APPENDIX-8 TO TECHNICAL SPECIFICATION

SPECIFICATION FOR WELLHEAD CONTROL SYSTEM AND SCADA SYSTEM WORKS

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SAFETY & SECURITY ENHANCEMENT AND SCADA SYSTEM FOR JURASSIC WELLS AT NORTH KUWAIT AREAS

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SAFETY & SECURITY ENHANCEMENT AND SCADA SYSTEM FOR JURASSIC WELLS AT NORTH KUWAIT AREAS

1. INTRODUCTION

1.1 Premises

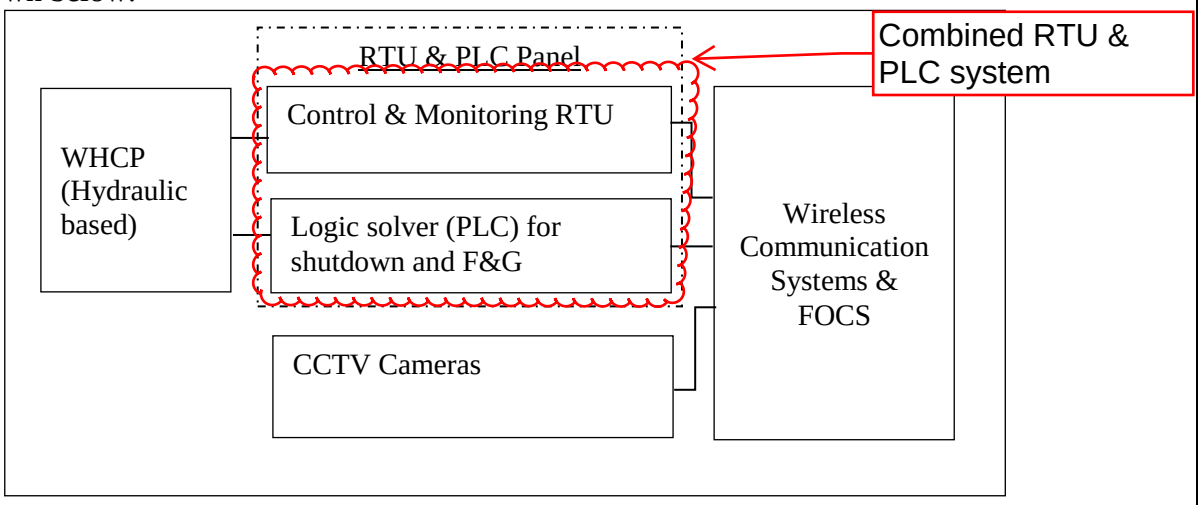
The Jurassic wells and connected flowlines are provided with wellhead control system and instrumentation for control and monitoring wellheads and flowlines from the associated SCADA systems installed at various KOC facilities.

This specification, associated reference drawings and documents detail the design, documentation, testing, installation and commissioning requirements and associated works for new wellhead control system (RTU and PLC) and integration of wellhead control system to existing SCADA systems. This document also provides the requirements for a new SCADA server cabinet that shall be supplied and installed under this Project.

1.2 Scope, basic data and design requirements

Jurassic wells shall be provided with wellhead Control system (RTU & PLC at wellhead) integrated to existing SCADA systems to facilitate the monitoring, control and shutdown of Wellheads and Flowlines remotely from the associated KOC processing facility. The systems installed under this project shall consists of wellhead control systems (RTU & PLC) installed at wellhead locations, communication equipment for KOC wireless connectivity installed at wellhead locations, new SCADA server cabinet, operator consoles and integration of aforesaid systems with the existing SCADA servers/MTUs at various KOC asset locations for seamless monitoring, control and shutdown of the wellhead and the flowline as part of this project.

This Specification describes basic data and design requirements for selection and installation of wellhead control system comprising of control RTU and separate standalone PLC for ESD and F&G logic applications. So whilst the wellhead control system covers traditional data collection and control, it also provides fail-safe, SIL-2 certified (IEC 61508 / IEC 61511 certified as identified in KOC-I-017) local logic solver for ESD and F&G applications as shown below.



Typical control system at wellhead

For overview of wellhead SCADA system refer to the drawing GPII-SCADA-I-01 provided in Appendix-6 to Technical Specification.

This Specification also provides the requirements for fully mounted and tested new SCADA server cabinet consists of redundant servers, associated network devices and related items. The scope of new SCADA server cabinet shall also include new operator workstations as detailed in this document.

For this document, the usage "the Vendor" shall mean the supplier of the above said systems as fully assembled, inspected and tested to the project requirements.

1.3 Performance and documentation requirements

This Specification also provides the performance and documentation requirements for the Wellhead Control System.

2. ABBREVIATIONS

BVS	Block Valve Station
CCR	Central Control Room
CPE	Consumer Premises Equipment
DCS	Distributed Control System
ESD	Emergency Shutdown
FAT	Factory Acceptance Test
F&G	Fire and Gas
FGS	Fire and Gas System
FOC	Fibre Optic Cable
FOCS	Fibre Optic Communication System
GMIS	Gas Management Information System
HMI	Human Machine Interface
I/Os	Inputs and Outputs
KOC	Kuwait Oil Company
MSV	Master Safety Valve
MIS	Management Information System
MTU	Master Terminal Unit
NTP	Network Time Protocol

OPC UA	Open Platform Communications Unified Architecture
PAT	Performance Acceptance Test
PLC	Programmable Logic Controller
POIS	Production Operation Information System
RAID	Redundant Array for Inexpensive Disk
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SOE	Sequence of Events
SSV	Surface Safety Valve
WHCP	WellHead Control Panel

3. REFERENCE CODES AND STANDARDS

3.1 List of Standards and Codes

The Vendor shall conform in design, manufacture, performance and testing, except where otherwise specified, with the current issue and amendments of the applicable codes, standards and the Company specifications.

3.2 International Standards

EEMUA 191	Alarm systems - a guide to design, management and procurement
ANSI/ISA 18.2	Management of Alarm Systems for the Process Industries
ANSI/ISA 99	Security Technologies for Industrial Automation and Control Systems
IEC 61508 Part-1 to 7	Functional safety of electronic/electrical/programmable electronic Safety-related system.
IEC 61511 Part-1 to 3	Functional safety – Safety instrumented systems for the process industry sector.
IEC 62443	Industrial network and system security

3.3 KOC Standards / Project Drawings and Documents

For list of applicable KOC Standards, refer to Appendix-1 to Technical Specification.

3.4 Project Drawings and Documents

For list of Project Drawings and Documents, refer to Appendix-6 to Technical Specification. Any conflicts among these specifications, drawings, documents and other applicable KOC Standards or International Standards, most stringent clause, at the discretion of KOC shall apply.

4. ENVIRONMENTAL CONDITIONS

Refer Technical Specification for the related information.

5. HEALTH SAFETY AND ENVIRONMENT

The Contractor shall refer to Technical Specification for all the relevant HSSEMS procedures while performing the design, installation and integration of the wellhead control system for wellheads.

6. PROJECT DATA

6.1 Area Classification

Refer the Technical Specification for the applicable hazardous area classification. Ingress protection shall be minimum IP-65 unless otherwise specified in the respective data sheets provided. Hazardous area execution of field instruments shall be typically Ex'd' as per KOC-E-004 (Part-1 to Part-6) unless otherwise specified.

7. DESIGN REQUIREMENTS FOR WELLHEAD CONTROL SYSTEM

7.1 General

This Section covers the design basis and system requirements for the wellhead control system consisting RTU, PLC logic solver, communication systems and associated installations.

7.2 Project Description

Panel HMI-Outdoor rated????

A wellhead control system shall be provided to facilitate the monitoring, control and shutdown of Wellheads, Flow-lines, remotely from the KOC processing facility. The remote wellhead control system shall be integrated into the existing systems to allow seamless monitoring of the systems from the connected wellheads and flowlines. Well control system shall have RTU and standalone Logic solver for ESD and F&G functionality. At the processing facility, operator functionality normally through native SCADA HMI console.

Wellhead control system shall be connected back to the processing facility and to the other existing systems by means of KOC existing wireless connectivity. All associated communication devises required at wellhead such as CPE antenna, network communication switches for integrating the wellhead SCADA system shall be part of the wellhead control system installed by the Contractor. The wellhead control system shall also be suitable to connect to FO cable to transfer wellhead data to the existing KOC SCADA network without using wireless connectivity.

The Contractor shall take full responsibility for delivering a fully working system – including RTUs, ESD Logic Solver, new SCADA server cabinet, Integration for communication, cabling, testing, commissioning, and PAT. However, the following descriptions cover a summary of the scope of the Contractor and the system the Vendor.

7.3 Wellhead Control system (RTU and PLC Logic Solver) design basis

Wellhead control system shall be interfaced appropriately with field instrumentation, Wellhead valves (including ESDV, MSV, SSVs & choke valve) and WHCP for wellhead and flowline controls.

The Vendor responsibilities of engineering, design, documentation, testing, supply and commissioning of the wellhead control system shall include, but not limited to, the following:

- Provide Wellhead Control System with communication to the processing facility systems (SCADA) by means of KOC wireless network, capable of controlling Wellhead equipment.
- Provide RTU, ESD Logic Solver with data interface and integrate with the existing systems at various KOC facilities.
- Interface for 3rd Party systems such as Supervisory Control and Data Acquisition (SCADA) systems shall support Open Industry Standard protocols and shall include but not limited to Modbus (ASCII, RTU and TCP), DNP3, UDP and TCP level 4
- Provide interfaces for field instruments and F&G detectors for local and remote control & monitoring of process and F&G events.
- Assign junction boxes for field instruments in line with the requirements in KOC-I-002 for signal segregation.
- Choke valve electric actuator is controlled remotely from the processing facility & wellhead control RTU, however the choke valve position shall be automatically ramped closed by the RTU, if high pressure is sensed.
- Provide ESD Logic Solver that shall act upon local ESD Instruments and/or high Level remote shutdown signals received from the processing facility.
- Provide ESD Logic Solver functional safety trip 2oo3 Pressure high-high that closes flowline ESDV.
- Provide ESD Logic Solver that shall trip hydraulic based Wellhead Control Panel via remote shutdown signal from the processing facility.
- Provide F&G Logic function that shall act upon wellhead F&G Device initiations and transmit any F&G events to the existing systems.
- Provide F&G Logic function to interface Manual Call Points; H2S Gas Detectors; UV/IR Flame detectors; Fire and Gas Alarms. Quantities of each shall be as specified in the reference drawings.

- Provide serial interface for motorised choke valve with the wellhead RTU.
- Provide the complete design documentation including as-built documentation.

The Vendor shall implement the finalised control scheme approved by the Company during the time of project execution.

The wellhead control system is required to communicate with the existing SCADA network and pass control information to/from the wellhead control system and to the processing facility.

The Wellhead is controlled and shutdown as follows:

- The choke valve position is remotely set by the facility operator control via the wellhead RTU, however the choke valve position shall be automatically ramped closed by the RTU, if high pressure is sensed.
- If the Wellhead pressure continues to rise and the choke valve fails to control the wellhead pressure, the high pressure trip obtained in the hydraulic based Wellhead Control panel shall trip the SSV, MSV and ESDV via hydraulic logic implemented in WHCP.
- If the Wellhead pressure continues to rise and the choke valve and the control panel fails to actuate/control the wellhead pressure, 2oo3 voted high pressure trip obtained in the ESD Logic Solver shall trip the Wellhead flowline ESDV.
- The Company shall review and finalize the above described preliminary wellhead control logic scheme during the time of project execution.

7.4 Requirements of new Wellhead RTU:

7.4.1 General

The function of the RTU is to respond to the SCADA MTU request for information about wellhead/flowline data and to carry out any local control actions required.

The RTU consist of a data requisition unit, a main processor, together with communication interface unit.

The separate safety logic solver for ESD and F&G shall be provided for which requirements are provided in next section.

Wellhead control system (RTU/PLC) shall be Time synchronised by the NTP GPS Time Server as directed by the Company during installation phase of the project.

The Vendor scope of supply shall include:

- Functionality assessment and implementation
- Transmission protocols
- Communications interfaces for KOC wireless connectivity
- Communication interface for third-party field devices
- RTU and Instrumentation power requirements
- Detailed functional specifications

RTUs shall be mounted in environmental shelters/enclosures above ground together with the PLC and communications systems. Design of enclosures, a common housing or separate housing for various systems shall be confirmed with the Company during detailed design of the project. This proposal shall in no way compromise the requirements on hazardous area classification, ambient conditions and other related contract requirements.

RTU cabinet require an overhead sun shield of such proportions that the temperature of the panel does not rise to impair the hardware and functionalities due to direct sun effects. All cabinets shall have dedicated temperature sensor, connected to RTU for logging alarms in the SCADA MTUs. The Vendor shall only offer robust designs for the complete panel which are suitable for high ambient temperatures, 65 DegC as minimum, and proven solutions for such conditions.

Wellhead control system earthing (safety earthing and instrument earthing) shall be as per the requirement specified in technical specifications, project reference documents/drawings and applicable KOC standards.

7.4.2 RTU System Cabinet/Panel Hardware Aspects

The general requirements for detailed RTU and cabinet are described by the following:

- Typically, at one RTU/Cabinet there could be incorporating RTU control equipment, power supply equipment, and network switch installation.
- RTU cabinet and its internals shall be provided suitable for the ambient conditions, without assistance of any additional/external cooling systems.
- The shelter roof covering of the panels shall be typically installed along with side protection to avoid direct sun light on the panels.
- The panels shall all be stainless steel 316 and sized as required for their function - typically meeting required hazardous area classification rating.
- The panels shall have hinged doors with handle for opening and locking. A light (24V DC) shall be fitted in the panels.
- The panels shall be IP 65 and all cables shall enter from the bottom via suitable gland plates.
- Equipment shall be suitably protected against occasional sand storms.
- The panels shall have spare expansion space capacity, a permanent document pocket inside and engraved metallic labels (25 mm lettering) on front and rear doors.
- The panels shall have dedicated safety earth bus bar, isolated instrument earth bus bars and the means to connect to the site instrument earthing.
- RTU/PLC cabinet shall meet the requirements specified in the KOC standard KOC-I-007.

7.4.3 Field connections

The RTUs shall accept hardwired signals and serial data from field instrumentation.

The RTU shall have the capability to transfer serial data in both directions, to the MTU using open Industry Standard protocols and shall include but not limited to Modbus (ASCII, RTU and TCP), DNP3, UDP and TCP level 4.

Each RTU shall be fitted with I/O modules/cards. All field-sensing circuits shall be powered from the RTU. All cabling accessories, equipment cabinets, for the complete assembly and interconnection of the RTU and associated instrumentation shall be included in the RTU scope of supply. Galvanic isolation barriers shall be provided for connecting input/output circuit cables from the remote instrumentation to the RTU terminations.

RTU system shall have dedicated RS-485 based Modbus-RTU interface for permanent connection with multiple field devices at wellhead such as choke valve and downhole pressure/temperature sensors.

RTUs shall be equipped with dual 10/100 Base TX communication ports to interconnect with the dual network switch to transport the signals to KOC wireless network. The communication link established through this port shall be capable of transporting data between the MTU SCADA Server and the RTUs and at the same time shall provide access from the Engineering Work Station for configuring the RTUs.

RTUs shall be capable to interface with Modbus-TCP/IP enabled field devices connected to the network switches installed in the RTU cabinet.

7.4.4 RTU processing

The RTU processor scan time shall be 20 milliseconds and this shall be reviewed and agreed during detailed design phase according to the configuration implemented in the existing SCADA MTUs.

The SCADA MTU shall set each RTU internal clock to match with that of SCADA MTU, typically on an hourly basis. Time stamping shall be performed by the RTUs on each signal received from the remote sites. The RTUs shall be capable of generating time stamps within 20 ms of the RTU receiving the signal.

The RTUs shall time stamp all data, alarms and events.

7.4.5 Reliability

Each RTU shall have its own real time database thus allowing process data to be updated and stored locally to ensure no data is lost if there is a breakdown in communications between the RTUs and the SCADA MTU. Power loss shall not result in previous data loss. On failure of the communication link and or power loss with any RTU, the failure shall be detected by loss of communications watch dog and alarm signals shall be generated at RTU and MTU server on a priority basis.

The RTU shall continue to operate and store the data until communication has been re-established. On resumption of communication all stored data shall immediately be transmitted to the MTU database. The recording capability of the RTU historian depends on

potential field data and the expected outage time. The number of signals is small, and it shall be considered initially that 72 hours backup shall suffice for most instances of unplanned interruptions.

The RTU shall store and re-transmit the selected data of signals connected to PLC logic solver also on the event of the wireless communication failure. PLC logic solver data for RTU to store and re-transmit shall be configuration to optimize RTU data recording feature.

RTU data received at the MTUs shall be time stamped at the MTU. In addition the RTU timing shall be preserved in message data. Under operational conditions any single event occurring at the remote RTUs shall be displayed on the Operator Work Station within 2 seconds after occurrence, with time stamp of the RTU.

The RTUs shall be modular in design to allow for future I/O expansion. The same hardware platform shall be used for all locations to minimize spare parts and support requirements.

Critical RTU components shall be redundant. Critical components shall include, as minimum, processor unit, network/communication modules, and power supplies along with circuit breakers / wiring.

The RTUs shall be equipped with dual power input modules to receive power simultaneously from two different sources.

It shall be possible to replace a redundant component without interruption to RTU operation.

The RTU shall have an internal battery to back up power to memory for a minimum of 6 months so that the installed programs and/or configuration is not lost if primary power is disconnected. LED indicators on the RTU shall indicate operating, power and battery status.

7.5 Requirements of new Wellhead Logic Solver:

Common, SIL-2 rated, Local Logic Solver for ESD and F&G functionalities shall be provided at the Wellheads. This Logic Solver, related power supplies, I/O modules and all other associated accessories shall be segregated and independent to the control RTU's available for the same wellhead.

The power supply requirements shall be derived from 24VDC solar power (installed by the contractor as part of this project) outgoing MCBs. The power requirements of the field instruments and the local fire & gas detectors shall be from the wellhead control system

The Logic solver at wellhead complete with CPUs, power supplies, 10/100 Base TX communication modules, I/O modules, interfacing relays, related accessories, shall be fully redundant and certified SIL-2 capable as per IEC-61508, IEC-61511 and KOC-I-017. The Logic solver system for ESD and F&G application shall be fully redundant, irrespective of SIL-2 requirement, to avoid any common mode failure. The modules of PLC system shall be of on-line replacement without any interruption to the ongoing functioning of the PLC.

For specific ESD and F&G logic at wellhead refer to Cause & Effects Diagrams (GPII-SCADA-P-CE-101) attached in Appendix-6 to Technical Specification.

ESD and F&G logic functions shall be implemented as separate logic / program units for ease of maintenance and future reference.

7.6 Network Switches:

7.6.1 Network switches for SCADA network interface at wellheads

Redundant network switches (two switches of identical type) shall be provided for interfacing wellhead RTU, PLC systems with the SCADA systems available in existing KOC facilities using KOC wireless network connected to one of the redundant switches.

The network switches shall have a minimum of 2 x 1 Gbps SM fibre interface (LC-SFP) of suitable type (Lx/LH) and 2 x 1000BASE-T interface, built-in, to connect to the backbone network. For user devices interface, the switches shall have a spare provision of minimum 50% subject to a minimum of 8 ports for user interface such as RTU, PLC. No external media converters shall be considered for interfacing the wellhead users to the network switches. The contractor shall also provide FO patch panel and necessary FO connector cables along with the network switches mounted inside the control cabinet for data communication from wellhead to the existing SCADA network over FO cable media.

7.6.2 Network switches for CCTV system at wellheads

Single network switch shall be provided with minimum of 2 x 1 Gbps SM fibre interface (LC-SFP) of suitable type (Lx/LH) and 1 x 1000BASE-T interface, built-in, to connect to the backbone network. For user interface (CCTV Cameras), the switches shall have a spare provision of minimum 50% subject to a minimum of 8 ports for the user interface such as RTU, PLC. No external media converters shall be considered for interfacing the wellhead users to the network switches.

7.6.3 Power over Ethernet (PoE)

Minimum of four (nos.) PoE ports shall be provided suitably in wellhead control cabinet for powering devices such as communication equipment (CPE).

7.7 Power Supply at Wellheads

The wellhead control system power supply requirements shall be derived from outgoing MCBs of 24VDC solar power (installed as part of this project), with voltage variation of 10%. The power requirements of the field instruments and the local fire & gas detectors shall be through the wellhead control system. Sizing of the power supply units inside the control system panel shall consider minimum 50% spare capacity. Power supply distribution (CBs, Terminals) shall have 15% wired spare provisions.

7.8 HART Connectivity for wellhead control systems

With the proper wellhead control system integration, it shall be possible to initiate partial stroke test (PST) of wellhead ESDVs from SCADA system and the resulting PST status (PST Success, PST Failed) shall be reported at the HMI consoles in the processing facility. The Contractor/Vendor shall demonstrate this integration as per the approved procedure as part of FAT and pre-commissioning activities.

7.9 Portable Programming Devices (Laptops) for RTU and PLC at wellhead

One set of Portable programming device for commissioning and maintenance of wellhead control systems (RTU and ESD Logic solver) in the field shall be provided. This devise shall provide features for diagnostic checking of RTU and logic solver functionality, the ability to locally adjust parameters {e.g. exception limits, internal scanning rates} and also data dialogue with the MTU (e.g. to reproduce RTU traffic). The portable programming device shall be connected to the on-line RTU through a USB connection and through network switch. The portable devices shall be supplied, complete with all necessary software, accessories and licenses for all engineering/maintenance functions of wellhead control system. These devices shall be latest state of the art devices at the time of supply, shall be industrial type and shall be suitable for locations where these devices are intended to be used.

The control RTU shall support remote configuration facility for maintenance purposes from the processing facility using the same communication channel used for data transfer. It shall be possible to upload data for back up purposes.

Any changes to safety related functions shall be protected by strict access controls via keys and passwords.

8. SCADA SYSTEM SCOPE OF WORKS FOR WELLHEADS

8.1 General

This section defines the minimum requirements for Supervisory Control and Data Acquisition (SCADA) systems scope of works under this Project. The SCADA system here primarily intended for data acquisition, remote and supervisory control of Jurassic wells over a wide geographically spread area.

To perform the scope of work specified here, the Contractor/Vendor shall undertake proper site survey of required existing systems to identify the adopted design philosophies and other details. The hardware/software designed and supplied by the Contractor to perform the scope of work shall be compatible in all aspects to the identified existing systems/components related to the integration of wellhead SCADA system and shall be in compliance with KOC IT Security Guidelines provided as Appendix-5 to Technical Specification.

8.2 Requirements of new SCADA server cabinet and Operator workstations at P&P (Gas) building:

8.2.1 Overview

The overall SCADA server cabinet scope consists of SCADA Application/Database/MTU Servers (redundant), two (nos.) operator stations, switches, firewall, fibre optic cabling and connections to existing KOC network. Hardware and software of the new SCADA system shall be sized and designed to interface with 200 nos. of wells and associated wellhead control systems. Refer the attached drawings GPII-SCADA-I-06 (SCADA system network diagram for wellhead data) for an overview of requirements for the new SCADA system

The normal operational control of the wells will be from the native SCADA HMI/consoles. SCADA Engineering facilities/application shall also be made possible from one of the operator stations.

The hardware platform for SCADA servers and workstations shall be as per highest configuration available in the market at the time of bidding.

The software (OS & Apps) platform for the SCADA System Servers and workstations shall be capable for integration with the available SCADA platform in existing KOC SCADA system for wellheads.

The hardware and software installation and commissioning shall be in the presence of and guided by the Company representatives of the Company. Necessary anti-virus (and licence for software) as approved by the Company shall be included in the project scope of work.

8.2.2 Requirements for SCADA MTU Hardware

The MTU provides monitoring of associated Wellhead RTUs. The MTU functionality shall include:

- Database I/O
- Polling of RTUs
- Alarming
- Trend displays
- History and archiving
- Interfacing (third party PLCs)
- Configuration and configuration management
- Graphic display and display construction
- Report generation
- Communications

All terminal computers, monitors, printers, peripherals, Ethernet switches and other equipment provided by the Vendor as part of the system shall be the latest model commercially available which has been tested and approved for compatibility by the Vendor

at the time of the hardware freeze date as defined in the contract or purchase order, whichever is the later.

The SCADA communications shall consist of 10/100/1000 Base TX Ethernet links between the MTU and the RTUs. It is expected that a combination of high speed polling of RTU full value and exception reporting is required. The timing of data acquisition shall be configurable as precise as possible (e.g. to 10 milliseconds) and this time stamping shall be retained in all data received at the MTUs. The MTU shall be time-synchronized with the existing SCADA network of KOC, which shall, in turn, be distributed to each RTU clock for local time synchronization at RTUs.

The servers shall consist of high-performance processors along with accompanying features such as RAM memory, hard drive, CD ROM drive supporting the selected processors.

Each Operator Work Station shall consist of a processor, one flat LCD screen (23" minimum), each with keyboard and mouse.

The redundant SCADA MTU servers shall be configured in a Primary/Secondary (hot-stand-by) configuration. The architecture shall provide dual, redundant processors with automatic changeover to the backup unit in the event of failure of the primary controlling processor. The time delay acceptable for changeover shall be one second upon failure of the operating processor. Provision shall be made to select either processor as the primary operating processor. The redundant unit shall be continuously updated with current system status and data to enable switchover in the event of failure of the operating unit. Redundant equipment and software shall be continuously monitored for errors, raise system alarms and failovers to back up component on pre-set criteria. The SCADA system shall allow the user copying the application software source code or compiled executable code from the storage media without software or hardware locking mechanisms. The SCADA system's operation and maintenance shall not be dependent on license renewal of any hardware or software.

New SCADA server cabinet shall consist below listed hardware equipment as minimum:

- Redundant SCADA Servers
- Network devices as per the Datasheet GPII-SCADA-I-DAT-1022
- Other associated items necessary to complete the SCADA server as fully installed and tested cabinet.

8.2.3 Software platform for SCADA MTU.

Features of the software platform for new SCADA MTU shall be capable to data exchange and integrate with the existing SCADA system for wellheads already installed in P&P (Gas) building, JPF-ER, JPF-SA and JPF-WR. All proprietary software, shall be the most recent, commercially released, software revision level that is applicable to the hardware freeze date as defined in the contract or purchase order.

The SCADA system shall support Open Industry Standard protocols and shall include but not limited to Modbus ASCII, RTU and TCP, DNP3, UDP, TCP level 4, OPC-DA, OPC-HDA and OPC-UA support for various systems and devices in the existing SCADA network.

8.2.4 Other specific requirements.

Support will be available for 10 years for ABB software, whereas any upgrade or spare parts not included as part of this offer

a) The SCADA Vendor shall guarantee to support all system hardware, firmware, and software with spare parts and services for a period of ten (10) years from the system delivery date or as defined in the contract or purchase order for all proprietary components and software. This support shall not be contingent on the customer upgrading to later releases of software or hardware unless this upgrade is included as part of supply scope.

b) The system components shall be capable of being integrated into open distributed real time and historical data in client/server architecture.

c) The system shall be modular in design. This means the same hardware is used for small, medium and large SCADA configurations, with expansion being based on adding components. It shall be possible to expand the SCADA system by adding additional servers and required components without the need to shut down the entire system during the expansion process.

d) CPU utilization of the SCADA Servers and workstations shall not exceed 30% during normal operations and shall not exceed 75% for a period of 5 seconds during initial startup.

e) The system shall support distributed network equipment such as terminal servers, communication servers, network printers, network workstations, mass storage/backup devices.

f) The system shall network its nodes using non-proprietary industrial standards such as Ethernet (i.e., TCP/IP) and shall be fault tolerant utilizing a network configuration that prevents a single point of failure

g) Unrecoverable communications shall be alarmed and shall be logged and stored in a history file with an appropriate failure message.

h) Interface with 3rd Party Subsystems: The Supervisory Control and Data Acquisition (SCADA) system shall support Open Industry Standard protocols and shall include but not limited to Modbus ASCII, RTU and TCP, DNP3, UDP and TCP level 4.

i) The SCADA system shall support redundant OPC DA, OPC had and OPC-UA interface with applications and other systems.

j) The system shall provide user configurable scan rate for each communication channel, for each RTU and for each data point.

k) The requirement is to access HMI such that the KwIDF users are visualizing the same screens as the field SCADA users.

l) The system shall count number of requests sent, error requests, scan overruns, bytes transmitted/re-transmitted, bytes received/re-received, framing errors, timeouts, CRC errors, as applicable to the protocol for each communication channel, route and RTU on the system.

m) It shall be possible after loss of power and restoration of power to reboot automatically with operating system, system database and application software without user intervention.

n) The system shall be capable of updating calculation algorithms, and dynamic fields of the displays within one second of actual recent event received at the system from field RTUs.

o) It shall be possible to perform all configuration, database generation, graphics building/editing, and software linking/compiling from single engineering workstation.

p) The system shall provide configurable parameter to allow polling data on the communication channel from all connected devices (RTUs, PLC or other connected subsystems), by group of devices and /or by point level.

q) Feature of user-ID based access and privileges to the complete database, Alarm limits and other application parameters.

r) Multi-page alarm summary displays shall include page forward or backward and scroll up and down options.

s) IP address assignment and subnet allocation of all nodes shall be as per the guidance and written directions from the Company.

8.2.5 Cabinet / Panel:

a) The new SCADA server cabinet(s) shall be supplied, installed and commissioned as per KOC-I-007 standards and recommendations.

b) Number of cabinets/panels required shall be determined by the SCADA Vendor based on the items to be housed as per the requirements specified in this document.

c) One 24 core fiber optic patch panel to be installed inside SCADA cabinet.

d) UTP cables shall be arranged using UTP patch panels 50 % spare ports.

e) Cabling shall have appropriate labels, mentioning server / workstation information.

f) It is advised to have cable entry from side and bottom of the cabinet, to be confirmed at the time of design.

g) Fiber optic cable of 24 cores to be laid in P&P (Gas) building between telecom room and SCADA cabinet.

h) Fiber optic cables, laid for SCADA should be terminated in the FOPP, inside SCADA cabinet.

i) Electrical supply should be from facility UPS of AC 110V/240V 60Hz.

8.3 Modification of the Existing Systems

8.3.1 Overview

The Contractor shall refer the attached drawing GPII-SCADA-I-01 (SCADA Network Overall Data Flow Block Diagram) for the overall scheme for the wellhead SCADA system.

The Contractor shall carryout necessary site survey with Vendor to assess and identify the complete requirements to perform the integration and modification works of existing SCADA systems. The Contractor shall carryout installation and configuration of necessary software & hardware to integrate each wellhead for the normal operation of monitoring and

control from the processing facility. The Contractor shall complete the integration and modification works seamlessly on various existing systems consistent to the design philosophy adopted and already implemented in the respective systems.

The hardware and software installation, configuration and commissioning of the modification/integration works shall be in the presence of and guided by the Company representatives of the Company.

Details of various existing systems connected to KOC wellhead SCADA network are listed in below table. The Contractor shall modify the existing systems, as identified and instructed by the Company, to incorporate new wellheads and flowlines information.

SYSTEM DESIGNATION	**LOCATION**	**SYSTEM DETAILS**
KWIDIF	Ahmadi	Schlumberger, AVOCET.
Data Servers	KOC IT Centre, Ahmadi	
	KOC Disaster Recovery Building, Ahmadi	
SCADA MTU & Workstations	One Facility (EPF-50/JPF-ER/JPF-WR/JPF-SA) per well	Rockwell FactoryTalk View SE
	P&P (Gas) Building, North Kuwait (Currently in JPF-SA, shall be shifted to P&P (Gas) building)	a. Rockwell FactoryTalk View SE b. VMonitor
Notes:- - For reference purpose only, relevant drawings and documents for existing SCADA system for Jurassic wells are provided in Appendix-19 to Technical Specification.		

Modification of all existing systems shall follow the design philosophy and requirement based on which the existing configuration is already implemented. The Contractor/Vendor shall consider the upscaling of required licenses in the existing systems as necessary to complete the modification of incorporating data from the new Jurassic wells applicable for this Project.

8.3.2 Communications

IP address assignment and subnet allocation of all nodes in this project shall be configured as per the guidance and written directions from the Company.

8.3.3 Engineering Workstation

The Engineering workstation installed, existing, in engineering room or the designated area shall be used for engineering support, e.g. configuration (of signals, screens, limits, alarm

categories, communication), report generation, software installation, diagnostics of the existing systems.

8.3.4 Modification and Configuration of existing systems at various KOC facilities shall include, but not limited to:

SCADA Systems

- SCADA Operator workstation
- SCADA Engineering workstation
- SCADA Training workstation
- Event Log and trend printers

Modification of these existing systems shall follow the existing design philosophy and requirement based on which the existing configuration is implemented.
The Contractor shall assess the complete scope of modification based on the site survey carried out by the respective system vendors during the execution phase of the project. The Contractor/Vendor shall submit the site survey report by the vendors detailing the complete scope of modification for the Company approval.

8.4 General Requirements for modification of existing SCADA systems

8.4.1 SCADA MTU & Workstations.

As part of integration of wellhead control system to the existing SCADA MTU & Workstations, the Contractor shall modify various functionality/features of the existing systems including but not limited to following:

- Database I/O
- Polling of RTUs
- Alarming
- Trend displays
- History and archiving
- Interfacing (DCS, ESD, F&G, third party PLCs)
- Configuration and configuration management
- Graphic display and display construction
- Report generation
- Communications

The timing of data acquisition shall be as precise as possible (follow existing philosophy or confirm the same with the Company) and this time stamping shall be retained in all data received at the MTUs.

8.4.2 Graphic Displays (HMIs)

The Contractor shall complete graphics modification in the existing systems related to the integration and modification works of wellhead instrumentation in consistent to the design

philosophy adopted and already implemented in respective systems, including but not limited to:

- Color codes
- Process (pressure, flow, temperature),
- Diagnostic,
- Alarms,
- Trends,
- Reports,
- Faceplates,
- Communications link status,
- Communications error summary,
- Overview of wellhead and flowlines.
- Various overview graphics
- Other philosophes already implemented

The Vendor shall submit all SCADA templates and graphics to the Company for review/approval.

Engineering Workstation graphics shall include the full set of operating screen graphics, to include a selection of screens for:

The Company approval of the screen graphics is required.

8.4.3 Alarm Management

The Vendor shall complete the modification/integration works in alarm management.in consistent to the design philosophy adopted and already implemented the existing systems.

8.4.4 Event Manager

The Vendor shall complete the modification/integration works in event manager in consistent to the design philosophy adopted and already implemented in the respective systems.

8.4.5 Sequence of Events (SOE)

The SOE function shall be implemented at RTU level and consolidated in an SOE application hosted in existing systems. The Contractor shall complete the modification/integration works for SOE in consistent to the design philosophy adopted and already implemented in respective systems.

8.4.6 Historian

The Vendor shall complete the modification/integration works in SCADA-Historian in consistent to the design philosophy adopted and already implemented in respective systems.

8.4.7 Reporting

The Vendor shall complete the modification/integration works for reporting in consistent to the design philosophy adopted and already implemented in respective systems, including but not limited for:

- Daily reports on flowline variables, SCADA characteristics (e.g. transmission errors) both at regular intervals and summarised 24 hour reports.
- Report detailing the log of all operator actions on the SCADA system.
- Alarm reporting as required (process, instrumentation, flowline, control systems, power).
- Historical reports as required with data resolution available to fine detail (e.g. 5 minute intervals).
- Reports for various levels of management.

8.4.8 Asset Management System

All available HART data within the wellhead control system, shall be transferred to the CPF AMS system installed by others in JGF-1. The Vendor shall complete the related modification/integration works.in consistent to the design philosophy adopted and already implemented in JGF-1

9. TESTING AND INSPECTION

All items shall be subjected to routine testing at the manufacturer's works as per relevant project specification and standards. No equipment shall be delivered until all applicable tests (internal and FAT) have been successfully completed. Test details shall be fully agreed by the Company once the functional design specification is advanced enough to produce test documents.

Wellhead control system testing and existing system modification testing shall be extensive and include:

9.1 Acceptance Test Procedures

The acceptance test procedures shall be developed to enable the demonstration and validation of all elements of the supply. A test plan shall be developed by the Vendor to set out the elements of Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT), which when approved shall be developed into acceptance procedures for each stage of testing. The test plan shall include partial testing and provisional testing of major portions of each system. The tests shall be designed to operate in a natural progression. Prior to delivery of each system to the facility the system shall undergo a FAT, SAT and Performance Acceptance Test (PAT) shall prove the complete system.

9.2 Factory Acceptance Test - FAT

The Vendor shall submit a comprehensive FAT procedures and schedule for the Company approval 180 days prior to commencement. Factory Acceptance Tests shall be undertaken using an agreed FAT procedure which shall include a complete listing (with revision numbers) of all relevant documents. These documents shall be approved by the Company

prior to the FAT commencement. The Vendor shall also comply with the requirements specified in KOC-I-004 for factory acceptance test to carry out the FAT of wellhead control system.

The FAT procedures shall include as a minimum:

- Test procedures,
- Schedules of tests,
- Specified performances expected,
- Test results,
- Space for recording test equipment calibration information, equipment under test software release version,
- Space for recording the names and signatures of participants.
- Space to record observations and comments.

The vendor shall submit a pre-FAT report prior to commence the Factory Acceptance Test (FAT).

Heat soak test shall be considered as part of the FAT for each package of the supplied RTU/ PLCs and certificates to be provided for the Company review. The Company shall witness 10 percent of the total RTU/PLC packages as maximum and at least one package as minimum. This test shall be conducted for a period not less than 48 hours at an average temperature of not less than 55°C (131°F). During the test period all the equipment shall be powered on and be in the normal operational condition. At the Company discretion, this test may have to be repeated if modifications are made as a result of acceptance testing.

All inputs and outputs shall be driven at their maximum voltage/current. All events/component failures shall be replaced and not repaired.

The FATs shall include related communications components and shall be comprehensive across all equipment to be supplied. The Vendor shall supply all certification relevant to the different type of tests. FAT results shall prove concepts, design theories and shall prove the operability of the system/equipment.

In the case of a fault seriously affecting the FAT, the FAT may be stopped and plans for corrective action and re-start mutually agreed. In the case of non-serious type fault, then the test shall continue and fault cleared and retested within the time as per an agreed corrective action category. An Action Item Log shall be produced for recording any faults and problems encountered during FAT.

The Action Item Log shall be signed by the Company representative and shall be provided for the Company record prior to equipment shipment to site. No equipment shall be delivered until all applicable tests have been successfully completed and punch list items incorporated.

FAT shall also be applicable for other systems (SCADA server cabinet & operator workstations and network equipment cabinet) supplied under this project. The Vendor shall

prepare dedicated FAT procedure for the Company approvals for all Factory Acceptance Tests.

A complete set of signed documentation used and red lined during FAT shall be scanned and copied to a CD for each attendee to take away as a record of the test.

9.3 Site Acceptance Test – SAT

Subsequent to the installation, integration and commissioning of each system a Site Acceptance Test (SAT) shall take place. The SAT shall retest any parts of the system that were shown to be deficient during the FAT and also a subset of the original FAT to demonstrate that the system is as tested. The emphasis of the SAT shall be to validate the performance of each system in an operating environment and demonstrate the seamless integration with other systems. The Vendor shall also comply with the requirements specified in KOC-I-004 for site acceptance test to carry out the SAT of wellhead control system.

Final comments on system graphic screens and report formats shall be provided by the Company during SAT. The Vendor shall prepare a formal procedure document for Site Acceptance Tests for the Company review and approval. The SAT documents shall include, as a minimum, the following:

- Test procedures,
- Schedules of tests,
- Specified performances expected,
- Test Results,
- Space for recording test equipment calibration information, equipment under test software release version,
- Space for recording the names and signatures of participants: The Contractor, Manufacturer, the Vendor, and the Company,
- Space to record observations and comments.

The Vendor shall be responsible for collecting and issuing the complete set of SAT result documents for approval of the Company at the conclusion of the SAT.

9.4 Performance Acceptance Test - PAT

The Performance Acceptance Test (PAT) shall be carried out by the Vendor as defined in the approved PAT procedure. Upon completion of the PAT, the Vendor shall apply, in writing, to the Company for a PAT Completion Certificate. The PAT procedures shall include methods that shall test and confirm the total integrity of the system. The PAT procedures shall be submitted by the Contractor prepared with inputs from all relevant Vendors in advance for the Company review and approval.

10. DOCUMENTATION & SPARE PARTS

10.1 Scope of documentation

The Vendor shall supply the documentation in accordance with, but not necessarily be limited to, the requirements of 'Company Standard for Instrumentation and Control System Design' (KOC-I-001) and shall cover detailed engineering, procurement, supply, installation and testing of various systems (such as RTU/PLC systems, Communication systems, SCADA server cabinet.) supplied under this Project.

Additionally, the user documentation listed in following sections and in Appendix-2 to Technical Specification shall be produced and submitted by the Vendors during the course of this contract for the Company Approval. User documentation shall be supplied in electronic and hard copy form.

Design Documents/drawings - these documents/drawings shall provide information on installation of field instrumentation connected to the wellhead SCADA system, shall include, but not limited to; field junction box schedule, cable schedule prepared in line with the requirements specified in KOC standard KOC-I-002.

Test Procedures - these documents shall provide detailed step wise testing and reporting activates to be performed as part of FAT, SAT and PAT. The Vendor shall provide dedicated FAT, SAT and PAT procedures as part of the documentation.

Systems Manuals - these manuals shall provide information on all elements of each system and shall detail procedures for operations such as system back-up.

User Manuals - these manuals shall provide detailed instructions on the operation of the system.

Configuration Manuals - these manuals shall contain comprehensive details on the configuration of the system.

Maintenance Manuals - these manuals shall provide details of any maintenance that can be undertaken by the Company personnel.

Manufacturer Record book.

10.2 Design Specification

The Functional Design Specifications shall be submitted for review and approval. They shall be maintained throughout the project and re-issued following completion of the acceptance tests as "As-built".

10.2.1 Wellhead Control System (RTU/PLC)

The Functional Design Specification documentation that shall be provided by the wellhead control system vendor immediately following the contract award. This document shall provide a functional definition of how the wellhead control system shall be implemented to meet the requirements of this specification. It shall describe in detail the functionality of all elements including specification, software & interfaces.

The Vendor shall also submit documentation of detailed design definition that shall describe in detail the functionality of all elements of each system including, but not limited to the following documentation:

- Specification of Control System equipment
- Overall Control System Architecture
- Shutdown cause and effect diagrams for ESD, F&G functions
- HMI Graphics
- Interface details between the systems
- Internal & external GA drawings for cabinets.
- Signal & power supplies wiring drawings.
- Complete Cable Block diagram/cable schedule (including JB schedule, cable glands and instrument cabling).
- JB Wiring drawings.
- Input/output schedule.
- Loop and system wiring diagrams identifying all equipment, cables, junction boxes and terminals.
- Heat and Power dissipation calculation.
- Complete earthing arrangement block diagram
- Details of user documentation to be supplied with the system
- Overview of the training courses for systems management of the system
- Overview of the training course for maintenance and reconfiguration of the system
- Descriptions of test procedures
- Certification.
- Separate SIL validation report for the entire system, i.e. from initiators to wellhead control system to final elements. (PFD values for Initiators and Final elements to be supplied by the Contractor/Vendor during SIL validation phase).

10.2.2 Wellhead Control System integration to the existing systems

A dedicated Functional Design Specification (FDS) shall be developed after the proper site survey for the integration scope, immediately following contract award. This document shall provide a functional definition of wellhead control system integration scope to the existing systems and how Vendors shall implement the scope to meet the requirements of this specification. The Vendor shall also prepare documents of detailed design definition that shall describe in detail the functionality and modification scope including, but not limited to the following:

- Detailed site survey reports
- Identification of existing systems
- Specification & modification details for the wellhead control system integration
- Modification scope and BOM.
- Modification details of the Human Machine Interface
- Details of User Documentation to be supplied as part the Vendor scope
- Method of statement for the implementation of modification scope
- Overview of the training details for Systems Management and maintenance/reconfiguration

10.2.3 New SCADA Server cabinet and Operator Consoles.

A dedicated Functional Design Specification (FDS) shall be submitted for the new SCADA server cabinet and operator consoles. The Vendor shall also provide detailed design definition documents of this new SCADA system and integration of this new SCADA to the existing SCADA network. The documentation shall describe in detail the functionality and modification scope including, but not limited to the following:

- Detailed site survey reports
- Identification of existing systems
- Technical Specification and drawings for the new SCADA system
- BOM.
- Integration scope.
- Specification of the Human Machine Interface
- Details of User Documentation to be supplied as part the Vendor scope
- Method of statement for the implementation of integration scope
- Overview of the training details for Systems Management and maintenance/reconfiguration.

10.3 Packing and Shipping

Packing, Marking and Shipping Documentation shall comply with 'Company Standard for Packing, Marking and Documentation' (KOC-G-004).

10.4 Spare Parts

The actual scope and number of spares required shall be as per details covered in respective project specifications, in accordance with the Company Standards for Spare Parts and Maintenance Data (KOC-G-009).

Commissioning spare include - commonly used parts such as fuses, lamps, fittings, terminals, IO boards which might reasonably be expected to require replacement during fault finding and rectification at the time of pre-commissioning and commissioning.

11. TRAINING REQUIREMENTS

On the Company request the Vendor shall provide training as part of the commissioning of the works, on the use of hardware, software and services of communications system and test equipment to support a comprehensive system of planned maintenance for the completed project.

Training shall also be provided for users, operating staff, maintenance, engineers and managers.

Training shall be provided for the Company operations and maintenance personnel in accordance with the requirements of the contract. As a minimum the system Vendors shall provide the following training courses for the Company personnel on request by the Company:

- System management training
- System reconfiguration/maintenance.

The content of these two courses are to be developed by the Vendors. The Systems Management course is to ensure that the Company personnel are adequately trained to undertake the necessary day to day system housekeeping and maintenance activities.

The content of the system reconfiguration/maintenance course shall ensure that the Company's engineers are able to undertake any maintenance/reconfiguration that the Vendor considers practical and necessary to ensure that the system operation is not unnecessarily disrupted. Class room and on the job training shall be undertaken to get the required results.

12. ADDENDUM

12.1 Addendum- A – Wellhead Control system Panels I/O Counts (minimum requirement)

General Notes:

IO quantities shown in below table is tentative only and provided as guidance for the Contractor/Vendor to develop further. The Contractor/Vendor shall review all reference drawings/documents and finalize the IO requirement as part of the system design. For further reference, tentative schedule of Inputs/Outputs for RTU and PLC system is provided in the document GPII-SCADA-I-22 in Appendix-6 to Technical Specification,

The wellhead control system shall be provided with 15% spare I/Os separately for RTU and PLC systems (rounded to next higher integer), additional to the finalized system design I/O quantity, fully wired till the field terminals inside the marshalling cabinets for each IO types.

The wellhead control system panels shall also be provided with 15% expansion space in addition to fully wired spare IOs.

Table of I/O Counts (Tentative) with application/system			
System	I/O Type	Application of I/Os	
		Wellhead & Flowline	F&G I/O's at Wellhead
ESD-PLC	AI	4	6
ESD-PLC	AO	NA	NA
ESD-PLC	DI	21	4
ESD-PLC	DO	18	7
RTU	AI	15	NA
RTU	AO	3	NA
RTU	DI	20	NA
RTU	DO	5	NA

APPENDIX-8 TO TECHNICAL SPECIFICATION: SPECIFICATION FOR WELLHEAD CONTROL SYSTEM AND SCADA SYSTEM WORKS

SAFETY & SECURITY ENHANCEMENT AND SCADA SYSTEM FOR JURASSIC WELLS AT NORTH KUWAIT AREAS

Table of I/O Counts (Tentative) with application/system
Notes: 1. I/O quantities listed above are NOT included for any system monitoring/diagnostic signal sources e.g. cabinet alarms, solar power and battery alarms, dedicated alarms for each power supply and communication modules, other auxiliary units. The Vendor shall include these IO requirements prior to calculating spare IOs and finalize total I/O requirements. 2. The Contractor/Vendor shall refer the attached reference I/O Schedule for additional information. 3. NA- Not Applicable.