

OIL & GAS DEVELOPMENT COMPANY LIMITED
PROCUREMENT DEPARTMENT, ISLAMABAD
FOREIGN SECTION E

(To be completed, filled in, signed and stamped by the principal)

ANNEXURE 'A'

Material UPGRADATION / REPLACEMENT OF YOKOGAWA CS-3000 R3 DCS SYSTEM INSTALLED AT SINJHORO GAS FIELD
Tender Enquiry No PROC-FE/CB/P&P-3107/2017
Due Date
Evaluation Criteria FULL PKG.

SCHEDULE OF REQUIREMENT

Sr No	Description	Unit	Quantity	Unit Price (FOB)	Total Price (FOB)	Unit Price C & F BY SEA	Total Price C & F BY SEA	Deviated From Tender Spec. If Any
1	UP-GRADATION/REPLACEMENT OF YOKOGAWA'S CS-3000 R3 DCS SYSTEM TO YOKOGAWA OR ANY LATEST EQUIVALENT DCS SYSTEM AS PER CONSULTANT SCOPE OF SUPPLY & SPECIFICATIONS(SEE ATTACHMENT)	Lot	1					
2	RECOMMENDED SPARES FOR 02 YEARS (OPTIONAL)	Lot	1					
3	SERVICES FOR INSTALLATION, TESTING & COMMISSIONING OF THE OFFERED DCS SYSTEM (AS PER CONSULTANT DOCUMENT)	Lot	1					

Note:

- 1) PURSUANT TO TENDER CLAUSE # 2.2, 11.4, 13 & 35.3.2, BID BOND AMOUNTING TO **US\$ 6,000/-** (US DOLLAR SIXTHOUSAND ONLY) OR EQUIVALENT TO PAK RUPEES MUST BE SUBMITTED WITH THE TECHNICAL BID.
- 2) EVALUATION CRITERIA: **FULL PACKAGE WISE (EXCEPT RECOMMENDED SPARES)** ON CFR KARACHI BASIS. **UNIT PRICE OF EACH RECOMMENDED SPARE TO BE QUOTED SEPARATELY IN THE FINANCIAL BID ONLY.**
- 3) **TERMS AND CONDITIONS:** BIDDERS ARE ADVISED TO CAREFULLY READ ALL THE TERMS AND CONDITIONS OF THE TENDER DOCUMENT AVAILABLE AT OGDCL WEBSITE IN THE MASTER TENDER DOCUMENT.
- 4) **SHIPMENT FROM ACU MEMBER COUNTRIES:** IN CASE OF SHIPMENT FROM ACU MEMBER COUNTRIES, THE LC BENEFICIARY SHOULD BE OF THAT PARTICULAR COUNTRY FROM WHERE THE CONSIGNMENT IS BEING SHIPPED.
- 5) **SUMMARY REJECTION CRITERIA:** THE SUMMARY REJECTION CRITERIA AT CLAUSE 35 OF THE TENDER DOCUMENT MAY ALSO BE EXAMINED CAREFULLY. ANY BID NOT MEETING THE CRITERIA SPELLED IN THE CLAUSE # 35 SHALL BE SUMMARILY REJECTED WITHOUT ANY RIGHT OF APPEAL.
- 6) DETAIL TECHNICAL SPECS, COMPLIANCE SHEET & ENAR TENDER DOCUMENTS ATTACHED.
- 7) DELIVERY PERIOD : 120 DAYS FROM LC

UPGRADATION/REPLACEMENT OF YOKOGAWA'S CS-3000 R3 DCS SYSTEM WITH YOKOGAWA OR EQUIVALENT DCS SYSTEM WITHIN LEAST SHUT DOWN TIME OF PLANT WHICH MUST BE UNDER 05 DAYS AT SINJHORO GAS FIELD.

EXISTING YOKOGAWA'S DCS SYSTEM DETAILS:

ESTIMATED NO. OF OPERATIONAL INPUT/OUTPUT's: 1000.

DETAILS OF INPUT/OUTPUT's:

ANALOG INPUT's: 430, ANALOG OUTPUT's:160, DIGITAL INPUT's: 310, DIGITAL OUTPUT's: 150

EXTERNAL INTERFACE PROTOCOLS : TCP/IP, MODBUS, RS485

FEATURES OF EXISTING DCS SYSTEM HARDWARE/SOFTWARE (CS-3000 R3):

NO. OF NODES: 07 (WITH REDUNDANT POWER SUPPLIES AND ESB DUAL BUS COMMUNICATION (PROPRIETARY OF YOKOGAWA) WITH FCU.

FCS-FIELD CONTROL STATION MODEL: AFG-30D-H4143 (100% REDUNDANT)

INTERFACING: SERIAL COMMUNICATION AT NODE-2 FOR RS485 AND RS232/RS485

HMI TO FCU INTERFACING: VNET (100% REDUNDANT)

APPLICATIONS SOFTWARE AT FCU & HMI : YOKOGAWA

OPERATING SOFTWARE AT HMI: WINDOWS XP SP-2

FOR ITEM NO. 1) INCLUDING ALL THE REQUIRED LATEST HARDWARE (EWS,OVS,SERVERS,HISTORY SERVER,PANELS,MAIN REDUNDANT PROCESSORS, POWER SUPPLIES,INPUT/OUTPUT MODULES, COMMUNICATION MODULES),LATEST DCS SOFTWARE, ITS ALL REQUIRED LICENSES,FIELD CONTROL UNIT/CONTROLLER,PANELS,CABLES, CABLE CONNECTORS, ANY INTERCONNECTING DEVICES,INTERFACES,PATCH CABLES & ACCESSORIES FOR THE REPLACEMENT/UPGRADE.

I) REPLACEMENT/ UPGRADATION OF ENGINEERING WORK STATION (EWS) & OPERATOR WORKSTATION (OWS): ENGINEERING WORK STATION (01) & OPERATOR WORKSTATION (02) NO. ARE REQUIRED HAVING DUAL MONITORS.

II) INDUSTRIAL PC's/SERVERS (HEAVY DUTY FAN LESS PREFERRED) & PERIPHERALS:

LATEST QUAD CORE PROCESSOR E5-1620 OR EQUIVALENT, MINIMUM 3.60GHZ / MOST LATEST AVAILABLE, MINIMUM 10MB CACHE, MINIMUM RAM's: 16GB (2X8GB- DDR3, ECC, RDIMM) / MOST LATEST AVAILABLE, DUAL HARD DRIVES: MINIMUM 1TB (2X1TB) HD.100 % REDUNDANT PORTS FOR COMMUNICATION AND NETWORKING WITH DCS.

III) MINIMUM 32" FULL-HD/LED- WIDESCREEN DIGITAL & TOUCH MONITOR WIDE VIEWING ANGLE: 178 / 178 DEGREES, HIGH CONTRAST RATIO OF: 3000:1, RESOLUTION: 1920 X 1080, SPEAKERS, BACKLIGHT LIFE TIME: 50000 HRS, OPTIONAL TOUCH: OPTICAL TOUCH, MULTI-TOUCH.

IV) ONE ENGINEERING LAPTOP.

V) REDUNDANT COMMUNICATION EQUIPMENTS.

VI) REDUNDANT COMMUNICATION INTERFACE WITH PLANT SAFETY SYSTEM.

VII) SYSTEM CABINETS.

VIII) LIFETIME LICENSES.

ATTACHMENT FOR INDENT #SGF/I/082/201

IX) INDUSTRIAL KEYBOARD AND MOUSE
INDUSTRIAL HEAVY DUTY DUAL POWER SUPPLY 220VAC.
INDUSTRIAL HEAVY DUTY A4 SIZE ONLINE SHARED PRINTER FOR REAL TIME ALARMS (01 No's)
HEAVY DUTY INDUSTRIAL COLOR PRINTER HAVING OPTION OF A3 SIZE PRINTING FOR TRENDS, GRAPHICS AND DAILY REPORTS. (01 No's).

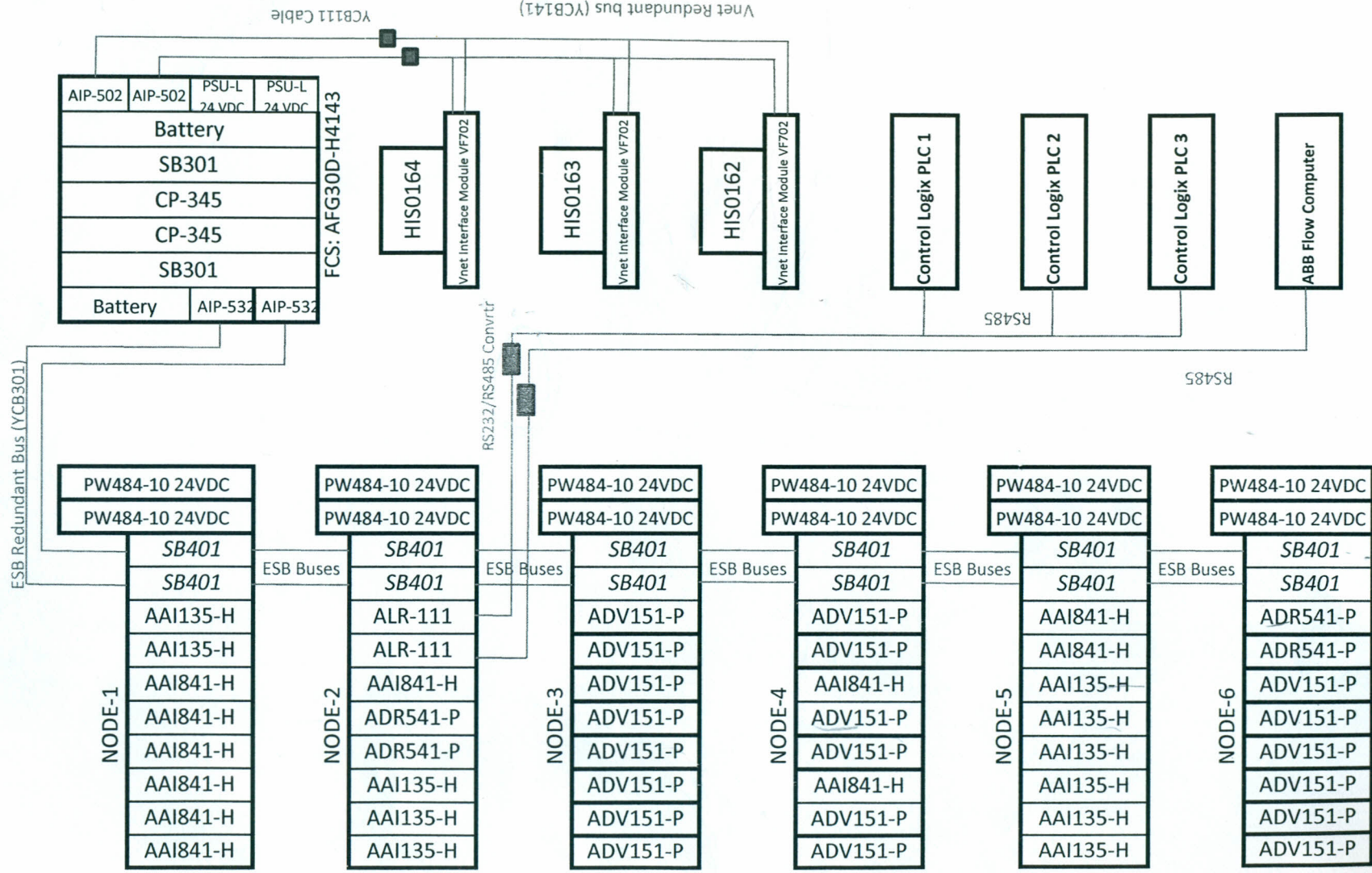
OGDCL HAS LICENCES OF WINDOW 10, MS OFFICE AND ANTIVIRUS,

X) EWS AND HMI LICENSED OPERATING / APPLICATION SOFTWARE TO OGDCL-SGF:
1500 LICENSED INPUT/OUTPUT's ARE RERQUIRED. (EXISTING ARCHITECTURE OF THE DCS SYTEM IS ATTACHED AT ANNEXURE "A")

TERMS AND CONDITIONS:

- 1.OEM AUTHORITY LETTER MUST BE PROVIDED.
- 2.BIDDER TO CONFIRM THAT THE SUPPLIED ITEMS ARE BRAND NEW WITH STANDARD WARRANTTEE/GUARANTTEE.
- 3.BIDDER TO CONFIRM THAT ALL ITEMS WILL BE PROVIDED IN STANDARD OEM PACKING.
- 4.BIDDER TO COMPLY ALL THE TERMS & CONDITIONS ATTACHED AT ANNEXURE "B"(COMPLIANCE SHEET), OTHERWISE CONSIDERED TECHNICALLY NON-RESPONSIVE.
5. BIDDER SHOUL SUBMIT TECHNICAL BID IN THE LIGHT OF CONSULTANT M/S ENAR SCOPE OF SUPPLY AND SPECIFICATIONS FOR THE DCS SYSTEM AT "ANNEXURE C"

Existing CS3000-R3 Architecture



Node-7 will be added in near future

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**COMPLIANCE SHEET FOR THE UPGRADATION/REPLACEMENT OF
YOKOGAWA'S DCS SYSTEM INSTALLED AT SINJHORO GAS FIELD AGAINST THE
INDENT#SGF/I/082/2017**

S.No.	Terms & Conditions	Compliance By Bidder (Yes/No)
1	FIELD TERMINATIONS WILL NOT BE DISTURBED.	
2	ACTIVITY FOR DCS INSTALLATION & COMMISSIONING WILL BE COMPLETED WITHIN 5 DAYS SHUTDOWN TIME OF SINJHORO GAS FIELD WHICH WILL BE PROVIDED DURING ATA-2018 (AUGUST/SEPTEMBER-2018).	
3	IT WILL BE THE RESPONSIBILITY OF THE BIDDER TO DESIGN, SUPPLY, ENGINEERING/INSTALLATION, TESTING AND SUCCESSFUL COMMISSIONING OF THE OFFERED DCS SYSTEM INCLUDING ITS HMI/EWS ON TURNKEY BASIS.	
4	THE BIDDER SHOULD VISIT THE SINJHORO GAS FIELD TO UNDERSTAND THE ALREADY INSTALLED YOKOGAWA'S DCS SYSTEM ARCHITECTURE/SCOPE OF WORK BEFORE THE SUBMISSION OF BID.(IF THE BIDDER DOES NOT VISIT THE FIELD, ITS BID WILL NOT BE CONSIDERED FOR TECHNICAL EVALUATION)	
5	BIDDER WILL PROVIDE THE COMPLETE BILL OF MATERIAL INCLUDING ALL HARDWARE, SOFTWARE & LICENSES SPECIFICATIONS WITH PART NUMBERS AND QUANTITIES WITH THE TECHNICAL BID	
6	BIDDER WILL PROVIDE THE PROPOSED SYSTEM ARCHITECTURE DESIGN FOR THE OFFERED DCS SYSTEM.	
7	BIDDER WILL BE RESPONSIBLE FOR PROVISION OF ALL THE REQUIRED LICENSES/SOFTWARES FOR THE OFFERED DCS SYSTEM.	
8	A KICK-OFF MEETING WILL BE ARRANGED BY THE BIDDER AFTER THE AWARD OF THE CONTRACT.	
9	BIDDER SHALL BE THE INTERNATIONALLY REPUTED OEM OF THE OFFERED DCS SYSTEM(COMPLETE HARDWARE/SOFTWARE/ENGINEERING SERVICES) WITH DOCUMENTARY PROOF OF BIDDER'S CONTINUOUS PRESENCE IN PAKISTAN AND HAVE WELL ESTABLISHED OFFICE IN PAKISTAN DURING LAST 3 YEARS AND WILL ALSO PROVIDE LIST OF THREE PROJECTS EXECUTED IN PAKISTAN.BIDDER WILL PROVIDE THE DOCUMENTARY PROOF OF SUCCESSFUL COMPLETION OF AT LEAST 3 No's OF SIMILAR PROJECTS (DCS SYSTEM) IN LAST THREE YEARS IN OIL & GAS,FERTILIZER AND PETRO-CHEMICAL SECTOR IN PAKISTAN AS PRIMARY CONTRACTOR.BIDDER SHOULD PROVIDE THE DOCUMENTARY EVIDENCE OF THESE PROJECTS.(MANDATORY REQUIREMENT OTHERWISE CONSIDERED AS TECHNICALLY NON-RESPONSIVE)	
10	THE NOMINATED TEAM FOR THE EXECUTION OF THIS PROJECT SHOULD HAVE VAST PROFESSIONAL EXPERIENCE OF COMPLETING THE DCS PROJECTS IN OIL & GAS, FERTILIZER & PETRO-CHEMICAL SECTOR WITH SIMILAR SCOPE AND QUANTUM OF CURRENT PROJECT.	

11	BIDDER WILL ARRANGE FACTORY ACCEPTANCE TEST (FAT) FOLLOWED BY FOREIGN TRAINING OF THE OFFERED DCS SYSTEM AT MANUFACTURING WORKS/OEM TRAINING FACILITY FOR 03 PROFESSIONALS.ALL THE TRAINING EXPENSES LIKE AIR TICKET, BOARDING, LODGING, HOTEL ACCOMODATION WILL BE BORNE BY BIDDER.THE FAT/TRAINING WILL BE CONSIDERED AS THE PART OF THE CONTRACT	
12	BIDDER WILL RESPOSIBLE TO ARRANGE AN ONSITE TRAINING FOR ENGINEERS/OPERATORS AND WILL ALSO PROVIDE THE COURSE DESCRIPTION AND WILL BE CONSIDERED AS PART OF CONTRACT.	
13	BIDDER WILL PROVIDE THE HARD AND SOFT COPIES OF DOCUMENTATION (ON DVD'S) OF COMPLETE UPGRADES OF THE PROJECT.	
14	THE BIDDER WILL PROVIDE 1 YEAR MANADATORY SUPPORT OF THE OFFERED SYSTEM AFTER THE SUCCEFULL INSTALLATION AND COMMISSIONING OF THE UPGRADED/REPLACED DCS SYSTEM.	
15	BIDDER WILL BE RESPONSIBLE TO COMPLETE THE PROJECT IN ONE GO WITHOUT ANY DELAY AND WITH IN THE STIPULATED TIME PERIOD.BIDDER TO ENSURE AVAILABILITY OF APPROPRIATE SERVICE ENGINEER/TECHNICIAN FOR RESPECTIVE JOB.	
16	IF ANY HARDWARD/SOFTWARE DURING ENGINNERING, INSTALLATION/ COMMISSIONING PHASE OR AFTER STARTUP OF THE SYSTEM FOUND FAULTY, NOT WORKING PROPERLY IT WILL BE RESPONSIBILITY OF BIDDER TO REPALCE IT FREE OF COST.	
17	BACKUPS OF ALL THE SOFTWARES WILL BE PROVIDED.	
18	BIDDER WILL PROVIDE ALL TYPES OF MANUALS RELATED TO UPGRADED HARDWARE/SOFTWARE.	
	BIDDER WILL PROVIDE PRIVILIGES OF ALL SOFTWARES.	
19	LIST OF RECOMMENDED SPARES AS OPTIONAL FOR 02 YEARS FOR THE OFFERED DCS WILL BE PROVIDED BY BIDDER ALONG WITH COST & PART NUMBERS BUT WILL NOT BE CONSIDERED PART OF FINANCIAL EVALUATION.	
20	RECOMMENDED CONSUMMABLES FOR THE OFFERED DCS WILL BE PROVIDED BY THE BIDDER AND WILL BE PART OF THE CONTRACT.	
21	SERVICES COST WILL BE LUMP SUM FOR THIS PROJECT, HOWEVER THE BIDDER WILL PROVIDE THE BREAKUP OF THE SERVICE CHARGES INCLUDING NUMBER OF PROFESSIONALS DEPUTED AT THIS PROJECT AND THEIR DAILY MAN RATES.	
22	THE MINIMUM LIFE OF THE OFFERED DCS SYSTEM SHOULD BE 10 YEARS.	
23	BIDDER TO PROVIDE THE SCHEDULE FOR THE SUPPLY/ INSTALLATION/TESTING/COMMISSIONING FOR THE OFFERED DCS SYSTEM	

Note: Bidder failed to comply all of the above mentioned Terms & Conditions (01-23 No's), will be considered as technically Non-Responsive.

**COMPLIANCE SHEET FOR THE UPGRADATION/REPLACEMENT OF
YOKOGAWA'S DCS SYSTEM INSTALLED AT SINJHORO GAS FIELD AGAINST THE
INDENT#SGF/I/082/2017**

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23	BIDDER TO PROVIDE THE SCHEDULE FOR THE SUPPLY/ INSTALLATION/TESTING/COMMISSIONING FOR THE OFFERED DCS SYSTEM	

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**UPGRADATION/REPLACEMENT OF
DISTRIBUTED CONTROL SYSTEM AT
SINJHORO GAS PLANT**

**Scope of Supply and Specification for
Distributed Control System**



0	Issued for Review	03-JULY-17	WAS	NAS	NAS
Rev.	Revision Description	Date	Prep.	Check	Appr.



**ENAR Petrotech Services
(Pvt.) Limited**



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1.0 GENERAL

The Sinjhoru Gas Plant was relocated from Dhodak, commissioned in 1990's. It was equipped with Distributed Control System (YOKOGAWA CS-3000 R-3) being an automated control platform for process variables related to Plant operations.

The aforementioned DCS system has already completed 15-year life in operation at Dhodak plant before being relocated to Sinjhoru. The hardware as well as software support is not available due to obsolescence of technology also its hardware components are not available in the market.

OGDCL intends to improve the control of Sinjhoru Field by upgrading/replacing existing Yokogawa Control System with latest Distributed Control System for controlling and monitoring of entire field process from Centralized Control Room.

This document specifies the scope of work for supply, engineering, designing, implementation, manufacturing, fabrication, assembling, configuration, programming, inspection, performance testing, documentation, shipping, supervision, start up, pre-commissioning, commissioning and inclusion of all the hardware and software supply and services for the required Distributed Control System.

Engineering configuration for the Distributed Control System shall be done as mentioned in this specification and referred documents. The system shall be configured by mutual participation of the vendor & client personals.



1.1 Definitions

Client / Owner	Oil and Gas Development Limited (OGDCL)
Engineering Consultant	ENAR Petrotech Services (Pvt.) Limited.
VENDOR / SUPPLIER / Manufacturer	Supplier for Distributed Control System
DCS	Distributed Control System
EWS	Engineering Workstation
OWS	Operating Workstation
CPU / Controller	Central Processing Unit of Control System
CCR	Central Control Room
FAT	Factory Acceptance Test

1.2 Language and Units of Measurement

The governing language shall be English language.

The units both in Imperial Unit System and SI System shall be applied as listed below:

Gas Flow	lb/hr, SCFM, MMSCFD	Liquid Flow	lb/hr, US GPM, Barrels
Pipe Diameter	In	Mass Flow	lb/h
Density	lb/ft ³	Viscosity	cP, cS
Temperature	°F	Voltage	V
Length	km, m, mm	Current	A
Mass	Lb	Power	kW, MW
Pressure	Psi	Noise	dB(A)
Level	mm, %		

1.3 Environmental Conditions

The Vendor shall take special note of environmental conditions associated with an installation being situated in Pakistan. The DCS will be placed in CCR where air conditioning will be available. The following service conditions shall be considered for control room devices .

Location:	Indoor
Ambient temperature:	36-121 °F
Control room temperature:	85 °F (average)
Humidity:	18% to 76%

1.4 Order of Precedence

In case of any conflict between this specification and its referred documents and the above codes and standards, the Vendor shall bring the matter to Client's attention for resolution and approval in writing before proceeding with design, manufacture or purchase. In all cases the more stringent requirement shall apply.

The order of precedence shall be as follows:

- ▶ This specification and referred documents
- ▶ Latest Revision of referenced International Codes and Standards

Any deviations from the requirements of this specification, its attachments and the referred codes and standards shall be listed as a section in the bid as "List of Exclusion / Deviations". In the absence of such a statement, full compliance shall be considered.

Compliance by the manufacturer with the provision of this specification does not relieve him of his responsibility to furnish equipment and accessories of a proper design, selection.

1.5 Deviations

All deviations from the requirements of any of the listed or attached Documents, specifications, codes, standards, regulations, guidance notes, etc. shall be clearly stated in the bid and agreed with Client before proceeding.

In the event of any conflict, inconsistency or ambiguity between the vendor scope of work, specification, international codes and standard, referenced in this Specification or any other attached documents, the Vendor shall be responsible for describing such confliction to Client.

2.0 SCOPE

The scope for supplier shall cover minimum the following and as illustrated in this document:

- ▶ Supply, Engineering, Configuration, Testing and Commissioning of Distributed Control System (DCS).
- ▶ Integration of Distributed Control System with existing skid mounted PLC based Control System.
- ▶ Integration of Distributed Control System with Plant Safety System
- ▶ Hardwired Interfacing with Motor Control Center (MCC).
- ▶ Supply of Commissioning and Two Years Spares.
- ▶ Supply of Engineering Laptop.
- ▶ Supply of Workstation Consoles and Furniture.
- ▶ Factory Acceptance Test (FAT).
- ▶ Site Acceptance Test (SAT).
- ▶ Training.
- ▶ Documentation.

The Distributed Control System services shall include supply of complete Hardware and Software. The Distributed Control System supply shall include Power supplies, Controllers, I/O modules, Communication equipments, marshalling and system cabinets, data servers, workstation, switches, consoles, printers, cables, connectors and other associated required equipment for complete and reliable operation.

The Distributed Control System I/O capacity shall be as specified in Section 26 “DCS System I/O Capacity”. The Distributed Control System Hardware, Software, Spares and all other associated equipment shall minimum meet the requirements as mentioned in this specification.

The Distributed Control System vendor shall be responsible for the complete engineering of the system. Minimum following services for engineering of Distributed Control System shall be provided by the supplier:

- ▶ Configuration of complete Distributed Control System hardware.
- ▶ Configuration of Control Loops
- ▶ Configuration of Engineering Workstation, Operator Workstations.
- ▶ Configuration of Data Servers
- ▶ Configuration of Alarms, Events, graphs, trends etc..
- ▶ Configuration of Printers.
- ▶ Preparation and configuration of Graphics (HMI Screens)

The Distributed Control System supplier shall be responsible for the complete and successful commissioning of the DCS system. The supplier shall provide complete support and assistance during plant startup.

It is envisaged that the existing Marshalling Panel shall be used for new DCS system and only new System Cabinets with Controller, I/O Cards, Power Supplies, Relays etc shall be supplied by DCS supplier. Field termination is not allowed to be changed/modified or disturbed.

In order to get complete overview of the installed marshalling cabinets DCS supplier shall must visit Sinjhor Gas Field to understand the already installed DCS system architecture/scope of work before submission of Bid.

Any modification required in existing marshalling panel in order to interface with newly supplied system cabinets and DCS System shall be responsibility of the DCS supplier.

Preparation/development of Complete As-built drawings for existing Marshalling Cabinet shall also be included in DCS supplier scope of work.

Distributed Control System vendor shall supply spare parts approved by Client. Vendor shall also submit the complete Distributed Control System parts list.

The Distributed Control System supplier shall be responsible for complete arrangements and planning for Factory Acceptance Test (FAT), Site Acceptance Test (SAT) and Training. Vendor shall submit the schedule and all related documents to Client prior to FAT, SAT and Training.

The Distributed Control System Supplier shall provide the documentation for the Distributed Control System as specified in this specification.

2.1 Documents to be submitted with Technical Bid:

Supplier shall submit the minimum following documents in its technical bid:

- ▶ Detailed Bill of Material (BOM).
- ▶ Functional Design Specification.
- ▶ Equipment Datasheets.
- ▶ Details of professionals who will be involved in the project.
- ▶ Complete list of control system hardware (Power supplies, CPU, I/O modules, communication modules, switches, servers etc) with model number and Quantities.

- ▶ Literature and details of offered DCS hardware (e.g. Power supplies, CPU, I/O modules, workstations, communication equipment, Printers, Data servers etc).
- ▶ Literature and details of offered DCS software (Development Software, Historian, alarm & events, diagnostic etc).
- ▶ System Architecture Layout of the Control System.
- ▶ Details for suppliers approach for Engineering of DCS system for complete integration of other system and plant operation.
- ▶ Sample of DCS graphics, Faceplates, details faceplates, historian, alarm & events, loop drawings, EWS Logic development tool snaps, etc.
- ▶ Details for DCS cabinets (Dimensional Drawings, layouts, related installation accessories etc).
- ▶ Details for all accessories installed in DCS system cabinets including manufacturer, type etc).
- ▶ Dimensional Drawings for Consoles and Cabinets.
- ▶ Load List (approximate).
- ▶ The vendor shall submit a Level 1 Project Schedule in which all project related activities should be covered.
- ▶ Tentative Delivery Date of the System.
- ▶ Details for integration with existing control system through OPC.
- ▶ Supplier tagging details.

2.2 **Documents to be submitted after Award of Project**

Supplier shall submit the following minimum documents for approval after mentioned weeks from award of LOI:

- | | |
|--|-----------|
| ▶ Level – II Project Schedule | 02 weeks. |
| ▶ Details of professionals who will be involved in the project | 02 weeks. |
| ▶ System Architecture Layout | 03 weeks. |
| ▶ Panel Dimensional Drawings | 07 weeks. |
| ▶ Final Load List with equipment and system level segregation | 12 weeks. |
| ▶ Workstation Consoles and Furniture Dimensional Drawings | 08 weeks. |
| ▶ Control Panel General Arrangement Drawing | 12 weeks. |
| ▶ Panel Internal Wiring Drawings. | 08 weeks. |
| ▶ Loop Drawings | 14 weeks. |
| ▶ Details of softwares | 08 weeks. |
| ▶ Literature and Details of offered DCS software functionality/capabilities not include as per current requirements of project but are available, if | |



required.	08 weeks.
▶ Power Distribution Drawings.	12 weeks.
▶ As-Built Marshalling Panel Termination Drawings	08 weeks.
▶ Availability Calculations	08 weeks.
▶ Literature of each hardware component	08 weeks.
▶ System Generated Controller Loading Report	12 weeks.
▶ HMI Snapshots	12 weeks.
▶ I/O Schedules	08 weeks.
▶ DCS Programming in IEC-61131 or IEC-61499	08 weeks.
▶ FAT / IFAT Procedure	16 weeks.
▶ SAT Procedure	20 weeks.

3.0 SYSTEM ARCHITECTURE

The control system architecture shall be based on standard field proven equipment. The Distributed Control System (DCS) shall have the capability to monitor, control, display, alarm logging, continuous trends and system diagnostic. DCS system shall have main central controller (central node) and three remote node/stations for monitoring and control of three separate process units.

The DCS shall be integrated for monitoring & control with the existing control system at the control network level through OPC. Data mapping on controllers for integration shall not be required and Controller Loading shall not be affected due to the integration of these systems. The system shall comprise of following equipments installed in control room:

- a) One Engineering Workstation (Dual screen)
- b) Two (02) Operator Workstations (Dual screen)
- c) One Engineering Laptop.
- d) Redundant Data Servers with single monitor.
- e) Redundant Power Supplies.
- f) Redundant Controllers.
- g) Analog, Digital, RTD, Thermocouple, Serial Interface, Fiber Optic Interface, Ethernet Interface and Pulse Type Input / Output Modules.
- h) Redundant Communication Equipments.
- i) Redundant Communication interface with Plant Safety System
- j) Serial / Ethernet Interface modules.
- k) A4 Laser Printer.
- l) A3 Laser Printer.
- m) System Cabinets.
- n) Lifetime Licenses.

Architecture shall be composed of standard based technologies including support for HART protocol, Profibus and their field devices.

Latest compatible available versions of Windows Operating System and DCS software shall be supplied at the time of shipment.

DCS shall comply with “Open System Architecture”. The number of Controllers shall depend on the I/O count and the computation load on the controllers. The offered DCS shall have single tag based database and capability to modify and upload the single control loop without interruption to the remaining plant process.

Vendor shall provide the system as per required number of I/O counts including the spares as specified in Section 26.0 “DCS System I/O Capacity”..

The DCS control configurations, Events, Alarms and HMI graphics shall be configured as per the plant P&ID’s and client instructions.

Vendor shall review and advice for the best possible solution to configure the DCS as per the requirements mentioned in this specification.

3.1 Use of Standard Products

- 3.1.1 The system shall be composed of manufacturer's standard hardware, system software and firmware that can be configured to meet the stated requirements. The Supplier's standard system, operating software is not recommended to modify for meeting the User's requirements.
- 3.1.2 Application Softwares shall be designed in a manner that requires no modification to the system operating software.
- 3.1.3 Software design shall be such that future revisions or updates of the system operating software shall not affect the successful operation of the system.

3.2 INTEGRATION WITH EXISTING THIRD PARTY PLC CONTROL SYSTEM

The Distributed Control System (DCS) shall be interfaced with Existing (third party) control systems through MODBUS RS 485 Serial Interface. The Data Servers shall be used to acquire the data from each third party package and serve the data to DCS and HMI for monitoring. The VENDOR shall supply, install and configure any required applications on the third party package SUPPLIER systems to avoid configuration related issues (if required). Configuration, Applications and Hardware required for data acquisition from the third party package to the data server and the DCS HMI shall be included in the SUPPLIER scope. The Third Party Package control systems basic information is given hereunder for bidding purpose however Vendor shall collect all other necessary information for successful interfacing from Sinjhor site before and after bid as and when required by SUPPLIER. Redundant Server Class Machines shall be provided to acquire data from Third Party Packages and serve the data to operator workstations. All alarms, events, trends, process values, set-point values and indications of the third party packages shall be displayed on the DCS HMI for monitoring.

The following Third Party Package Control Systems will be interfaced with DCS System.

- Control Logix PLC-1
- Control Logix PLC-2
- Control Logix PLC-3
- ABB Flow Computer

Minimum 500 tags shall be considered for each package (per interface) which will be configured for monitoring through RS-485.

3.3 Integration of Existing Plant Safety System with DCS

The Existing Plant safety system (ABB 800xA) shall be integrated with DCS for monitoring through redundant Ethernet based protocol at the control network level. Process & System Alarms & events, ESDV & BDV valve position indications, Shutdown Level Actuation Indications shall be transmitted and displayed on DCS HMI. All process values, alarm / events, indications and trends of DCS shall also be displayed on the Safety System HMI. The vendor shall be responsible for all required configuration, hardware, cables, external interfaces required to interface the Safety System with the DCS. The DCS and Safety System shall be integrated at the control network level to avoid controller loading and repeated data mapping of I/O points. The integration shall be such that monitoring, alarms, events and historian logs of both systems shall be accessible from either of the systems.

3.4 Redundancy

The System shall employ the minimum following redundancy:

- 3.3.1 Cabinet mounted redundant microprocessor based Control Processing Units (CPU's) with supporting electronics and auxiliaries.
- 3.3.2 System shall have support for redundant I/O modules. However the supplied I/O modules shall be non redundant.
- 3.3.3 Redundant Power Supply modules connected with each processor sized at 100% and operating on a load-sharing basis shall be provided. Redundant Circuit Breakers for incoming redundant UPS Supply shall also be provided.
- 3.3.4 Redundant communication equipment shall be provided for sub-communication system between the controller and operator interface etc.

- 3.3.5 Redundant servers shall be provided for entire plant data historization and further data connectivity to operator workstations.
- 3.3.6 Redundant Data servers shall be provided for data acquisition from third party package control systems.
- 3.3.7 Redundant Local Area Network (LAN) communications to all Workstations and Data Servers.
- 3.3.8 Redundant Communication Module for interfacing with Plant Safety System
- 3.3.9 The Dual LED, Engineering and Operator Workstations shall be redundant to each other for the entire plant monitoring and controlling. In case of failure of any of the workstation the other shall be able to perform the entire plant monitoring and controlling task depending upon the User security passwords. All of the information on the network shall be available and shared on each workstation.

3.5 Spare Capacity and Expansion

- 3.5.1 DCS should be scalable / modular in design so that future expansion could be made easily.
- 3.5.2 DCS shall be supplied with 30% spare capacity for all elements of the system including control configuration, graphics, history, reports, trends etc.
- 3.5.3 Each system shall be supplied with 30% spare capacity for all elements of the system configuration, including application software, graphics, history, reports, and trends. A spare capacity of 30% for each I/O type in the base system shall be installed. A minimum of 30% spare capacity for future expansion in the CPU to be supplied once all programming/configuration is completed. This capacity will be additional to the 30% spare I/Os which shall be supplied installed as specified in Section 1.2 of the specification. The base system is defined as the quantity of hardware and software needed to meet the project requirements.
- 3.5.4 Communication networks within the DCS shall include a 25% unused node addresses.
- 3.5.5 Redundant capacity is not to be considered as spare capacity. The system racks shall contain 25% spare capacity including terminal blocks, relays, power supply circuit breaker etc. The spare I/Os of the modules shall be terminated to appropriate terminals for easy interconnection in future. The cabinets shall have 25% spare capacity for future racks.
- 3.5.6 The system shall allow for upgrading of system operating software, control configurations, firm wares of the system components without the necessity of shutting

down the process, without losing the operator interface, and without the loss of access to any control function.

- 3.5.7 The system shall be sized such that not more than 60% of the processing capability and memory is utilized for the installed applications.
- 3.5.8 There shall be adequate space in the System Cabinets so that at least one I/O rack can be added in future.

3.6 Miscellaneous

- 3.6.1 The DCS shall be supplied with full system hardware, software, hardware and diagnostic software, preventive and predictive maintenance features.
- 3.6.2 Supplier shall supply all special tools and test equipment required for DCS installation, commissioning, start-up and maintenance.
- 3.6.3 DCS Supplier shall be responsible for preparation of Control Philosophy of complete Plant Control and Monitoring loops by Consulting With Owner during execution of Project. Supplier may also Visit Plant site for gathering of any required data as and when required during Project designing phase.
- 3.6.4 The DCS system supplied shall have a latest software and hardware at the time of delivery. DCS system software's, firmware's etc. if updated with in warranty period shall be provided free of cost with installation instruction guides. The vendor shall also confirm to provide local support (if required) for the up-gradation of the system.
- 3.6.5 The supplier shall maintain an effective program for quality assurance and quality control planned and developed in conjunction with system development, manufacturing, storage and application function, etc.
- 3.6.6 The graphics, continuous historian, alarms and events, faceplates, diagnostic, control configuration display shall be provided at each workstation.
- 3.6.7 Engineering, design, assembling, configuration, simulation / testing etc. of I/Os shall be the part of this project.
- 3.6.8 Communications with other foreign devices shall be via industry standard protocol, interfacing devices or as mentioned in this specification.
- 3.6.9 DCS system should have support for tested AGA-3 and AGA-8 software modules. The AGA-3 function computes the mass flow rate and the volumetric flow rate at base and flowing conditions of natural gas. AGA-8 function computes the super compressibility of natural gas. However no software AGA-3 & AGA-8 modules are required for this project.



4.0 ELECTRICAL REQUIREMENTS

4.1 Available Electrical Supply

Electric power available shall be 230VAC, 50 Hz. Supplier shall supply all necessary power transformation equipment for any other voltage levels required by the DCS supplier's equipments requirement.

4.2 Electrical Area Classification

Building containing DCS equipment will be rated as electrically unclassified.

4.3 Electromagnetic Compatibility

All supplied equipment shall have EMI / RFI suppression and shall meet all electromagnetic compatibility requirements of the IEC 61000-4-2, 61000-4-3, and 61000-4-4 standards.

4.4 Cabinet and Workstations Grounding

4.4.1 The AC SAFETY GROUND and instrumentation circuit shall confirm to NEC, Article 250 and IEC 61000-5-2.

4.4.2 The "SAFETY GROUND" bus shall be directly bolted to the cabinet without the use of insulators. A suitable sized screw-type compression connector shall be provided on either end of each ground bar for interconnection with other ground busses or to the instrument system ground node. The ground buses inside the termination and system cabinets shall be made of solid copper suitably drilled and tapped for screw terminals and wire lugs, or better arrangements.

4.4.3 AC SAFETY GROUND for all exposed metal surfaces of the cabinets, racks and chassis's ground connections. Individual wiring interconnections shall be made up of copper wire with green / yellow tracer insulation.

4.4.4 SHIELD CONNECTION for connecting cable and wire shields interconnections between shield consolidation points and the bus bar shall be made up of copper wire with green tracer insulation.

4.4.5 DC REFERENCE GROUND (i.e. for all DC analog / digital commons) interconnections between DC common consolidation points and the bus bar shall be made up of copper wire with green / yellow tracer insulation. The "SHIELD CONNECTION" and "DC REFERENCE GROUND" bus bars shall be segregated from the "AC SAFETY GROUND".

4.5 Input / Output Control & Signaling Voltage:

- i) Digital Input/Output : 24VDC etc. Refer Instrument Index
- ii) Analog Input/Output : 24VDC, 4-20mA with and without HART Protocol
- iii) RTD Input : Resistance (Pt-100)

4.6 System / Equipment Protection

- i) I/O Module Protection: Through Isolators (Galvanic / Optical)
- ii) Surge & Transient Protection: To be provided for controller / system power supply.

4.7 Noise Level

The maximum acceptable noise level for each piece of equipment installed in the Control Room shall be 55 dBA measured at a distance of one (01) meter.

4.8 System Power Supplies

The Supplier shall utilize redundant supply from UPS to provide full system power via a distribution board inside each system cabinet and supply all equipment required for system power supply. Supplier shall completely wire / terminate and test all power supply and cables inside DCS cabinets.

The DCS system power supply shall be redundant and working on load sharing basis. The system shall be fully operational on failure of any power supply. The replacement of failed power supply shall be possible online without any system process disturbance.

All wiring within cabinets shall be splice free copper wire, with flame-retardant insulation, and labeled at each end.

Necessary breakers, isolators shall be provided for disconnection of main supply and to various components of the DCS without interruption of the overall system process.

All power supplies (main incoming and system distribution power supplies) failure indication and alarm shall be provided on DCS HMI. The alarm shall be logged in system failure category. DCS supplier shall consider the I/O counts of these interfaces in the offered system. These I/O counts shall not be allowed to adjust in spare quantity.

5.0 SYSTEM HARDWARE SPECIFICATIONS

5.1 Controller / CPU

- 5.1.1 The controllers shall be Dual Redundant with redundant power supplies and redundant communication network ports.
- 5.1.2 The communication equipment between controller and I/O modules shall be redundant.
- 5.1.3 CPU shall be capable of both modulating and sequential control.
- 5.1.4 The controller loading shall not be more than 50 % after complete configuration and engineering of the system.
- 5.1.5 CPU must employ on line diagnostic routines for identification of failures throughout the system.
- 5.1.6 CPU Modules shall be capable of stand-alone operation without the need of operating consoles / workstations, data highway or other support hardware except for power.
- 5.1.7 Controller / CPU shall be capable of store all configuration, process parameters and in case of power failure shall reboot automatically without any user interfere to its last state at the time of failure.
- 5.1.8 All control algorithms shall continue operating with the last valid information in the event of communications subsystem failure.
- 5.1.9 It shall be possible to put any individual control loop in the manual mode. It shall be possible for an operator to manipulate the output of a control loop in the manual mode.
- 5.1.10 All cascaded loops shall support bump less transfer.
- 5.1.11 It shall be possible to switch CPU from primary to backup/standby CPU. The command to switch from primary to backup CPU / Controller shall be from Engineering Workstation only through engineering access.
- 5.1.12 All CPU's should be redundant. Transfer to the backup CPU upon failure of the primary CPU shall be automatic and bump less without the disturbance in system and plant operation. Replacement of the failed CPU with a spare CPU must be possible on line without control interruption. Newly replaced CPU module shall automatically configure the last good known status of the failed controller or from its partner (redundant CPU) and automatically communicate with its redundant

- CPU. The new installed CPU shall have a capability to go in active state after the confirmation of user without process abruption.
- 5.1.13 No computer programming shall be required to configure the system. Ladder diagram, function block and sequential function programming format shall be used. All CPU configurations shall be fill-in-the-blank type, utilizing a function block oriented software package; each block will be evaluated five times per second as a minimum.
- 5.1.14 Maximum program scan time shall be less than 250 milliseconds. The scan time shall not vary with input / output load and control configuration functional blocks.
- 5.1.15 CPU module shall base on industry standard and having capabilities for Profibus and HART integration as minimum.
- 5.1.16 CPU loading shall not be more than 50% at any time when completely running at peak load with all connected PLCs, Serial interfaces and Ethernet interfaces are operational. Vendor shall provide the CPU utilization details & graphs and other related parameters to HMI in Diagnostic option. CPU loading information shall be presented in percentage also in CPU diagnostic information.
- 5.1.17 Programming shall be based on open language i.e. IEC 61131-3 or compliant.
- 5.1.18 It shall be possible to put any individual control loop in the out of service.
- 5.1.19 CPU module shall have capabilities of fuzzy control. Vendor shall also provide software modules and licenses for the fuzzy controlling.
- 5.1.20 Vendor shall also take into account the following soft tags for required licenses and controller selection :
- 5.1.21 Soft Tags for Alarms (HH, H, L, and LL) shall be considered for all analog inputs.
- 5.1.22 Soft Tags for Alarms (H, L) shall be considered for all digital inputs.
- 5.1.23 Trends, historian and faceplates shall be configured for all I / Os.
- 5.1.24 All tags, alarms & events of DCS System will be integrated with each other.
- 5.1.25 Total Soft Tag capacity of system shall not be less than 10,000 Licensed.
- 5.1.26 Alarms and Events for data acquired from Third Party Packages through MODBUS TCP / MODBUS SERIAL RS 485 shall be configured and logged in the historian.
- 5.1.27 Vendor shall include the Power supply for CPU module as per their system requirement. CPU power supply shall be separate from the other system and field instruments power supply requirements.

5.1.28 System shall be provided with lifetime licenses for the maximum number of I/Os mentioned in attached Appendix – II, “DCS I/O Capacity”.

5.2 I/O Modules

5.2.1 It shall not be necessary to remove power or field wiring to replace input / output module.

5.2.2 The field instruments mostly used in the plant are explosion proof and DCS shall consider all the I/O modules accordingly else specified in the Client I/O list or in this document.

5.2.3 Common mode rejection ratios of 60 dB or greater at 60 Hz and normal mode rejection ratio of 30 dB or greater at 60 Hz are required.

5.2.4 Process I/O circuits shall be protected against common mode transient surges of up to 300 Volts RMS. Such transient surges shall not cause damage or system performance degradation.

5.2.5 All digital process I/O circuits shall be designed to ensure that accidental normal mode connection of up to 300 VAC/DC for an unlimited period of time shall not cause damage other than to the I/O module to which it is connected.

5.2.6 Digital output circuits shall be provided with surge suppressors for protection against switching of inductive loads.

5.2.7 DCS Supplier shall consider Separate Digital I/O Modules for Solenoid Valve (DO) and Field switches (DI) with High High Signal/Alarms (i.e. LSHH, PSHH, TSHH etc). Any other DO Signal in Solenoid Valve Module or any Other DI signal in High High Switches Module shall not be acceptable.

5.2.8 All I/O modules are isolated from each other, i.e. failure of one module or dismantling of one module shall not affect the other modules or system.

5.2.9 All I/O cards shall include a current limiting equipment / transformer to prevent shorting of the card. All I/O cards shall also provide transient suppression and undergo surge withstand capability testing. Galvanic or Optical isolation shall be provided for Digital input and output modules.

5.2.10 Failure of I/O module shall not cause the failure of field instrument power.

5.2.11 All I/O modules shall have an auto sensing capability.

5.2.12 All inputs / outputs to the field shall be individually fused. The DCS system shall be able to perform an integrity loop check and provide out of calibrated range indication.

- 5.2.13 All calibration constants of the I/O card shall be handled using software without the need of any external or internal hardware on the I/O card. Re-calibration shall not be required when replacing any I/O card.
- 5.2.14 Inputs and outputs shall be generally grouped by process unit. Each process unit shall have generally dedicated input / output cards, so that only one process unit will be affected by an input / output card failure.
- 5.2.15 The system shall be capable of supporting electronic 4-20mA, 24VDC, HART analog inputs and outputs. It shall be possible to install these I/O modules without removing power from the chassis. All components shall have Plug and Play capability.
- 5.2.16 DCS supplier shall currently provide all analog inputs and outputs supporting 4 – 20mA, 24VDC, HART signals. It shall be possible to install these I/O modules without removing power from the chassis. All components shall have Plug and Play capability.
- 5.2.17 All analog instruments shall be loop powered 4 – 20mA, 24VDC, HART compatible.
- 5.2.18 An LED indication of power, error condition, active and standby status shall be provided on each I/O module.
- 5.2.19 All I/O cards shall have a resolution of 12 bit or better.
- 5.2.20 System shall support Serial and Ethernet Interface cards. The cards shall configure and scanned automatically.
- 5.2.21 The system I/O modules shall have a capability of redundancy so that in case of card failure automatic switchover shall be taken place without disturbing the process where the redundant I/O modules are installed.
- 5.2.22 I/Os shall be provided as per attached Appendix – II, “DCS I/O Capacity” and as illustrated in this document.
- 5.2.23 Analog Inputs
- The system shall be capable of supporting the following analog process input signals:
- i) 4-20mA at 24VDC with HART
 - ii) Type B, E, J, K, N, R, S, and T thermocouples
 - iii) Platinum resistance temperature detector (RTD) as per IEC 60751
 - iv) Pulse input

Analog input modules shall provide the repeatability and accuracy shown below as minimum:

- i) Accuracy : $\pm 0.1\%$ of full span

5.2.24 Analog Outputs

The system shall be capable of supporting the following analog process output signals:

- i) 4 – 20mA
- ii) 4-20mA at 24VDC with HART protocol

Repeatability and accuracy shown below as minimum shall be provided for analog output modules:

- i) Accuracy : $\pm 0.25\%$ of span

5.2.25 Digital Inputs

The system shall be capable of supporting the following digital input types:

- i) 24 VDC

Time stamping of 1 second or better resolution shall be provided for each digital input I/O.

5.2.26 Digital Outputs

The system shall be capable of supporting the following digital output types:

- i) On/Off
- ii) Momentary (configurable width)

The following solid state output rating shall be available:

- i) 24 VDC

Supplier shall provide 24VDC (4PDT relays) for all digital output circuits.

Latching and non-latching momentary contact outputs shall be available.

5.3 Communication Equipments

5.3.1 All communication between workstations and CPU shall be on redundant high speed minimum 100 MBPS, Ethernet TCP/IP protocol according to IEEE 802.3.

5.3.2 Communication switches used shall be minimum 100 Base TX with at least 20% spare connections and capacity.

- 5.3.3 Communication wiring shall follow separate routes from the data / power cables. Proper tagging of communication wiring shall be implemented.
- 5.3.4 Primary and secondary (redundant) cables shall have different insulation colors and shall be tagged properly.
- 5.3.5 Communication interference with other plant control packages shall be possible through open industrial protocol. The interface shall be bidirectional for control, monitor and configuration purpose.

5.4 External Interface

DCS shall have a capability to interconnect with the other control systems with Serial port for serial communication and Ethernet card/module .

- 5.4.1 DCS shall have provision for RS-232, RS-485, Modbus TCP/IP, Ethernet TCP/IP interfacing and communication.
- 5.4.2 Serial Interface modules shall mount to any available slot in the controller I/O rack. The controller shall Auto sense the interface module and configured automatically for presence in the system. There shall be no need to setup any dip switches. Direct interface to workstations / servers is also not acceptable.
- 5.4.3 Communication will be required to interface the package PLC's to DCS system. The interfacing shall be used for monitoring / control of package control system data.
- 5.4.4 RS-485 communication shall have full and half-duplex operation with following selectable baud rates: 19200, 38400, 57600 and 115200.
- 5.4.5 IEEE 802.3 "Ethernet" protocol at 100 MBPS with TCP/IP communication shall be possible in DCS.
- 5.4.6 All devices connected through communication interface must be integrated into the DCS database for HMI, Alarm Logging, Data Historization and other requirements.

6.0 DCS WORKSTATIONS AND DATA SERVERS

The DCS shall be supplied with minimum One (01) dual screen Engineering Workstation, Two dual screen (02) Operator Workstations, Redundant Data Servers and Engineering Laptop.

6.1 Workstations General Requirements

- 6.1.1 All workstations shall be on the same redundant Ethernet / Bus and failure of any workstations shall not affect other workstation. Each workstation shall have access to (directly or through a network), a printer for logging alarms, system events, continuous historian and other information.
- 6.1.2 All Workstations data shall be shared on network and possible to connect any workstation data to any workstation on the network.
- 6.1.3 Hard drive data of each workstation shall be shared and available to all workstations.
- 6.1.4 Alarms, Events, Continuous historian, configuration etc shall be available on each workstation.
- 6.1.5 All alarms, events and trends of tags received through Serial Communication shall be available on EWS and OWS.
- 6.1.6 All process values, indications & set-point values of Third Party Control System received shall be available for monitoring on each DCS Workstation.
- 6.1.7 The Workstations shall be branded high reliability workstation approved by the DCS manufacturer and workstation manufacturer. Complete details and approval certificates for the workstations shall be submitted to Client for approval.
- 6.1.8 All workstation shall support Dual LED monitor installation. All LED monitors shall have VGA and DVI connectors.
- 6.1.9 Workstations shall be Full HD LED - Digital Wide Touch Screen having below mentioned specifications as minimum:
- Wide viewing: 178/178 Degrees,
 - High Contrast Ratio: 3000:1,
 - Resolution: 1920 x 1080,
 - Backlight Lifetime: 50000 Hrs
 - Optional Touch: Optical Touch, Multi Touch.

- 6.1.10 All workstations monitors, printers, keyboard, mouse and other accessories shall be industrial grade type.
- 6.1.11 All workstations shall be provided with Qwerty Keyboard and Optical Mouse. Supplier proprietary keyboards are not acceptable.
- 6.1.12 The USB ports shall not be accessible to operators and shift supervisors due to the security risk of the DCS system. USB Flash drives, USB hard drives and other USB media storage devices shall not be accessible through USB ports for the operators and supervisors. Any software required for this purpose shall be provided by DCS vendor. Administrator shall have an access to use USB ports for USB Flash Drives, USB Hard disk and other media storage devices.
- 6.1.13 All workstations shall have a latest Microsoft Windows operating system approved by the DCS manufacturer and Microsoft cooperation.
- 6.1.14 All workstations shall be equipped with latest version of Microsoft Office, Adobe writer, AutoCad and Antivirus software's.
- 6.1.15 All project documentation, vendor documentation, wiring drawing etc. shall be available online on the hard disk of each Workstations. Electronic version of all hard copy documents shall also be provided in PDF or JPEG image format for convenient access. The documents if hand marked or are not available in softcopy shall be scanned and submit to client. The scanned copies shall also be copied on all workstations hard drive.

6.2 Engineering Workstation

- 6.2.1 An engineering workstation shall provide the Administrative control to the DCS system with minimum following functions:
 - i) Configuration
 - ii) Database generation
 - iii) Graphics display generation and modification
 - iv) Control algorithm generation and modification
 - v) Report generation and modification
 - vi) System access configuration
 - vii) File access
 - viii) Field device configuration, maintenance and diagnostic
 - ix) System Diagnostic
 - x) Monitors, Control and Keyboard plant area assignments
 - xi) Utility program access

- 6.2.2 The Engineering Workstation (EWS) is a programming and engineering computer station connected over a redundant minimum 100 MB Ethernet network.
- 6.2.3 EWS shall also be used for monitoring and control of the plant operation.
- 6.2.4 Windows desktop shall be restricted by the user ID and passwords.
- 6.2.5 The Engineering Workstation (EWS) shall be equipped with lifetime licenses for all programming, database development, and communication servers etc.
- 6.2.6 The Engineering Workstation (EWS) shall support the creation, loading, activation, deactivation and deletion of control strategies on-line. Existing control strategies and modules will continue to function while on-line changes are being made. Online changes shall only be possible from EWS.
- 6.2.7 Engineering workstation shall be capable to capture the Alarms & Events and Continuous historian for the entire plant operation. The Alarm & Events shall be shared to any workstation available on the network.
- 6.2.8 Engineering Workstation shall also be used for the synchronization of time throughout the network so that one time shall be run for all the equipments connected to the network. All workstations, controllers and other DCS system equipment shall update their time through engineering workstation. In case of failure of workstation the primary controller shall be used as the Master equipment for time synchronization of the network.
- 6.2.9 Engineering workstation shall be of branded & latest model available in the market approved/recommended by manufacturer and DCS vendor with above specifications and minimum equipped with, but not limited to, the following:
- i) Latest Intel Industry proven technology approved by dually DCS and Workstation system manufacturers for its optimum performance for the functions illustrated in this specification shall be utilized for motherboard and processor
 - ii) Latest Quad Core Processor E5 or Higher, Minimum 3.60 GHZ / most latest available
 - iii) Windows 10 or latest version compatible with all application Software and drivers with latest version of licensed Antivirus
 - iv) 2 TB Hard disk or better (2 in Each System, One Primary and One Secondary)
 - v) 4 GB High Performance Graphics Card (supported by display software)
 - vi) 32" HD/LED Dual Monitor

- vii) 16GB (2 x 8 GB) RAM or better
- viii) CD/DVD Writer
- ix) Modem
- x) LAN Card (with one spare in addition to utilized capacity)
- xi) Speaker, QWERTY Keyboard & Optical Mouse
- xii) At least 4 USB 2.0 & 2 USB 3.0 ports
- xiii) Two (02) Nos. of 1 TB USB 3.0 portable disk drive (for backup)

6.3 Operator Workstations

DCS supplier shall supply Two (02) numbers of operator workstations. The Operator workstations shall provide the minimum following functions:

- 6.3.1 Each Operator Workstation shall be operating individually for Plant operating purpose shall communicate to data server for data monitoring and controlling.
- 6.3.2 User configurable buttons or screen targets to select operational functions or displays with a single entry shall be provided.
- 6.3.3 It shall be possible to change control assignments to allow control of any plant area from any operator workstation.
- 6.3.4 Each operator workstation shall be of “Dual Display” type i.e. Two 32” LED monitors shall be connected to the same workstation. No special user training shall be required. Without any special configuration, user shall be able to select an item on one screen and drag it to the other screen. Dedicated monitoring screen for any particular operating purpose shall not be acceptable. Any operating screen shall be drag to any monitor or share both screens as both screens are act as a single screen.
- 6.3.5 The operator workstation shall also allow user configurable graphical layouts. It shall be possible to dedicate either one or more monitors to the operator interface. Additionally, it shall be possible to use the second monitor to view other applications without occluding the operator process graphics and displays.
- 6.3.6 Windows desktop shall be restricted by the user ID and passwords.
- 6.3.7 Operator Workstation shall be of branded & latest model available in the market approved by manufacturer and DCS vendor with above specifications and minimum equipped with, but not limited to, the following:
 - i) Latest Intel Industry proven technology based system at the time of delivery approved dually DCS by Workstation system manufacturers for

its optimum performance for the functions illustrated in this specification shall be utilized for motherboard and processor

- ii) Latest Quad Core Processor E5 or Higher, Minimum 3.60 GHZ / most latest available
- iii) Windows 10 or latest version compatible with all application Software and drivers with latest version of licensed Antivirus
- iv) 2 TB Hard disk or better (2 in Each System, One Primary and One Secondary)
- v) 4 GB High Performance Graphics Card (supported by display software)
- vi) 32" HD/LED Dual Monitor
- vii) 16GB (2 x 8 GB) RAM or better
- viii) DVD Writer
- ix) Modem
- x) LAN Card (with one spare in addition to utilized capacity)
- xi) Speaker, QWERTY Keyboard & Optical Mouse
- xii) At least 4 USB 2.0 & 2 USB 3.0 ports

6.4 Data Servers

The redundant server shall be provided for data communication. The Data Servers shall be utilized to provide the minimum following tasks and functions:

- i) Database generation
- ii) Graphics display generation and modification
- iii) Report generation and modification
- iv) File access
- v) Data Historian
- vi) System Diagnostics
- vii) Utility program access
- viii) Continuous Historian viewer
- ix) Alarms & Events viewer
- x) Overall workstation diagnostic tool
- xi) User ID / Password managing software
- xii) Provide connectivity for data interface to all connected workstations and plant systems.

- 6.4.1 The Data Server shall connect over a redundant minimum 100 MB Ethernet network.
- 6.4.2 All workstation in DCS except engineering workstation used in the control system shall work as Client and Data Server shall be work as Server. The overall DCS system architecture may be Client – Server Architecture. However this is not a mandatory requirement.
- 6.4.3 The Data Server shall be used for monitoring and recording of continuous graphs, Alarms & Events and to serve the stored data to all other connected workstation on the network. Maximum time require to update the data to other workstations shall not exceed One (01) second.
- 6.4.4 The Data Server shall also perform time synchronization between DCS and all Third Party Package Systems.
- 6.4.5 The Data Server shall have lifetime licenses for all the softwares installed and system related licenses.
- 6.4.6 The Data Server shall be high reliable and high performance Computer Machine.
- 6.4.7 The Data Server shall also be utilized for generating and configuring the reports in Microsoft Excel. The report generation will be the process plant parameters, alarms & events etc. The report generated shall store on the hard drive and accessible to other workstations connected on the network.
- 6.4.8 The Data Server shall also be used to share data with other workstation and shall also operate independently.
- 6.4.9 The historian of 6 months (180 days) should be available on the Data Server. The data above 180 days shall automatically backup to Server hard drive. The backup data shall be loaded when required without any loss of current or active historian data. The loading of backup data in future shall not require any programming and commands. It shall be loaded through drag and drop technique.
- 6.4.10 The Alarms & Events of 6 months (180 days) shall be available on Data Server. The day after 180 days shall automatically backup to local hard drive and shall be accessible when required without any loss of current or active alarms & events services.
- 6.4.11 The loading of alarms & events in future shall not require any programming and commands and recommended to drag and drop technique.

- 6.4.12 Data Server shall also be used for previous data visualization in terms of Alarms & Events and Continuous trends for two years (730 days). The process shall not affect the overall performance of the Data Serve, other connected workstation and DCS system.
- 6.4.13 The data for above two years (730 days) shall be stored on backup media (CD or DVD as illustrated and recommended by the vendor as per the storage limit). The data above two years shall be deleted after confirmation by the system Administrator.
- 6.4.14 The data shall not be deleted automatically without confirmation by the system administrator. It is preferred that the deleting confirmation alarm shall be logged in system alarms & events list for confirmation.
- 6.4.15 Data Servers shall not be utilized for engineering purpose of DCS system.
- 6.4.16 Data Servers shall be of branded & latest model available in the market comply and approved by manufacturer and DCS supplier with above specifications and equipped with, but not limited to the following:
- i) Latest Intel Industry proven technology based system by dually approved by DCS and Workstation system manufacturers for its optimum performance for the functions illustrated in this specification shall be utilized for motherboard and processor
 - ii) 4GB High Performance Graphics Card (supported by display software) or better
 - iii) RAID Hard Drives
 - iv) 16GB (2 x 8 GB) RAM or better
 - v) DVD Writer
 - vi) Dual redundant power supplies
 - vii) Modem
 - viii) Redundant LAN Card (with one spare in addition to utilized capacity)
 - ix) Redundant LAN Cards for third party Serial Interface.
 - x) Speaker, QWERTY Keyboard & Optical Mouse

7.0 PRINTERS

DCS supplier shall provide the following network printers.

One (01) A4 Color Laser Printer

One (01) A3 Color Laser Printer

A4 and A3 printers are utilizing for printing trends, screen displays and historical data from any workstation. This printer shall also be utilizing for Alarms, Events and tabular reports on operator action.

All printers shall have Ethernet cards and shall be shared on a common network. Each printer shall be available to each workstation of the DCS System.

Cabinets / Base footing shall be provided for each printer.

All printers shall be connected through network and shall be available to all workstations. Vendor shall ensure that the overall performance of the DCS shall not affect due to printers.

The printer shall be able to differentiate between 'alarm' messages and 'return to normal' messages.

The operator shall have the capability of initiating any of the following printing functions from any of the workstation:

7.1 Real Time Trending

Print out of Real-time Trends of all analog points in the group display shall be possible without any interruption in the plant process and overall DCS performance.

7.2 Historical Trending

Historical trending shall be possible for all configured inputs. It shall not be required to configure printer separately for any input. All inputs shall be configured for printing by default. Supplier shall submit details of system trending capacity with respect to number of points and time base availability.

7.3 Tabular Printout

A tabular printout of hourly historical data for the preceding: 12, 24 or 72 hours shall be possible for each group.

7.4 HMI Screen Printout

Any display including graphics on the HMI shall be capable of being printed out as required to provide hard copy record.



7.5 Reports

Free formatted reports shall be printed on periodic for hourly daily, weekly or monthly and on operator's demand.

7.6 Print Out Scale

Printer shall have a built in feature to zoom or merge the printout and having a print preview feature.

8.0 SYSTEM CABINET

Supplier shall supply the cabinets as per the specifications mentioned below:

8.1 INTERCONNECTION CABLE WIRING / TERMINATION

The interconnection cable wiring and termination in the cabinets shall be done minimum as per the requirements mentioned below:

- 8.1.1 Cable of different colors shall be used for different type of signals as described below:
- i) Blue / Blue White for Digital Output
 - ii) Brown / Brown White for Digital Input
 - iii) Black / Black White for Analog Input
 - iv) White / White Black for Analog Output
 - v) Earthing Cables as described above in Section 4.4.
- 8.1.2 Perforated PVC cable ducts shall be used for covering of cables. PVC ducts fill area shall not be more than 60%.
- 8.1.3 Analog Input / Output and Digital Input / Output signals shall run in different cable ducts.
- 8.1.4 Cable ducts shall be of different colors to easily identify and trace cables of particular type with particular tags.
- 8.1.5 For analog Inputs / Outputs, all terminal blocks shall be provided with fuse and LED indication that will glow in case fuse burned out.
- 8.1.6 Terminal blocks for Analog Input / Output and Digital Input / Output shall be installed on different rails in order to identify the type of signals easily.
- 8.1.7 Proper tagging shall be implemented for identification of cables. The supplier shall achieve Client approval for the tagging method to be followed.
- 8.1.8 Cable used for interconnection within the system and marshalling cabinets shall be PVC insulated, stranded, tinned copper conductor type. Spade (U) and eye (I) lugs shall be used for termination of cables.
- 8.1.9 All terminal blocks shall be provided with best quality knife-edge terminals to ease repair / maintenance.

- 8.1.10 The proper tagging of terminal blocks shall be implemented to identify the cable termination for the particular signals easily. The supplier shall achieve Client approval for the tagging method to be followed.
- 8.1.11 Data communication and network communication cables shall maintain a minimum separation of 75mm from any AC power cables.
- 8.1.12 Supplier installed cables shall be designed and installed in such a way as to allow cable disconnection in order to service the equipment. Cables shall not interfere with removal of any circuit board, module or equipment.
- 8.1.13 Supplier shall submit the complete wiring diagram to Client and system shall be assembled after the approval of documents by Client. Any short coming pointed out by Client shall be incorporated / rectified by the supplier.

8.2 System Cabinet

- 8.2.1 The system cabinet shall house the I/O modules, controller modules, Power supply units, Communication interfaces etc and other relevant equipments.
- 8.2.2 System cabinet shall be of freestanding design and pre-wired.
- 8.2.3 Lifting Lugs shall be provided on top of each cabinet.
- 8.2.4 System cabinet enclosures shall have minimum IP54 environmental protection.
- 8.2.5 Ventilation fans with filters and pads to maintain the IP rating of the panel shall be provided.
- 8.2.6 System cabinets shall be double door with front and rear access and shall have the dimensions of 1200mm Width x 800mm Depth x 2100mm height (including 100mm plinth).
- 8.2.7 Spare space in each system cabinet shall be such that it shall be possible to install at least one complete I / O rack / station in the cabinet and shall have 40 % minimum spare space. The vendor shall submit the complete cabinet sizing details. The quantity of cabinets shall be finalized by the vendor
- 8.2.8 Ducting area in system cabinet shall not be more than 60% occupied by wiring.
- 8.2.9 System cabinet shall be suitable for bottom cable entry, via suitably drilled gland plates.
- 8.2.10 All wiring shall be ferruled at each end, using non-adhesive type wire markers in accordance with the wire numbers shown on drawings.

- 8.2.11 All necessary fittings such as terminal clamps and end plates etc required for good and proper installation shall be provided. All terminals shall be mounted on a steel back plate.
- 8.2.12 System cabinet shall be provided with lifting eyes, ventilation fans, door locks and door switch operated lights.
- 8.2.13 Temperature thermostat shall be installed in the system cabinet. The switch indication and alarm shall be configured in DCS. DCS supplier shall consider the I/O count of switch interface in their offered system. These I/O counts shall not be allowed to adjust in spare quantity.
- 8.2.14 Drawing pockets for A3 size documents shall be provided in the system cabinets at rear and front doors.
- 8.2.15 System cabinets shall have a 25% extra capacity for future expansion of the system. The fittings for 25% extra capacity shall be pre-installed in the cabinet so future expansion shall not require any system modification and only the required equipment shall be mounted for plug and play.

8.3 Marshalling Cabinet

- 8.3.1 Existing Marshalling Panel Shall be used by DCS Supplier and shall be interfaced with newly supplied System Cabinet. Any modification required in existing marshalling panel for interfacing with system cabinet shall be included in DCS supplier scope.
- 8.3.2 DCS Supplier shall also be responsible for development of As-Built Drawings of Existing Marshalling Panels.

9.0 WORKSTATION CONSOLES AND FURNITURE

The Industry standard ergonomic and modular metallic console furniture along with Six (06 Nos.) heavy duty industrial grade chairs shall be provided. The consoles shall be sized and arranged according to supplied Workstations and Printers

The supplied furniture shall be minimum as bellow:

- 9.1.1 House the PC casing and cabling of the PCs associated with the engineering and operator workstation.
- 9.1.2 Provide power connections, circuit breakers, earth connection etc to all the console equipment through individual circuit breakers for each workstation. The operator console shall have the computer power socket with 30% spare capacity.
- 9.1.3 Separate desk space for placing the printers with minimum one bay for telecommunication equipment.
- 9.1.4 Furniture shall have an enough space for placing documents, printers, printer pages and other utilities.
- 9.1.5 Two (2) coats of epoxy zinc chromate primer to a total minimum dry film thickness of 0.075mm (3 mils) shall be applied on operator consoles.

Operator Consoles shall be supplied for the following:

- DCS Engineering and Operator Workstation Consoles Suitable for 32“ Dual LED Monitors
- DCS Printer Bay (Vertical Rack type) for one A4 Laser Printer and one A3 Laser Printer
- Data Servers Console

Vendor shall prepare the operator consoles drawings and submit to Client for approval. The furniture shall be manufactured and delivered after the approval of Client.

Supplier shall bring into the knowledge of Client if any change in consoles dimension is required to accommodate the workstations and printers.

10.0 SYSTEM SOFTWARE SPECIFICATIONS

All system software shall be the most recent revision available at the time of supply with lifetime licenses.

The DCS scope of supply shall include as part of its offer all the development and lifetime runtime licenses required from various hardware / sub-system vendors as well as those required from third party software vendors in order to fulfill the requirements of this specification and in order to achieve a complete functional and maintainable system.

10.1 Display and Graphics

The graphic displays shall be initially built by the Supplier with the involvement of Client as part of this scope of supply. Minimum hundred (100) numbers of P&IDs shall be considered for configuration and HMI development.

The format of the basic graphics displays will be similar to the process line and instrument diagrams. The graphic display builder program shall be “object oriented” and easy to use.

Following guidelines shall be followed while developing system HMI.

By default process flow scheme display (P&ID) shall be shown on right screen of dual display OWS.

Company Logo and Plant name to appear on lower left side of left screen of dual display station.

Alarm status shall appear on upper left side of left screen of dual display station.

Next/Previous button shall be available at lower right.

A ‘Home / Overview’ button should appear on each screen ideally lower left corner next to company logo.

Navigation buttons to select different Units should be obvious and large enough to select quickly and to be placed at bottom bar.

Different background shall be assigned to different Units. For example, light grey may be used for the main plant, very light brown for the oil tank farm, light blue for the water plant. Dark colors shall not be used for backgrounds.

Use black outlines to highlight objects

Text size needs to be large enough to read at a distance e.g. Arial 16.

More detailed text should be added as pop-up windows or ‘tool-tips’.

Alarm colors will follow the convention: Red = alarm, Yellow = warning, green = status OK.

Data Resolution should be appropriate to use, avoid too many decimal values; 546.45 C is pointless and unclear.

Data should be grouped logically and placed on left screen of dual display station.

All workstations shall share the displays and graphics simultaneously from the data server. All dynamic values shall be updated simultaneously to all workstations without any degradation or time updating delay in the system performance. The maximum time for updating shall be less than 1 second or better.

All Displays and graphics shall incorporate dynamic process parameters.

It shall be possible to drag any operation window to any monitor screen on dual display workstation. Dedicated screens on particular monitor shall not be acceptable.

It shall also be possible to open multiple operation windows on single monitor for the ease of plant operators to monitor the plant operation.

The operator interface and windows desktop shall be restricted through user ID and Password. An operator cannot access the Windows Desktop unless and otherwise authorized by system Administrator. The Configuration of system shall be done through accessing the windows desktop through system administrator or authorized personnel's for security purpose.

10.1.1 Updating Capability

All displays and graphics that show real time data shall be automatically updated when the display or graphic is on a screen. Updates shall not require operator initiation.

The graphic display update time shall be 1 second or less. This time is the interval between instant of calling a particular graphics display to the screen and the instant when the full background information and all latest dynamic information as existing in the system database appear on the display.

10.1.2 Displays and Graphics Access

Operators shall be able to easily access specific displays and graphics by pressing dedicated function keys or screen targets, selecting from a list of displays in directories or menus, or by typing display or graphic names.

As the workstations are capable of dual display, therefore it is possible to drag and drop or open any graphic to any monitor of the workstation.

10.1.3 Hierarchical Displays

It shall be possible to move between related displays and graphics of different detail levels or of the same detail level with a maximum of two operator actions.

10.1.4 Paging

It shall be possible to cycle through a predefined series of displays with a maximum of one operator action.

10.1.5 Invalid Values

Special indication shall be used to indicate that a value is invalid.

10.1.6 Faceplates

10.1.7 Faceplates shall show dynamic process and status information about a single control loop and shall permit an operator to change control parameter values or operation mode (Loop Auto, Manual, Cascade, Out of service etc) for the loop.

10.1.8 The system shall automatically provide default faceplates for each control loop with tag number. It shall not be required to configure a faceplate or detailed display faceplates for each loop.

10.1.9 Faceplates shall be defined to pop-up when the appropriate location on a process graphic is selected with the mouse.

10.1.10 Faceplate shall have an option to call their respective operation window. The Software shall have an ability to search and call any faceplate from any operation window.

10.1.11 Operator shall have an option to open multiple faceplates (minimum 15 numbers) with user screen adjustment on HMI. The previously opened faceplates shall not be closed on opening of new faceplates.

10.1.12 It shall be possible that the faceplates shall be zooming through mouse to any selectable zooming scale range or stretch / skew through mouse as per the operator requirements.

10.1.13 Click on any Control Valve shall provide pop-up window showing control valve parameters.

10.1.14 Faceplates shall display the following information as applicable:

- i) Tag ID.
- ii) Tag descriptor.

- iii) Process input, set point, and output values displayed numerically with engineering units.
- iv) Process input, set point, and output in bar graph representation.
- v) Auto, manual, cascade and out of service (OOS) operation mode.
- vi) Visual indication for alarm status.
- vii) Symbolic and alphanumeric indication of discrete states both for two state devices and multi-state devices.
- viii) Option to view the alarm of module tag for which the faceplate is open.
- ix) Option to view the continuous historian of particular module tag for which the faceplate is open.
- x) Alarm Acknowledgement.
- xi) Option to open loop control configuration screen.
- xii) Option to open detail faceplate.

10.1.15 It shall be possible to perform the following control actions from a faceplate:

- i) Change control block mode (Auto, Manual, Cascade, Out of service etc).
- ii) Change set point and other operation parameters.
- iii) Issue commands to multi-state devices
- iv) Adjust alarm set point values.
- v) Adjust outputs in manual mode

10.1.16 Single faceplates shall be provided for control and indication of multi-state devices e.g. a motor operated valve shall indicate open, closed, intermediate position, and fault.

10.1.17 System Diagnostic Displays

10.1.18 Standard displays shall show the operational status of the communication system. The communication parameters of each module connected to the communication system (on-line, off-line, failed, primary failed, backup failed) shall be shown.

10.1.19 On-line displays shall indicate the results of self-diagnostic tests. Failure diagnosis shall be sufficiently specific to indicate which printed circuit boards, modules, or devices are at fault. The displays shall be designed to help maintenance and engineering personnel diagnose faults in the system and communications paths. Each category of diagnostic display shall be organized hierarchically.



- 10.1.20 Communications diagnostic displays shall show errors for each of the redundant paths.
- 10.1.21 Historian, alarms & events, workstation and servers diagnostic shall be shown in system diagnostic feature and failure shall be logged and captured in the system diagnostic event logger.
- 10.1.22 All events generated by the system shall be captured and electronically logged chronologically to the event database on data server. Events shall be time-stamped by the event generator. Events and their associated time stamp are passed to the event handler for capture.
- 10.1.23 It shall be possible to retrieve and sort events by time (ascending or descending order) or by type. The Operator shall be able to filter the events on certain criteria such as time, tag name, area name, or any specific event. Events and the historical trend information for a control tag shall be integrated into a single view.
- 10.1.24 All events shall be time stamped at the point of origin. Events generated in the controller shall be time-stamped in the controller. Those generated in the workstation and servers shall be time stamped in the workstation and data server.
- 10.1.25 Print on demand shall be included for all views possible with the alarm and event viewer application.
- 10.1.26 User Interface Graphics
- 10.1.27 A standard utility shall be provided that is able to generate and modify user-defined color graphics. The utility shall have the capability to make a copy of an existing graphic in order to build a new graphic that is similar. It shall use the same tag IDs that are used in the process database to access real-time variables from any database. No intermediate index numbers or addressing shall be required. It shall be subject to system access protection.
- 10.1.28 It shall be possible to place a new graphic in service without interrupting an operator's ability to control the plant.
- 10.1.29 It shall be possible to scan images and use them in a graphic display to help an operator to easily identify the process parameters being operated. Dynamic information shall easily be added to the images.
- 10.1.30 All control, monitoring and status attributes of any tag shall be displayable on graphics. For analog points this requirement includes measurement, set point, alarm limits, and output. For digital points this requirement includes input and output status. Status information includes: alarm status, control mode, and control status.

- 10.1.31 Numeric data shall be configurable on an individual basis. If the decimal point is not used, it shall be suppressed.
- 10.1.32 It shall be possible for each state of a multi-state device to be indicated by a unique foreground / background color combination.
- 10.1.33 It shall be possible for inactive alarm or status messages to be invisible to the operator by user authorities.
- 10.1.34 Symbolic representation of data on the graphics shall be performed by color changes (foreground and background independently), and flashing in any combination.
- 10.1.35 It shall be possible for users to create symbols and store them in a permanent library. The graphic builder utility shall have facilities to maintain this library.
- 10.1.36 It shall be possible to configure a screen target that calls up other displays.
- 10.1.37 It shall be possible to export any graphic to gif, jpg, jpeg and bmp format with the available dynamic information currently available.

10.2 Alarms and Messages Handling

The Alarms and Messages shall be configured separately for each mode of operation that is defined in this specification earlier. Alarms and messages of the particular selected mode shall be visible to the operator. The Alarms and messages shall be configured by the Engineer through restricted user ID and Passwords.

Alarms & events shall be share from data server to all workstation.

- 10.2.1 Alarms and Events shall be configured on Data servers. All workstations shall share the Alarms and Events from the data server. All workstations in the system shall share the alarms and events simultaneously without any degradation of the system performance or time delay.
- 10.2.2 Process and designated system alarms shall be annunciated, displayed and stored in history files. Normal plant operator actions, events and normal system actions shall be stored in history files if designated.
- 10.2.3 Alarms and messages shall be grouped to allow the user to readily identify and respond to alarms and conditions.
- 10.2.4 There shall be lifetime licensed for Alarms and Events feature.
- 10.2.5 Customized Alarm Summary and System Status Page shall be available.

- 10.2.6 Customized Process Report Summary on daily basis in Office, Excel or equivalent format shall be available.
- 10.2.7 For any process alarm, it shall be possible, by no more than one operator action, for an operator to access a display from which he may take corrective action.
- 10.2.8 The Alarm & Events shall be once acknowledged from any workstation shall be acknowledged globally and does not require acknowledgement from each workstation.
- 10.2.9 The highest priority alarms shall be displayed in descending order of priority.
- 10.2.10 Historian, alarms & events, workstation diagnostic shall be shown in system diagnostic feature and failure shall be logged and captured in the system diagnostic logger.
- 10.2.11 All events generated by the system shall be captured and electronically logged chronologically to the event database on data servers. Events shall be time-stamped by the event generator. Events and their associated time stamp are passed to the event handler for capture.
- 10.2.12 It shall be possible to retrieve and sort events by time (ascending or descending order) or by type. The Operator shall be able to filter the events on certain criteria such as time, tag name, area name, or any specific event. Events and the historical trend information for a control tag shall be integrated into a single view.
- 10.2.13 All events shall be time stamped at the point of origin. Events generated in the controller shall be time-stamped in the controller. Those generated in the workstation / server shall be time stamped in the data server.
- 10.2.14 Print on demand shall be included for all views possible with the event viewer application.
- 10.2.15 It shall be possible for inactive alarm or status messages to be invisible to the operator by user authorities.
- 10.2.16 Operator Actions
- It shall be possible to store all operator actions in history files, including:
- i) Inhibit / enable alarm
 - ii) Change mode of controllers
 - iii) Change set point of controllers
 - iv) Changes to alarm limits
 - v) Changes to tuning parameters

- vi) Changes to output
- vii) Acknowledgement

10.2.17 Engineer Actions

Engineer actions that change the control and monitoring of the process shall be stored in history files including:

- i) Placing stations and devices on-line or off-line.
- ii) Download of point configurations.
- iii) Any system changes.

10.2.18 It shall be possible to initiate process alarms by configuring alarm attributes of any physical or calculated I/O point.

10.2.19 To minimize analog input "chattering" there shall be configurable dead band parameters, on an individual tag basis.

10.2.20 For analog tags, the configurable triggers for process alarms shall include:

- i) Process variable high high limit exceeded
- ii) Process variable high limit exceeded
- iii) Process variable low limit exceeded
- iv) Process variable low low limit exceeded
- v) Process variable rate-of-change high
- vi) Process variable deviation from set point
- vii) Process variable invalid value

10.2.21 For digital tags, the configurable triggers for process alarms shall include:

- i) Either state
- ii) Change of state.

10.2.22 A list of inhibited alarms shall be available to be displayed and printed.

10.2.23 All devices connected to the DCS communication network shall be monitored for failures. A system alarm shall be generated for each failure detected.

10.2.24 All alarms shall be stored in history files with the capability to archive these to removable media. Capability shall be provided to recall these alarms in visible display lists according to selectable filtering options.

10.2.25 Process and System Alarms Audible Annunciation



The audible alarm shall be user configurable for different tones or patterns. The system shall have an adjustable volume control.

10.2.26 Process and System Alarms Visible Annunciation

The annunciation shall be less than 1 seconds of detecting the initiating event.

10.2.27 Active Process Alarms Summary

There shall be a summary display of active process alarms.

11.0 CONTROL AND DATA HANDLING

11.1 Fault Handling

- 11.1.1 Invalid value status shall be generated for inputs and calculated variables.
- 11.1.2 A value shall be declared invalid if any of the following conditions are true:
- i) If a value is out of range
 - ii) If a value cannot be measured or calculated
 - iii) If a value is declared invalid by an application program
 - iv) If a value is declared invalid by the source instrument
- 11.1.3 In the event of communications subsystem failure, regulatory control algorithms shall continue operating with the last valid information.

11.2 Control Modes

- 11.2.1 It shall be possible to put any individual control loop in a manual mode; and it shall be possible for an operator to manipulate the output of a control loop in the manual mode.
- 11.2.2 For cascade control, it shall be possible to configure remote set points from other regulatory controllers or from other DCS modules.
- 11.2.3 All control blocks that can accept a set point shall be capable of being switched between local set point (operator entered) and remote set point.
- 11.2.4 All cascaded loops shall support bump less transfer.
- 11.2.5 Control blocks shall be able to perform automatic mode switching based on external or internal logic inputs.
- 11.2.6 Mode switching shall include the following:
- i) Auto/computer/manual switching
 - ii) Local/remote set point switching

11.3 Initialization

- 11.3.1 Initialization shall occur when any of the following conditions exist:
- i) The control block is turned from OFF to ON
 - ii) The control block mode is changed from manual to automatic, from manual to cascade or from automatic to cascade or vice versa.

- iii) The control block output is cascaded to a control block which is being initialized

11.3.2 Variables that are being initialized shall be subject to the following:

- i) The system shall suppress nuisance alarms created by the initialization of the algorithm.
- ii) Calculations involving time-based data shall be reset.

11.3.3 Set point shall be initialized when the block is turned from OFF to ON. It shall be possible to configure its initial value.

11.3.4 The control blocks shall offer the option of either initializing the set point to the input value or of maintaining the last valid set point upon algorithm initialization.

11.3.5 In a cascade loop an output tracking option shall be available. When configured for output tracking the primary controller output tracks the secondary controller set point when the secondary controller is in either manual, automatic, or is itself output tracking.

11.3.6 Algorithm calculations shall be performed in floating-point engineering units or other such equivalent methods that do not require scaling.

11.4 Regulatory Control

11.4.1 Standard software algorithms shall be available to perform regulatory control functions. These process control functions shall be performed by predefined algorithms with configurable parameters.

11.4.2 Standard control algorithms shall be identical regardless of whether they reside in system controllers or the Foundation field devices.

11.5 Input Scanning

The scan time of all type of analog/digital inputs cards & DCS algorithm (Scan time means the sum of total time required for reading an input, running control algorithm and writing the output values) shall be better than 250 milli-seconds for any type of channel.

11.6 Input Functions

11.6.1 Square root extraction:

- i) Linearization of type B, E, J, K, N, R, S, and T thermocouples
- ii) Linearization of RTDs
- iii) Time-based filtering

- iv) Digital input tantalization
- v) Pulse input to frequency conversion
- vi) Dead band on a per loop basis

11.6.2 It shall be possible to force flow measurements to zero if the input is below a configured value (after square root extraction).

11.6.3 Input filtering and signal conditioning shall be performed before alarms are checked and control calculations are made.

11.7 Computational Functions

The following computational functions shall be supplied as standard, configurable items or simple algebraic instructions.

- i) Addition/Subtraction
- ii) Ramp generator
- iii) Lead-lag
- iv) Integrator / Accumulator
- v) Dead time
- vi) High / low select
- vii) Tangent
- viii) Multiplication/Division
- ix) Time averaging
- x) Signal selection switch
- xi) Exponential polynomial
- xii) Logarithms
- xiii) Square root
- xiv) Absolute value
- xv) Totalizing

11.8 Continuous Control Functions

The following control functions shall be supplied as standard configurable items:

- i) Proportional Integral Derivative (PID)
- ii) Proportional Integral
- iii) Proportional Derivative
- iv) Proportional only
- v) External feedback

- vi) Auto / manual with bias control
- vii) Ratio control
- viii) Integral only
- ix) PID with non-linear gain
- x) Override control
- xi) PID with feed-forward
- xii) Adaptive tuning
- xiii) Fuzzy logic control
- xiv) Signal Splitter

It shall be possible to select the execution frequency of each control loop regardless of execution in the system controller or field device:

11.9 Output Functions

The following output functions shall be supplied as standard configurable items and shall be the same regardless of execution in the system controller or field device:

- i) Linear
- ii) Linear with clamping (high and low restricted)
- iii) Non-linear characterization
- iv) Rate of change limits

11.10 Set Point Clamps

Upper and lower clamps on all set points shall be available.

11.11 Windup Protection

11.11.1 Control functions that include integral action shall provide windup protection.

11.11.2 Windup protection shall inhibit the integral action when the control block output is constrained by conditions such as:

- i) Output at high or low limits of span
- ii) Output at high or low clamps
- iii) Output is connected to the set point of a secondary controller which is clamped
- iv) Output tracking is active
- v) Output is not connected to any valid device or algorithm

11.11.3 When windup protection is active, this status shall be clearly visible to the operator in a standard faceplate display, and shall set a parameter that is accessible to graphic displays and application programs.

11.11.4 Control functions and computational functions shall include the ability to propagate the windup parameter through multilevel control strategies.

11.12 Discrete Control

The following discrete control functions shall be supplied as standard configurable items:

- i) Logic functions -- and, or, not, nand, nor, xor
- ii) Change of state detect
- iii) Set/reset flip-flops
- iv) Timers and counters
- v) Comparison elements -- greater than, less than, equal to, not equal to
- vi) Multiplexer (selects one of up to 16 signals)
- vii) Positive, negative, and bi-directional edge trigger

11.13 Sequential Control

11.13.1 It shall provide the necessary facilities for real-time control of sequential processes.

11.13.2 It shall have access to process control and other database information.

11.14 Sequential Functions

The following sequential functions shall be supplied as standard instructions:

11.14.1 Relational Expressions

- i) Equal to
- ii) Not equal to
- iii) Less than
- iv) Less than or equal
- v) Greater than
- vi) Greater than or equal

11.14.2 Calculations

- i) Add
- ii) Subtract
- iii) Multiply

- iv) Divide
- v) Exponentiation (whole and fractional)
- vi) Square root

11.14.3 Timers

- i) Output true after preset delay
- ii) Output false after preset delay

11.14.4 Counters

- i) Count up
- ii) Count down

11.14.5 Logical Expressions

- i) And
- ii) Or
- iii) Not
- iv) Exclusive or
- v) Single bit memory elements (flip/flops)

11.14.6 Hold Sequence

- i) Manual or preset time
- ii) Recycle to prior step
- iii) Skip one or more steps
- iv) Restart at beginning

11.15 Fuzzy Logic Control

The system shall allow configuration using fuzzy logic control. It shall be possible to use the auto tuning facility to tune loops implemented using fuzzy logic. Vendor shall provide all licenses, software and any other requirement related to the system manufacturer requirement to implement these controls.

11.16 Control Execution Monitoring

The system shall provide a mechanism to view control strategies as defined in the configuration while they execute in real-time as well as the real-time input and output values.

11.17 Loop Performance Monitoring

The DCS shall monitor all active control loops and set a flag upon detecting degradation in any loop performance or upon detecting an abnormal condition in a measurement, actuator, or control block.

11.18 Auto Tuning

An auto tuning feature shall be available in the supplied DCS system. The Auto tuning shall be:

- i) Applicable to processes with slow and fast dynamics
- ii) Used with self-regulating and integrating processes
- iii) Immune to noise and process load disturbances

This auto tuning facility shall minimum allow tuning of PID and fuzzy logic control loops.

An easy-to-use graphical interface shall be provided for auto tuning.



12.0 DATA HISTORIZATION

- 12.1 A configurable, real-time and historical data collection package shall be available to support trending, logging, and reporting.
- 12.2 The lifetime licenses shall be provided for Continuous historian for total number of I/Os the system supplied. The other requirement mentioned in this specification and vendor system requirement shall be included by the vendor. Vendor shall ensure that in future, no problem shall be faced regarding licenses when configured I/Os for historization.
- 12.3 Data Historian shall be configured for all tags received through MODBUS Serial and shall be available on DCS OWS & EWS HMI.
- 12.4 The historization shall be configured for maximum number of offered analog and digital I/O's.
- 12.5 Each control strategy would maintain its own historical configuration information. When a new control strategy is created, it shall include the history definition and is configured to the historian.
- 12.6 Data historian shall be capable of keeping all historical trend, alarm and event values for the complete plant on continuous basis for minimum 40 days without any need to archive the data. Data historian after 40 days shall be saved on hard drive automatically. Archived data historian shall be accessible easily without stopping and interrupting the current running historian when needed.
- 12.7 The data historization capabilities as specified in Section 7.4 shall also be followed as minimum.
- 12.8 The system historization shall also be configured for system power supply, controller / CPU efficiency, I/O modules efficiency, communication interfaces etc as minimum.
- 12.9 Report Generation and Trend Display
 - 12.9.1 Every workstation shall provide viewing for real-time and historical trend information.
 - 12.9.2 The system shall support user defined sets of trends so that commonly viewed historical information can be defined in trends once and easily accessed by selecting a pre-configured screen target incorporated in the graphic display.
 - 12.9.3 Single Page with Multiple sheets (atleast 08) for selection of Real Time Trend Data of AI at OWS.

12.9.4 A reporting utility shall be provided. It shall be possible to use any variable in the system or the history files in a report. It shall be possible for all reports to be displayed on a workstation screen as well as printed on a report printer. Scheduling for Hourly, daily, monthly, end-of-month, quarterly and yearly reports shall be supported. Reports shall be printed and also saved to disk when a process event occurs as defined by the user. It shall be possible to activate a report in the following manner:

- i) Upon demand (operator request)
- ii) Scheduled (hourly, daily and monthly)
- iii) Upon event occurrence

13.0 DIAGNOSTIC

13.1 Diagnostic of system and related equipment & accessories shall be available to engineering workstation and data servers.

13.2 On-line and off-line diagnostics shall be provided to assist in system maintenance and troubleshooting. Diagnostics shall be provided for every major system component and peripheral. If diagnostics do not exist for particular peripheral devices (for example printers and terminals,) the system must detect and provide an error indication for the failure of these devices.

14.0 CONFIGURATION AND DATABASE

The DCS system shall be configured as per attached I/O list 0162-ISL-6001.

14.1 Configuration Tool

- 14.1.1 The DCS shall use a single global configuration database to be shared by all components of the system. User shall not be required to enter the same data or configuration more than once.
- 14.1.2 The DCS database shall be configure for each three modes of operation.
- 14.1.3 A configuration tool shall be provided to generate or modify database and configuration data. The configuration tool shall employ fill-in-the-blanks or graphical block connecting format.
- 14.1.4 The configuration tool shall allow drag-and-drop functionality to move or copy configuration data from one location to another.
- 14.1.5 User shall be able to view control strategies as defined in the configuration while they execute in real-time, as well as view the real-time input and output values.
- 14.1.6 The configuration tool shall include a help utility to provide configuration guidance. This utility shall be similar to the Microsoft wizard.

14.2 Engineering Units

- 14.2.1 Each analog input, output, and control block shall be assigned an engineering unit designation.
- 14.2.2 It shall be possible for engineering units in the field devices to be different than engineering units in the other modules of the system.

14.3 Global Search Utility

Utilities shall be provided for global searching of the database. These utilities shall be under system access control.

14.4 Cross Reference Listings

The system shall be capable of generating listings containing the following fields:

- i) Tag ID
- ii) Tag descriptor
- iii) Point type
- iv) Hardware address

14.5 System Access

14.5.1 Access to DCS functions shall be restricted by using User ID and passwords. It shall be possible to define single users with selectable access privileges. It shall also be possible to define groups of users. All users within each group shall have the same privileges. It shall also be possible to limit a user to particular areas of the plant / DCS system configuration.

14.5.2 At a minimum, the following access privileges shall be available:

- i) Operate
- ii) Tune
- iii) Download configuration
- iv) Plant Area
- v) System Administrator
- vi) Operating system desktop access
- vii) Alarm Management
- viii) Continuous Historian / Trend of System
- ix) System Diagnostic

15.0 SHIPPING, STORAGE & PROTECTION OF EQUIPMENT

The disassembled DCS system shall be properly stored and protected from damage at all times. Storage and protection shall be in accordance with the Supplier's procedure.

Preparation for shipment shall be in accordance with Supplier's procedure. Supplier shall be solely responsible for the adequacy of the preparations for shipment and for ensuring that materials and equipment arrive at their destination in undamaged condition.

Supplier shall supply a list of weights and sizes of shipment packages prior to dispatch, to ensure that there are adequate facilities available at the project site for safely unloading and placing the equipment in its designated location.

It shall be the Suppliers responsibility to ship the equipment to Pakistan at Karachi port safely.

All shipping documents shall be in the English Language.

16.0 WARRANTY

- 16.1 Supplier shall have final and total responsibility for the design, manufacturing, and performance of the DCS system supplied. Supplier shall warrant the materials, construction and performance of the DCS system.
- 16.2 The supplier will have to provide the warranty/guarantee for 12 months faultless functioning of the unit from the date of commissioning including free of cost repair maintenance, procurement and installations of parts.
- 16.3 All firmware or software upgrades during the Warranty period shall be done free of cost.

17.0 DCS SUPPORT AND AFTER SALES SERVICES

- 17.1 The DCS supplier shall guarantee the confirmation of the DCS hardware / software support regarding technical services and spares for at least Ten (10) years.
- 17.2 DCS vendor shall provide the full support during Engineering, configuration, commissioning phase.
- 17.3 DCS vendor shall provide support for the full operation of the DCS system as per the satisfaction of Client.
- 17.4 Any up gradation in software, hardware and firmware shall be provide free of cost within a warranty period and DCS vendor shall also provide assistance for the implementation of upgrading the system.
- 17.5 DCS vendor shall also ensure to provide services from the local representative 24 hours / 7 days a week for maintenance, troubleshooting and configuration purposes. Vendor shall submit details for the offered support and services.
- 17.6 Commissioning Support and Site Services

The Vendor shall provide the service for the system installation, start-up, pre-commissioning, commissioning operation, maintenance and training to the personals nominated by the Client at site. The training shall be both classrooms oriented as well as hands on training on the system for the operation and maintenance purposes.

It shall be the responsibility of the supplier to co-ordinate with each Third Party Package Supplier representatives at site for data integration through OPC and MODBUS.

The Vendor shall clearly state how site support will be provided during the DCS warranty period (12 months from Commissioning) and how long-term services shall be provided for the installed system.

18.0 CLIENT PARTICIPATION

During the period of detail engineering, design & configuration of the system the Client should have the option to involve their engineer to be associated with Control system technical team.

19.0 TRAINING

- 19.1 The trainer shall provide training in English. The training shall include engineering, design, configuration operation and maintenance of DCS system along with interfacing devices for other related systems. Methodology shall include classroom and hands-on training. The training course for Engineers shall be completed before one month prior to the commissioning.
- 19.2 The DCS training shall be carried out as per details mentioned in Volume-I.
- 19.3 The training shall be carried out on simulation systems which shall be arranged by the supplier. The aim of the training shall be to educate the engineers and provide the minimum required knowledge to engineers to develop an understanding of the supplied system. The vendor shall ensure that after completion of training the engineers shall have the following capabilities:
- a. Understanding of the complete system hardware components for troubleshooting and replacement of hardware.
 - b. Sufficient knowledge and training shall be provided to engineers to diagnose any hardware faults, take remedial steps and replace the faulty hardware if required.
 - c. Understanding of the implemented logic and making modifications in the logic if required.
 - d. Making modifications in system configuration and HMI graphics.
 - e. The engineers shall have the required knowledge to configure / add a new control loop to system and make modifications in the system software where required.
 - f. The vendor shall provide the required information to engineers regarding preventive and routine maintenance activities.
 - g. The supplier shall explain the integration philosophy of the Control System to engineers. The engineers shall be capable to integrate and data from either systems.
- 19.4 Training shall be carried out after the approval of system in FAT. Complete schedule for training shall be submitted by the supplier for approval.
- 19.5 The vendor shall also provide training as per details mentioned in Volume-I.
- 19.6 Vendor shall provide the Training manuals to Engineers and Shift Supervisors & Operators prior to training at site.

20.0 INSPECTION & TESTING

Inspection & testing shall be divided into below mentioned areas:

- i) Factory Acceptance Test (FAT)
- ii) Site Acceptance Test (SAT)
- iii) Sustained Performance Test (SPT)

20.1 Factory Acceptance Test (FAT)

20.1.1 FAT shall be carried out at DCS manufacturing facility. All equipment shall be subject to inspection by the Client nominated representative. Inspection shall include verification of the equipment, dimensions, examination and checking of the documentation.

20.1.2 FAT arrangement as per details mentioned in tender shall be arranged by the supplier at manufacturer training center where such services have been provided on routine basis and shall have all setup, equipment and qualified professionals. DCS supplier shall arrange all boarding, lodging for the representatives.

20.1.3 The supplier shall submit a complete plan of the Factory Acceptance Test (FAT) to Client. This plan must be complete and in sufficient detail to indicate the exact nature of each test, time required, expected results and systematic procedure. The plan shall be submitted at least 45 days in advance to the FAT. The objective of the FAT is to verify that the purchased systems as configured for delivery to site meets or exceeds the specified designed functional requirements. The FAT shall be a 100% complete system functional test and shall be witnessed by the Client.

20.1.4 It is responsibility of the vendor to make all the arrangements for the personals carrying out test including Boarding, Lodging etc.

20.1.5 It is the responsibility of the vendor to make all the arrangements to carry out the FAT effectively.

20.1.6 All relevant certified documentation shall be sent to the Client at least 45 days prior to the test. The test will be witnessed only if the documentation is complete and acceptable to Client. No testing shall commence without written approval of Client. The inspection and testing procedure shall as a minimum cover:

- i) Assembling sequence, including inspection and testing.
- ii) Proposed check of system architecture against approved for construction documents.

- iii) Proposed physical inspection of equipment.
- iv) Proposed check of documentation.

20.1.7 The FAT shall include, but not be limited to the following:

- i) Simulation and observation of 100% inputs/outputs (including used and spares) to confirm operation of DCS system in accordance with the P&ID's, Control Philosophy, Cause and Effect matrices, Logic Diagrams and I/O Schedule.
- ii) Loop Checks from Marshalling Cabinet up to DCS HMI.
- iii) Controller Loading shall be verified prior to FAT
- iv) Confirmation of correct functions of all communication links.
- v) Confirmation of availability of all specified screen functions and Operator Interface functions, including a proof test of automatic switchover to the Redundant Hardware Equipment.
- vi) A radio interference test shall be carried out or certification shall be provided in compliance to standard industrial requirements.
- vii) Verification of installation of required software.

20.1.8 Verification / Confirmation of correct functions of all communication links and protocol such as:

- i) Serial / Ethernet Interface and Communication.
- ii) Package PLC control system (shall be simulated using Modbus slave simulators or Allen Bradley simulator, Vendor to arrange all equipment to carry out the test).
- iii) Communication protocols including HART (shall be simulated using Hart simulator).
- iv) Supplier shall be responsible for providing all simulation systems at its own cost during FAT.
- v) FAT shall also include 72-hours soak test, graphics & data base verification, logic / cause & effect verification, verification of AGA calculation etc.

20.2 Site Acceptance Test (SAT)

The supplier shall submit a complete plan for the Site Acceptance Test to Client. This plan must be complete and in sufficient detail to indicate the exact nature of each test, time required, expected results and systematic procedure.

The SAT shall include but not be limited to the following:

- i) A complete repeat of the FAT.
- ii) Communication with Third Party Packages through OPC and MODBUS 485 protocols shall be checked.
- iii) Full loop tests of all input / output to the field equipment. Supplier's responsibility limited to functional test for DCS system or limited to Supplier Scope of Supply.

20.3 Sustained Performance Test

- 20.3.1 A Sustained Performance Test (SPT) for the system shall be conducted. The objective of the SPT is to determine the long-term stability and availability of the systems under normal operating conditions. It will also verify the ability of the systems to report all malfunctions in an easy way to understand and the system supplier's ability to diagnose and fix and problem in a timely manner. The tests commence when the systems start to control and monitor a portion of the process.
- 20.3.2 The Contractor will conduct the SPT over a sustained period of 30 consecutive days (or longer under agreed conditions). The criteria for success will include at least 99.9% availability (in the standard statistical sense) and there shall be no hardware and / or software failure during the 30-days period. A failure is defined as any occurrence preventing full utilization of the systems availability. The SPT will be suspended in case of any failure caused by the project supplied equipment or services.
- 20.3.3 The success of SPT does not relieve the vendor from providing any required after sales support by the client.

21.0 DOCUMENTATION

The Supplier shall supply documentation in accordance with applicable codes and standards. All additional documentation required by this Specification shall also be provided by the Supplier. All documents shall be in English language.

DCS supplier shall provide the documents for the installation of operating system software, DCS system software, Configuration of DCS system as per this specification for each mode of operation etc.

Supplier shall take approval for each document. Shipment of DCS shall be carried out after the approval of all documents from Client.

Supplier shall provide all the documents and details mentioned in this specification. Supplier's documents shall include the following information as a minimum:

- i) DCS operating Manual for Plant Operators, Engineers etc
- ii) DCS system Software Installation Procedure
- iii) DCS Configuration Procedure
- iv) DCS architecture layout.
- v) Full range of Engineer configuration manuals & Equipment manuals
- vi) DCS system operational flowchart
- vii) Network Drawing with IP addresses
- viii) Logic diagrams
- ix) Loop diagrams
- x) Wiring diagrams
- xi) I/O schedules
- xii) System Cabinet dimensional layout drawings
- xiii) DCS operator consoles dimensioned layout drawings
- xiv) Cable and cable gland schedule
- xv) System communication details and drawings
- xvi) Inspection and certification
- xvii) Description of all implemented computational algorithms
- xviii) All system installation drawings
- xix) Complete "As-built" documents and drawings package
- xx) Commissioning Manual
- xxi) License of all software in favor of client.

Supplier shall provide three (3) hardcopies and two (2) soft copies for all documents.

Supplier shall also provide the individual hardcopies of operating manual to training operators (maximum 10 numbers).



22.0 SOFTWARE'S SUPPLIED WITH DCS SYSTEM

Supplier shall provide all software's in English Language. Supplier shall provide the below mentioned required software's as minimum:

- i) Microsoft Windows Operating system software (01 set with each workstation)
- ii) DCS system software (01 sets with each workstation)
- iii) Workstation software's and Drivers (01 set with each workstation)
- iv) Microsoft Office (01 set, latest edition)
- v) Antivirus (01 set, latest edition)
- vi) Zip utility (01 set, latest edition).
- vii) Adobe Acrobat Writer (01 set, latest edition).
- viii) AutoCAD (01 set, latest edition).
- ix) Any additional software mentioned in this specification or required by DCS vendor (01 set).
- x) Lifetime Licenses for all software in favor of OGDCL.
- xi) All software licenses shall be provided on CD. (02 sets)

23.0 SPARE PARTS

The supplier shall submit the list of all required spares for commissioning. The Supplier shall also furnish in his bid a separately itemized price list of recommended spares for two (2) years operation.

The supplier shall also provide the following spares as minimum.

Analog Input Module (08)

Analog Output Module (02)

Digital Input Module (05)

Digital Output Module (02)

Communication Interface Module (02)

CPU / Controller (02)

Power Supplies (02)

Communication Switch (02)

Hard Drive for Workstation (02)

Key Board (02)

Optical Mouse (02)



24.0 CLIENT PREFERENCES

24.1 After Sales Service

The DCS offered by the supplier having local after sales service set-up in Pakistan. Availability of spare parts within Pakistan shall be preferred. (Provided other specifications met). Supplier is requested to provide the details along with the bid.

24.2 Installed Base Systems

The supplied system shall utilize latest technology available to date. However supplied system should have been installed and running successfully for one (01) year.

24.3 Product Life Cycle

The DCS delivered to the installation site be the most recent revision available at the time of order. Supplier is requested to provide detail data related to worldwide volume of sales per year since launching of the quoted model in the industry along with documentary evidence.

25.0 CODES & STANDARDS

The DCS shall meet but not be limited to the requirements stipulated in the latest edition or revision of the following codes and standards. In the event of conflict, the most stringent requirements shall apply and the Client will decide the applicable code.

ANSI/ISA S84.01	International Standards And Safety Codes
ANSI/ISA MC 96.1	Temperature Measurement Thermocouple
ANSI/IEEE C37.90.1	Surge Withstand Capacity Tests – Shall apply only to equipment with power input(s).
IEC 801.2,3,4	Electromagnetic Interference / Susceptibility
EN 55022	Radio Interference Specification for Limits and Methods of Measurement of Radio Interference Characteristics of IT equipment
IEC 61131-3	International Standard for Programmable Controllers
IEEE Std. 730.1	Software Reliability Plans
IEEE Std. 828	Software Configuration Management Plans
IEEE Std. 1042	Software Configuration Management
ISA S51.1	Process Instrument Terminology
ISA S71.01	Environmental Conditions for Process Measurement And Control System: Temperature And Humidity
ISA S71.04	Environmental Conditions for Process Measurement And Control System: Airborne Contaminants
NEMA Std. 250	Manufacturing Standards for Enclosures for Industrial Controls and Systems
IEC 61158-2	Foundation Field bus Standard for use in Industrial Control System
BS 6121	Cable Gland
BS 6346, EN 50288	Cables



26.0 DCS SYTEM I/O CAPACITY

I/O TYPES	SYSTEM I/Os	SPARE I/Os	TOTAL I/Os REQUIRED
ANALOG INPUT	430	190	620
ANALOG OUTPUT	160	70	230
DIGITAL INPUT	310	130	440
DIGITAL OUTPUT	150	60	210
MODBUS TCP / IP INTERFACE (Note-2)	3	2	5
SERIAL INTERFACES (MODBUS RS 485) (Note-2)	7	3	10