The following training courses are proposed for the selective attendance of suitable personnel such as Engineers, Supervisors and Technicians. The purpose of these training courses will range from gaining an appreciation of the PCS, its software and associated hardware, to acquiring an in-depth knowledge for administration and system configuration and software development purposes:

(nnn) System Architecture (all)

(ooo) Systems Software and Maintenance (System Administrator)

(ppp) System Administration (System Administrator)

(qqq) Network /Cyber Security (System Administrators, Supervisors)

(rrr) Application Programming (Engineers, Supervisors)

(sss) Advance Programming Techniques (Engineers, Supervisors)

Above training shall be included nominally for 10 Engineers / Supervisors and 6 Technicians.

21.2 Training Course Documentation

For each trainee who will attend a training course, a copy of the complete training course, notes, and drawings shall be provided to COMPANY eight weeks prior to the commencement of the training course. The copies shall be retained by the trainees on completion of the training course and shall be the property of COMPANY.

In addition, five copies of the training course documentation shall be available on site prior to the installation and pre-commissioning for reference purposes.

21.3 Maintenance Training Course

The purpose of the course is to train Engineers/ Supervisors/ Technicians for first line fault diagnosis, and repair by replacement.

21.4 System Engineering Course

The purpose of this course is to enable COMPANY Engineers/Supervisors to be able to modify system I/O and system application software including interfaces to the PCS. The course shall include:

(ttt) System Hardware.

(uuu) System operating software.

(vvv) Review of project specific typical application software modules, data formats, data table allocations.

22. DOCUMENTATION

VENDOR shall submit the type and quantity of drawings for COMPANT/CONTRACTOR authorization or information as per VENDOR Document Register and Schedule (SDRS) provided in Purchase Order.

The VENDOR shall provide all standard and project-specific documentation and software required for system definition, installation, initialisation, operation, maintenance, troubleshooting and training. This information shall provide complete documentation for the PCS in sufficient scope and detail to permit programming and maintenance of the equipment.

Mutual Agreement on document list and documents issue dates shall be an integral part of Purchase Order.

Comments made by CONTRACTOR on drawing submittal shall not relieve VENDOR of any responsibility in meeting the requirements of this specification. 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.

All drawings, documents, information, correspondence, test reports, operating and maintenance instructions and like items shall be in the English language and metric Units.

All documents and drawings issued by the VENDOR shall be produced in an electronic format compatible with Microsoft Office computer software. Documentation shall also be provided in Native format, in order to allow company to update during operational upgrade and future projects. VENDOR shall provide final documentation on DVD-ROM with search and retrieval capabilities.

All system drawings shall be prepared and submitted in accordance with recognized standards. Every effort shall be made to minimize the total number of drawings prepared by use of common drawings, where practicable without loss of clarity.

Before SAT, VENDOR shall issue As-Built drawings incorporating all changes that have taken place during installation, testing and commissioning at site. Each drawing shall be clearly marked ‘As-Built’ and dated.

The below list of documents required is intended to define the minimum technical documents to be provided by the VENDOR. This list is not exhaustive and additional documentation necessary for the work execution be provided by VENDOR. PCS system documentation to be supplied by VENDOR shall include, but not be limited to:

(1) System Architecture Diagrams

(2) System Block Diagrams and interface schematic

(3) Functional Design Specifications for Hardware and Software, Cabinets, Networking, Interfaces, Cyber Security etc

(4) System Configuration Specifications including Logic and Application Program Design

(5) Reliability/Availability Calculations and Reports

(6) Loading Calculations (CPU, memory, networks, power supplies, spares)

(7) Cabinet and Console General Arrangement drawings

(8) Cabinet internal wiring diagrams

(9) Inter-panel Cable Connection Schedule

(10) Interconnection Wiring Diagrams

(11) Input/Output Assignment List.

(12) Configuration database.

(13) Functional Logic diagrams.

(14) Loop Diagrams

(15) Software licenses

(16) Power supply, distribution and earthing drawings.

(17) Power and Heat Loading calculations

(18) Electrical Load Schedule

(19) I.S. certification dossier (if applicable).

(20) Bill of Materials

(21) Comprehensive data sheets for all major items, including completed data sheets included in the enquiry/purchase order.

(22) Inspection Test Plan (ITP)

(23) QA/QC Procedures

(24) Internal Testing and Pre-FAT Report

(25) FAT Procedure & Report

(26) SAT Procedure& Report

(27) SIT Report

(28) List of all spare parts, tools, test equipment and installation materials.

(29) Spare Part Interchangeability List

(30) Packing, Marking and Shipping Procedure

(31) Preservation and Site Storage Procedure

(32) Complete catalogue sheets of all furnished items.

(33) System Hardware Manuals

(34) Programming Manual

(35) Application software manuals.

(36) System Security Manual

(37) Functional Safety Manual

(38) Operation and Maintenance Manuals

(39) Installation and Configuration Manuals

(40) Quality Manuals

(41) Third Party Manuals

23. GUARANTEES & WARRANTY

VENDOR shall provide warranty support for a period of two years, commencing on the date of the system PAC following the site acceptance test. Warranty shall apply to defective material workmanship and facility

design, and/or facility software. Warranty work shall be done at COMPANY local facilities. The cost of diagnostics and/or correction of any warranty items shall be borne by the VENDOR.

The VENDOR will not be required to provide resident maintenance personnel during the warranty period, but shall have competent technical personnel available from the local facility within 24 hours, if so required by COMPANY.

The VENDOR shall guarantee that the software to be supplied shall be free from errors, for example software/firmware failure to perform function(s) as specified in this specification or COMPANY documentation.

24. PROJECT ADMINISTRATION

24.1 Project Personnel

The VENDOR shall insure that sufficient qualified personnel are at all times allocated to the project. The VENDOR shall utilize a project team structure to achieve continuity and accuracy of implementation. The VENDOR shall submit for CONTRACTOR'S approval the résumés of all personnel engaged in the project.

It is anticipated that the project team shall comprise at least the following disciplines:

(www) Project Manager (Commercial/Technical) (shall be nominated representative of the VENDOR with responsibility and authority to fully implement the project with technical correctness, on schedule and within the budget).

(xxx) Senior System Designer (Technical).

(yyy) Hardware Design (Technical Hardware).

(zzz) Software Designer (Technical Software).

(aaaa) Test Technician (Technical Testing).

(bbbb) Site Engineer (Installation/Commissioning).

24.2 Project Schedule

The VENDOR shall include with his quotation, a detailed Project Schedule showing the VENDOR'S best estimate of the achievable major schedule milestones.

The Project schedule shall be used as the main progress control document during the implementation of the project. The Project Schedule shall clearly show any 'float' or 'slack' time available together with any freeze dates required by the VENDOR and major milestones for equipment design, manufacture and delivery. The schedule shall clearly indicate required dates for each of CONTRACTOR supplied design data.

The VENDOR may include in the proposal any additional material which clarifies the procedure for implementing the Project Schedule.

24.3 Progress Reporting

The Project Schedule shall be used as the basis for monthly progress reporting, schedule controlling and schedule forecasting. At regular intervals, the VENDOR shall revise the Project Schedule to include the effect of changes and to reflect actual Project Progress.

24.4 Coordination Meetings

Coordination meetings shall be held as required between COMPANY, CONTRACTORS and VENDOR. The agenda for each coordination meeting will be prepared by the VENDOR prior to each meeting. Detailed

meeting minutes will be taken by the VENDOR and submitted for COMPANY and CONTRACTORS for approval. An ‘action item’ log shall be prepared and continuously updated by the VENDOR.

Coordination meetings, to be held either in Abu Dhabi or home office, will be a part of the purchase order scope.

SECTION D

25. DATA SHEETS TEMPLATES (AS APPLICABLE)

Not Applicable

26. STANDARD DRAWINGS (AS APPLICABLE)

Not Applicable

SECTION E

27. APPENDIX

Not Applicable