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## Definitions

AISC	American Institute of Steel Construction
C.V	Curriculum Vitae
CB	Circuit Board
CCR	Central Control Room
Client / Owner / Company	Oil and Gas Development Limited (OGDCL)
CPU / Controller	Central Processing Unit of RTU/MTU/Data Server/EWS/OWS
CRC	Cyclic-Redundant Checksum
dB	Decibel
DCS	Distributed Control System
EPCC	Engineering, procurement, Commissioning Contract
ESD	Emergency Shutdown System
ETSI	European Telecommunication Standard Institute
EWS	Engineering Workstation
F&G	Fire and Gas Detection System
FHSS	Frequency Hoping Spread Spectrum
FIFO	First In First Out
FOC	Fiber Optic Cable
GFSK	Gaussian Frequency Shift Keying
GPP	Gas Processing Plant
LCP	Local Control Panel
Manufacturer / OEM	Manufacturer of the equipment
May	Signifies a feature which is discretionary in the context in which it is applied
MCCBs	Molded Case Circuit Breakers
MMSCFD	Million standard cubic feet per day
Monitor	High Resolution LED
MTD	Metric Tons per Day
MTU	Master Terminal Unit
MUST	Signifies a legal or statutory requirement
ODBC	Open Data Base Connectivity

OLE	Object Linking and Embedding
OPC	OLE for Process Control
OWS	Operating Workstation
P&ID	Piping & Instrument Diagram
PFD	Process Flow Diagram
PID	Proportional Integral Derivative
PV	Process Variable
RMS	Root-Mean-Square
RTD	Resistance Temperature Detector
RTS	Request To Send
RTU	Remote Telemetry Unit
Safety System	Combine ESD & F&G System
SCADA	Supervisory Control and Data Acquisition System
SCFM	Standard Cubic Feet per Minute
SCSSSV	Surface Controlled Sub-surface Safety Valve
SCSSV	Surface safety valve
SDV	Shutting Down Valve
SGM	Sales Gas Metering
Shall	Signifies a requirement made mandatory by this Specification
Should	Used where a provision is preferred; a strong recommendation
SLD	Second Level Domain
SOE	Sequence of Event
SOG	Software Operational Guaranty
SOV	Solenoid Valve
UCP	Unit Control Panels
UHF	Ultra High Frequency
Vendor / Supplier / Packager	SCADA and Telemetry System supplier/integrator
VPN	Virtual Private Network
VSWR	Voltage Standing Wave Ratio
WHCP	Wellhead Control Panel
Will	Signifies a feature which may assume to be already present

## 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:

<b>Gas Flow</b>	lb/hr, SCFM,MMSCFD	<b>Liquid Flow</b>	lb/hr, US GPM, Barrels
<b>Mass Flow</b>	Lb/h	<b>Pipe Diameter</b>	In
<b>Temperature</b>	°F , °C	<b>Pressure</b>	Psi, bars
<b>Voltage</b>	V	<b>Current</b>	A
<b>Density</b>	lb/ft <sup>3</sup>	<b>Viscosity</b>	cP, cSt
<b>Length</b>	Km, m, mm	<b>Mass</b>	Lb
<b>Power</b>	KW, MW	<b>Noise</b>	dB (a)
<b>Level</b>	mm, %, Inch	<b>Heating Value</b>	BTU/ scf
<b>Time</b>	Sec (s), Min (m), Hour(h)		

## Codes and Standards

Codes, specifications and standards referred within this specification, form a part of the requirements of this specification in a manner and to the extent specified within those codes and standards.

Unless otherwise specified, the latest edition or revision to these codes specifications, and standards in force at the time of request for quotation and/or Tender Document shall apply.

No deviations from the Codes and Standards listed in this document will be allowed unless such deviations are clearly identified in the bids, with the reasoning. In addition, they must be approved in writing by OGDCL.

AGA Report 3	Orifice metering of natural gas and other related hydrocarbon fluids
AGA Report 3	Compressibility Factors of Natural Gas and Other Related Hydrocarbon Gases
API RP 551	Selection of Process Measurement Instrument
API RP 554	Process Instrument and Control
ASTM A36	Specification for Structural Steel
ASTM A123	Specification for Zinc (Hot Galvanized) Coatings on Products
ASTM A394	Specification for Galvanized Steel Transmission Tower Bolts
ASTM B209	Aluminum and Aluminum Alloy Plate and Sheet, General Requirements for Testing Specification



BS 6121	Cable Gland
BS 6346	Cables
BS 7671	Requirements for Electrical installations
EIA-RS-232	Interface between Data Terminal Equipment (DTE) and Data Communication Equipment (DCE) Employing Serial Binary Data Interchange.
EIA-RS-485	Balanced Serial Data Communications Interchange
IEC-60068	Environmental testing procedures
IEC 60073	Coding of Indicating Devices and Actuators by colors and supplementary Means
IEC 60099-4	Surge Arrestors –Metal oxide Surge Arrestors without gaps for A.C systems
IEC 60168	Low voltage control gear
IEC 60331-21	Fire Resisting Characteristics of Electric Cables
IEC 60332	Tests on Electric Cables under Fire Conditions
IEC-60529	Degrees of Protection provided by Enclosures
IEC 60751	Standard for Industrial platinum resistance thermometers and sensors
IEC 60801	Electromagnetic Compatibility for Industrial process measurement and control
IEC 60865	Short Circuit Currents - Calculation of Effects
IEC 60870-5	Set of standards which define systems used for telemetry control (SCADA)
IEC 61000	Electromagnetic Compatibility
IEC 61131-1	Standard for programmable controllers
IEC 61131-3	Standard Programming standard for programmable logic controllers
IEC 61158-2	Foundation Field bus Standard for use in Industrial Control System
IEC 61200	Electrical Installation Guide – Wiring Systems
IEC 61508	Safety of electrical/electronic/programmable electronic safety-related systems
IEC 62061	Safety of machinery: Functional safety of electrical, electronic and programmable electronic control systems
IEC 801.2,3,4	Standard for Surge Immunity
IEEE Standard 81	Guide for Measuring Earth Resistivity
IEEE 472	Surge Withstand Capability

IEEE 730:	Software Quality Assurance Plan
IEEE 754	Standard for Floating point arithmetic
IEEE 802.3	Standards for Ethernet networks
IEEE 802.4	Token-Passing Bus Access Method and Physical Layer Specification
IEEE 802.11	Standards for Wireless LAN
IEEE 828	Software Configuration Management Plans
IEEE 830:	Software Requirement Specification
IEEE 1042	Software Configuration Management
ISA 12.0.0.1	Electrical Apparatus Zone Requirements
ISA 71.04	Environ. Conditions for Control System: Airborne Contaminants
ISA RP55.1	Hardware Testing of Digital Processing Computer
ISA S5.1	Instrumentation Symbols and Identification
ISA S5.3	Graphic Symbols for Distributed Control, Logic and Computer Systems
ISA S5.4	Instrument Loop Diagrams
ISA S5.5	Graphic Symbols for Process Displays
ISA S18.1A	Annunciator Sequences and Specifications
ISA S50.1	Compatibility of Analogue Signals for Electronic and Industrial Process Instruments
ISA S51.1	Process Instrument Terminology
ISA S71.01	Environmental Conditions for Process Measurement and Control System: Temperature and Humidity
ANSI/ISA S84.01	International Standards and Safety Codes
ANSI/ISA MC 96.1	Temperature Measurement Thermocouple
ISO-4016	ISO Metric Hexagon Commercial Bolts and screws
ISO-4032	ISO Metric Hexagon Nuts, Including Thin Nuts, Slotted Nuts and Castle Nuts
ISO-5167	Measurement of Fluid Flow in Closed Conduits (All parts)
ISO-5168	Measurement of Fluid Flow. Estimation of Uncertainty of a Flowrate Measurement
ISO-67498	Information Systems Processing Systems Interconnection Basic Reference
NEMA 250	Manufacturing Standards for Enclosures for Industrial Controls and Systems

## **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:

- i. This specification and referred documents
- ii. Relevant laws of Islamic Republic of Pakistan
- iii. Referenced International Codes and Standards

## **Deviations**

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

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.

The deviations / exceptions not mentioned in the Deviations section shall be considered complying with the document.

# 1. INTRODUCTION

## 1.1 Geographical Setup

The Kunnar Pasakhi Deep (KPD) and Tando Allahyar (TAY) fields of Oil & Gas Development Company Limited are located in Hyderabad District about 25 km away from Hyderabad city of Sindh Province. Presently KPD-TAY field is consisting of 30 number of producing well sites. Field is operated with full potential having 5000 BPD oil, 250 MMSCFD gas and 400 + MT/day LPG.

The KPD-TAY field comprises of following facilities

- Wellhead facilities (30 nos. producing well)
- Surface Gas Gathering Network
- Gas Processing Plant (including Amine Sweetening Unit)
- LPG extraction units (2 trains of Dew Point Control, Turbo Expander / Recompression, De-Ethanizer, De-Butanizer etc.)
- Condensate Stabilization units (2 trains)
- Sales Gas Compressors (3 x 50% capacity)
- LPG & Condensate Storage
- LPG & Condensate Loading
- LPG & Condensate Metering
- Power Generation
- Utilities such as Hot Oil System, Fuel Gas System, Compressed Air System etc.
- LPG and Condensate Recovery
- Produced Water Handling System
- Custody and Metering Systems

OGDCL intends to expand existing SCADA/Telemetry system for eleven (11) additional wellheads for scope including Engineering, Design, Procurement, Supply, Installation, commissioning, troubleshooting testing and integration of extended SCADA/Telemetry system with the existing SCADA & Telemetry system which is fully functional with thirty (30) well sites at Kunnar Pasakhi Deep & TAY (KPD-TAY) fields.

(This tender document has been prepared as per Public Procurement Regulatory Authority (PPRA) requirements and provides the basis of design and successful implementation of SCADA system.

The Bids are invited on **Single stage-two envelope bidding procedure**. Under this procedure the bid to be submitted shall comprise of a single package containing two separate envelopes. Each envelope shall contain separately the technical (proposals) and financial (proposals) bids.

The bids shall be valid for 180 days after the Technical Bid Opening date.

The award will be made in favor of lowest evaluated and technically responsive bidder at the sole discretion of OGDCL.

OGDCL reserves the right to accept or reject any bid or part of a bid and or to annul the bidding process and reject all bids at any time prior to award of contract, without thereby incurring any liability to the affected bidder or bidders or any obligation to inform the affected bidder or bidders of the grounds for OGDCL's action.

## **1.2 Site Visit**

OGDCL may arrange for a visit to the Site from the date of issue of the Tender Document. Bidders shall also note that the Visit to Site can only be arranged by OGDCL. In order to visit the site of proposed facilities the prospective bidders should send to OGDCL the request for Site Visit & Pre-Bid Meeting.

For the purpose of these Visits the following conditions should be noted:

- i. Pre-Bid site visit request shall be received by OGDCL at least 15 Days from bid closing date. Any requests received after that may not be entertained.
- ii. Attendance will be limited to a maximum of two (02) representatives per Bidders, unless OGDCL agrees otherwise, in writing.
- iii. All costs associated with the Visit will be to Bidder's account.
- iv. Bidders intending to visit the Site will be required to submit to OGDCL documents for security clearance of the Bidder's representatives together with the Acknowledgement Letter; and
- v. During the Site Visit, Bidders will be expected to carry out all necessary investigations/examination of site conditions, collect all required data and local information including environmental data and to study the existing facilities and necessary interfaces.

## **1.3 Pre-Bid Meeting**

A Pre-Bid Meeting may be held at OGDCL Head office, Islamabad to clarify the scope of work and to provide the opportunity to the bidders to obtain OGDCL's interpretation and clarifications on all outstanding issues of technical and commercial nature related to the Tender Document.

Attendance will be limited to a maximum of one (01) representative per Bidder, unless OGDCL agrees otherwise, in writing.

All costs associated with the meeting will be to Bidder's account.

## **1.4 Environmental Conditions**

### **1.4.1 Site Conditions**

Site elevation:           Approx. 60 m above sea level

Site conditions:       Cultivated area

Climate of the area is characterized by four periods, the cold season (Mid- December to February), the hot season (March to June), the monsoon season (July-September) and the post monsoon (October to Mid-December).

### **1.4.2 Environmental Data**

Equipment Location	Outdoor
Ambient temperatures (min)	0 °C
Ambient temperatures (max)	+55 °C
Design temperature (min) for equipment	0 °C
Design temperature (max) for equipment	+140 °F (+60 °C)
Relative humidity (min)	10%
Relative humidity (max)	90%
Rainfall	Maximum daily rainfall recorded over 24 Hours 251 mm. Max. monthly rainfall recorded 286 mm
Snow fall	No
Wind direction	The prevailing wind directions are either blowing from the North to the North-East, or blowing from the South-West to South-East.
Wind velocity for structural design	45 m/s at 10 m elevation, Exposure factor C- flat open terrain, Importance factor 1.15

	essential facility
Earthquake zone	Zone 2A of Uniform Building Code 1997.
Airborne dust Particles	Possible effect of airborne dust particles shall be considered when developing the design.
Bearing Capacity at Existing KPD Plant	0.9 Ton / ft <sup>2</sup> (95.0 KN/m <sup>2</sup> )
Maximum allowed Sound Pressure Level	< 85 dB (a) at a distance of one meter

## 2. OPERATIONAL PHILOSOPHY GENERAL ARRANGEMENT

### 2.1 General arrangement of the SCADA System

For remote monitoring, Wellheads operation, control, alarms, emergency and planned shutdowns and reporting of wellheads and production facilities process variables, a highly reliable SCADA & Telemetry system is required. The required SCADA/ Telemetry system shall be comprising of Remote Telemetry Units (RTU), Remote Radios at each wellhead, Primary field Instrumentation, communication Network, Solar power and E&I equipment etc. The communication link from individual remote RTUs through Remote Radios to existing Master Radio at Plant area shall be through UHF Ethernet based license free radio communication link.

The new proposed RTUs of SCADA/ Telemetry system for well site shall be connected for data communication with the existing SCADA system already installed for monitoring and controlling of thirty (30) KPD-TAY well sites.

The existing SCADA system of KPD-TAY field is comprising of redundant RTUs, Remote radios, Solar power system with redundant controllers, Primary & secondary Instrumentation and at (Plant area) redundant Master (Base radio) system, Redundant SCADA Servers, Historian, OWS with HMI system, Networking systems etc. Complete details of existing SCADA & Telemetry system of KPD-TAY are given at **Annexure-A**

**Note:** For better understanding, Engineering and development of SCADA/Telemetry System, the Vendor/Supplier is required to review **Annexure-A**, it shall be helpful while designing, procurement, installation & commissioning of SCADA/Telemetry system for eleven additional wells and finalization of integration philosophy between new and existing SCADA/ Telemetry system.

In existing SCADA & Telemetry system dual redundant Servers are working as main controllers for the SCADA system. Network Management between, SCADA Servers, EWS, OWS and 3<sup>rd</sup> party systems are implemented by proprietary software resident with the SCADA Servers. HMI systems

equipped with state of the art user friendly branded SCADA HMI software. For details of HMI system & HMI software, please refer **Annexure-A**

The 3<sup>rd</sup> party systems like Sales Gas Metering equipment, Online Gas Chromatographs, Raw gas allocation Metering equipment are connected through multiple type selectable communication protocols I.e. MODBUS TCP, MODBUS RTU (RS-485 & RS-232) etc. General network layout for reference purpose only is placed at **Flag-A**.

In the new proposed SCADA/Telemetry system for eleven (11) well sites, all process related primary Instrumentation like Pressure, Temperature, Flow and voltage transmitters etc. as well as F&G detection system and manual ESD system on each wellhead shall be connected to its respective RTU. RTU shall be responsible to monitor, control and isolate / shutdown (in case of process or fire related upsets) the wellhead on activation of pre-designed process operation logic and Emergency Shutdown logics for safety & protection of well sites and equipment. The shutdown sequence shall be based on Cause and Effect study shall be provided by OGDCL or Operational philosophy with the consultation of OGDCL.

RTU shall be responsible to get connectivity with the Field / Primary instrumentations and packages installed at well and collect data / parameters (PVs, indications, alarms, status, etc.) and transmit via remote radio to the existing Redundant SCADA Data Servers installed in Plant CCR for monitoring, operation & supervisory control, recording, reporting, Historian from CCR.

RTUs shall also receive Supervisory signals from Redundant Data Servers (such as remote ESD, choke / PCV / FCV set points or any other instruction by EWS/OWS / Servers from CCR and shall control the all installed Final control elements/ actuator devices accordingly. Wellhead facilities & primary Instrumentation shall be required for monitoring & control, through RTU.

The RTU have minimum: accessibility of

1. Well site/ raw gas main parameters monitoring (local and remote).
2. Well site Gas Pressure, Flow and Level etc. control.
3. Solar power monitoring and control
4. Well site raw gas Flow measurement, calculation and reporting
5. Status of Main Valves (SCSSV/ SDV, SCSSSV).
6. Well safety and security system
7. Status/display of Skid packages (i.e. corrosion inhibitor, Chemical injection, pig launcher, instrument gas scrubber, power supply health and function)
8. Complete monitoring & controlling of ESD logic and its operation.
9. Effective designing of F&G detection system



**Note:** SSV and SCSSSV shall be operated by the Hydraulic/Pneumatic Wellhead Control Panel (WHCP) on signal from RTU permissive on activation of ESD logic or directly on activation of built-in high and low pressure pilots.

### 3. WELL SITES PRESSURE & FLOW CONTROL PHILOSOPHY

The concept behind the designing & development of logic for Pressure & Flow control through SCADA system shall be purely based on the operational requirement of processing Plant by keeping pressure constant and gas flows/ volumes as variable. Gas Volume/ Flow increases gradually when Plant required more gas flow and decreases when required less or no flows.

For well site flows and pressure control through SCADA system, Vendor shall be responsible to design primarily Well Sites Pressure & Flow Control philosophy/Software (control logic, application program etc.) which shall fulfill the Plant Gas flows and pressure requirement on auto & manual selectable modes of operation and also to encounter the emergency conditions abruptly in case of any ESD of plant.

KPD-TAY field is operational and High pressure Raw Gas from thirty (30) wells is commingled at Plant gathering area and injected into Processing Plant through two (02) different separators named as KPD (Kunnar Pasakhi Deep) and TAY (Tando Allah Yar) separators.

For optimal process and gas flow control at specific Plant inlet pressures, the required flow and pressure of gas shall be either maintained by operator by giving set points on HMI to each well site and on Master PID Controller manually or set to Auto mode through SCADA Master Software Controller or as per Vendor's recommended Engineering and Design.

Detail of operating parameters of eleven well sites where SCADA/Telemetry system to be installed are given as under for appropriate designing of well site raw gas flows with respect to plant inlet Pressures:

S. No.	Well Coordinates	Well Name	Choke	WHFP	WHFT	Line Pressure	Oil	Gas	DISTANCE
			(* / 64")	Max (PSIG)	(°F)	Min (PSIG)	(BPD)	(MMSCF)	(Km)
1	Surface :- Lat: 25°-25'-50.213" Long: 68°-33'-30.2989" Target :- Lat: 25°-25'-50.489" Long: 68°-33'-41.043"	PD#04	32/64	2650	122	1100	110	13.05	8
2	Lat: 25°-26'-41.70" Long: 68°-33'-28.10"	PD#05	32/64	2600	90	1100	105	14.005	10
3	Lat: 25°-26'-07.74" Long: 68°-33'-33.32"	PD#06	32/64	1900	140	1100	0	9.32	9
4	Lat: 25°-25'-31.574" Long: 68°-33'-34.474"	PD#07	32/64	1850	115	1100	50	9.75	8
5	Lat: 25°-21'-36.4525" Long: 68°-35'-03.333"	KD#09				1100			10
6	Lat: 25°-22'-59.95" Long: 68°-34'-25.39"	KD#10	32/64	2045	220	1100	55	10.85	1
7	Lat: 25°-21'-03.74" Long: 68°-35'-21.85"	KD#11	32/64	2325	106	1100	60	11.828	6

8	Surface :- Lat: 25°-21'-49.4863" Long: 68°-34'-25.2325" Target :- Lat: 25°-21'-53.4951" Long: 68°-34'-28.2158"	KNR W#02	32/64	2200	146	1100	145	9.516	5
9	Latitude: 25° - 22 - 05.626 N Longitude: 68° - 45 - 04.7366 E	Sand#01	32/64	1510	99	1100	65	6.852	8
10	Latitude: 25° - 22 - 52.1764 N Longitude: 68° - 44 - 56.2166 E	Sand#02	32/64	1570	104	1100	60	7.4	9
11	Lat: 25° - 19' - 25.399" N Long: 68° - 33' - 22.213" E	TAY- SW 1	32/64	2600	136	1100	75	11.5	10

The SCADA and Telemetry System packager shall be responsible for the complete Engineering and Designing of well site Flow and Pressure control philosophies with respect to required Plant inlet pressures at gathering areas. Line pressure. A Cascade type control loop will be setup to control Flow Control valves (FCV) installed by OGDCL at well sites. Its primary controller will be based on back pressure transmitter. Secondary controller will be based on wells individual flow. The HMI must have the options for Supervisor / operator to select software PID controllers with selectable options of one at a time either Pressure or Flow control feature by using same FCV depending upon the operational requirement.

In this Flow control philosophy wells Flow shall be controlled proportionally with line pressures in accordance with the Plant operational requirement. The PID loops settings shall have faceplate and HMI screen for operators to adequately control / configure the cascade loops in Auto and manual modes. In the HMI control parameters & alarm set points shall be set-able using on screen text box entry and up/down toggle buttons. Further to this a scroll up/down (increase / decrease) toggle button must be added in HMI to select for percentage of flow from each well. The logic program shall be developed with enough intelligence to determine whenever a particular well shutdown occurs. The Flow loss of a well shall not disturb other remaining wells and loop shall react to make up and eventually maintain total flow by managing set points automatically. Option of manual control along with each controller shall be given.

#### **4. SCOPE OF SUPPLY / WORK**

The SCADA and Telemetry System package supplier shall be responsible for the complete Engineering, Design, Procurement, Supply, Installation, commissioning, and troubleshooting of extended SCADA/Telemetry system for eleven (11) well sites and its integration with existing SCADA System including successful Testing, start-ups and documentations

This specification defines the minimum mandatory requirements of the system to be installed at well site and CCR, for Supervisory Control and Data Acquisition (SCADA) systems. This

specification applies to all SCADA equipment and associated system software required to remotely control (supervisory) and monitors 11 Nos. additional KPD-TAY Gas Wellhead Facilities. The SCADA and Telemetry System including but not limited to complete Hardware, Software (including addition of one new operator workstation in existing HMI layer), well site RTUs, Controllers, I/O modules, marshalling cabinets, UHF based remote radio communication system, Antennas, RTU shelters, Solar power system, process & F&G instrumentation. Integration of extended system with the existing SCADA system and development of complete operation & control philosophies, designing of logics, development of all configuration programs for existing redundant Data Servers & redundant Master Radios, HMI screens designing, Historian, Reports, Alarm summary etc in the existing system installed in CCR & at Plant area.

The SCADA & Telemetry system composed of (11) new Remote Terminal Units (RTU) with basic primary and secondary Instrumentation for monitoring and control of wellhead facilities, with sufficient solar power arrangements and remote radio communication system for (11) KPD wellheads with 02 Configuration machine/ Laptops for software development and maintenance/ troubleshooting purposes and one new OWS client connected with existing SCADA servers. This system shall be awarded on Turnkey basis. Minimum following services of SCADA and Telemetry System shall be provided by the supplier/ Vendor.

- 4.1 Design, Engineering, Procurement, Installation, configuration/ software development and Commissioning of complete Supervisory Control and Data Acquisition (SCADA) /Telemetry System as required in existing SCADA system.
- 4.2 Engineering and development of P&IDs, PFD, Control System Architecture drawing, Logic diagrams, Layouts, overall Plot Plan and associated drawings.
- 4.3 Designing of Functionality, Control philosophy and integration philosophy for new Radios with existing Master radios and new RTUs with existing SCADA/Telemetry system.
- 4.4 Electrical and Mechanical works required at well sites and associated places for the installation of SCADA/Telemetry equipment and field Instrumentations
- 4.5 Design, Engineering, Procurement, Installation, configuration/ software development and Commissioning of Remote Terminal Unit (RTU) with RTU cabinets and overhead shelters at each wellhead.
- 4.6 Design, Engineering, Procurement, Installation, configuration/ software development and Commissioning, of License free remote UHF radio communication / telemetry system including but not limited to UHF modems / transceivers, antennas, communication towers,

repeater station (if required between remote site and base station) etc. at all remote sites and the integration with existing Base/ Master radio station, complete in all respects, as defined in specifications and elsewhere in tender document. (for remote well site)

4.7 Basic to advance level Training of Design, Engineering, configuration, software development at Vendor's facilities.

4.8 Design, Engineering, Procurement, Installation, software development and Commissioning, of Solar Power Systems including solar cells, charge controllers, batteries and complete accessories for well site facilities with at least 02 days backup power in case of cloudy conditions.

4.9 Design, Engineering, Procurement, Installation and Commissioning of Primary Field Instruments I.e. Pressure, Flow, Temperature transmitters, Flow, Pressure & Temperature Switches, Solenoid valves, Indicators (if required), Gauges etc. with installation material, and secondary Instrumentation i.e. Barriers, Slave modules, Electrical Safety equipment etc. for each wellhead

4.10 Interconnection, Integration and commissioning of all primary field instrumentation i.e. PTs, TTs, FTs, PCVs, Switches and all associated systems with RTUs at each well sites.

4.11 Development of loop wiring diagram, interconnection with RTU, arrangement of material, power & data cables, accessories and, programming / integration with RTU shall be Vendor's scope.

4.12 Design, Engineering, Procurement, Installation, configuration/ software development and Commissioning of One new HMI OWS with all relevant accessories.

4.13 Engineering, development & commissioning of software for HMI system in existing Engineering Workstation, SCADA Servers & Operator Workstations.

4.14 All software required for individual components of SCADA & Telemetry system, as well as for overall system integration, complete in all respects, including HMI, database software, programming / configuration software application software, general software etc. All Control System / HMI software shall be supplied with lifetime licensing in favor of OGDCL

4.15 Software development/ modification in existing SCADA Data/ Historian Server for new 11 well sites data.

4.16 End-to-end engineering of the SCADA system complete in all respects, including programming, configuration, functional design specification, etc. as further elaborated in specifications.

- 4.17 Integration of Telemetry System with existing 3<sup>rd</sup> party packages installed at well sites through multiple type selectable communication protocols i.e. MODBUS TCP, MODBUS RTU (RS-485 & RS-232) etc.,
- 4.18 Design for equipment placement layout, cable ways (trench, tray, etc.), instrument earth network at well sites. It should be noted that the civil works are not included in Vendor's scope.
- 4.19 Procurement of Configuration machine/ Laptops for development, configuration, maintenance and troubleshooting of SCADA & Telemetry system i.e. RTU, Radios, Redundant data Servers, SMART field Instrumentation, Solar power controllers etc.
- 4.20 Configuration of SCADA & Telemetry System hardware and networking equipment.
- 4.21 Development of application programs & Configuration of all new RTUs, Radios, HMI, Historian Server and Network equipment etc.
- 4.22 Development of application programs & Configuration of new wells in EWS & OWS and network system.
- 4.23 Development & Configuration of ESD logics, Control Loops Alarms, Events, Reports, Graphs, trends etc.
- 4.24 Configuration and interfacing of all wellhead RTUs I/Os with radio / Communication equipment.
- 4.25 Configuration and electrically interfacing existing Well Head Control Panel (WHCP) with RTU for remote Emergency Shutdown from Plant CCR through RTU,
- 4.26 Configuration and Integration of Maser/Base radio, Remote radio and all remote well site facilities.
- 4.27 Integration of existing SCADA Data Servers/Historian Server with OGDCL Production Data Management System (PDMS)
- 4.28 Configuration and interfacing of existing 3<sup>rd</sup> party systems installed at well sites
- 4.29 Supply, installation of all required Instrument cables, Data cables, Power cables, junction boxes and cabinets etc. to be installed at well sites.
- 4.30 Complete arrangements and planning for material inspection & Factory Acceptance Test (FAT) at Vendor's foreign facilities.
- 4.31 Site services for installation of Telemetry equipment at well sites including Electrical, and Mechanical works.
- 4.32 Arrangement of Site Acceptance Test and performance monitoring/ evaluation of all SCADA/ Telemetry system

- 4.33 Complete arrangements for the Training for Software, configuration development of RTU, Radio communication, Server, EWS & OWS at Vendor's foreign facilities (Basic to Advance levels).
- 4.34 Complete arrangements of training at site for OGDCL technical staff.
- 4.35 Compliance of Warranty / Guarantee of all Supplied Equipment
- 4.36 Designing, Development & Configuration of Emergency shutdown (ESDS), F&G system, Safety system logics activated from Master Controller & HMI.
- 4.37 Designing & Development of HMI graphics for proper Monitoring, Control, Troubleshooting, Maintenance, Reporting and Historian etc.
- 4.38 Support and assistance during startup and operation of SCADA System and Telemetry System after commissioning.
- 4.39 Supply of Commissioning Spares. Price for commissioning spares will be included in total price for commercial evaluation.
- 4.40 Supply list of 2- years operational spares of SCADA & Telemetry System.
- 4.41 Provision of complete as build system/Project documentation etc.

**Note-1:** Vendor shall be responsible for data collection of existing system and all requisite studies/ surveys (such Path Project survey, UHF path profile study).

**Note-2:** Third Party Inspection will be arranged by OGDCL and will be carried out at vendor's site. However, vendor shall provide facilities and support to Third Party Inspector.

## **5. GENERAL DESIGN REQUIREMENTS**

### **5.1 General**

The SCADA System's equipment shall be standard products with minimal modification to suit the project needs. The SCADA system for eleven (11) well sites, composed of minimum system like PLC/ RTU, remote Radio Communication system, Primary & Secondary Instrumentation, F&G detectors, Solar power at remote site, Laptop/Configuration machines, Telemetry standard Configuration /Application software, AGA-3 & AGA-8 gas flow calculation. Historian, Reporting, Trending and data archiving programs shall be supplied from the same Packager/ Integrator.

The proposed system shall be the Packager's / Vendor's standard product and have been previously field proven experience in applications similar to this project. The system shall not be

dependent on specialized/unique or proprietary equipment or software available from only a single Packager / Vendor.

System security shall be maintained using an "Area of Responsibility" login and multilevel password system, which will allow specified levels of system access according to the password assigned.

The system and associated software shall be fully supported and kept up to date and the support for the selected hardware/ software shall be provided by the Packager / Vendor for fifteen (15) years.

## **5.2 System Size and Expandability**

Modifications to the existing SCADA system will be made in such a way that after complete addition of 11 new wells; SCADA servers, SCADA historian, OWS etc. shall have 20% spare capacity left unused in terms of connected controllers, IOs, tags, displays and memory etc.

## **5.3 Reliability**

SCADA system shall have a high level of reliability achieved through the design of the system. The system shall be designed such that the occurrence of a single unplanned incident will not result in the loss or degradation of performance of any data monitoring or control. In addition, as a result of such an incident, no damage to any process or loss of delivery or acceptance of product on the system shall occur.

The system shall perform periodic checks of its own health and promptly report any problems to the operator. The system shall also monitor the status of communication circuits and maintain statistics to warn maintenance personnel and aid in troubleshooting.

## **5.4 Availability**

The SCADA/ Telemetry / host system shall have an availability of at least 99.9%. The system failure time shall be reckoned as the time that the full functionality of the system is not available and this period of time shall be measured in hours and whole minutes, during which the productive work of operators cannot be carried out due to a failure of any item of hardware or software.

Intervals between successive periods of system failure time that are 30 minutes or less are deemed to be system failure time. The system failure time shall not exceed 0.1% when calculated on a monthly basis.

The design shall ensure that no interruption in the real time system occurs when the system is concurrently performing other functions i.e. printing, programs, displays, etc.

## **5.5 Open Systems**

The system shall be open such that SCADA system shall allow for access to the real-time data by other application programs and other users within the organization.

## **5.6 Modularity**

The design of the SCADA/ Telemetry system shall be modular so that modules can be added, removed and relocated without reloading and reconfiguring the core SCADA system.

The hardware shall be modular in nature to allow for future expansion in capacity and performance. The system shall allow the easy addition of disks, memory, terminals, processors and peripherals without disrupting the on-line operation of other parts of the network. All RTUs offered shall also be modular in nature.

## **5.7 Flexibility**

The system shall allow any of the workstations ie OWS to perform any of the functions provided with appropriate access level.

## **5.8 Design Life**

The design of the SCADA / Telemetry system, Equipment and components shall be suitable for continuous duty operation based on a 24 hour per day, 365 days a year design for a period not less than 15 years, without the need for a complete system revamp due to technological obsolescence.

## **5.9 OWNERSHIP OF SOFTWARE**

All SCADA software licenses which are being supplied shall be purchased/issued/registered in name of OGDCL and this registration should be verifiable from OEM database. Trial / Demo / Cracked / Limited versions / not register in name of OGDCL shall not be acceptable.

SCADA software licenses include (but not limited to):

- SCADA Server Software
- OWS Software
- HMI software
- EWS Software
- Remote Client Software
- RTU software



- Radio Communication Equipment Software
- Calibration Software used with HART and Pressure calibrators
- Solar power Controllers software
- Operating System, Office Tools and Antivirus software
- OPC Server – Client and Database software
- Drivers and Utilities
- Any other software component which is included in SCADA package or requires for desired functionality of SCADA system

## **6. THE SCADA & RTU SYSTEM FUNCTIONALITY**

### **6.1 General**

The RTU Systems shall be responsible to collect real time Process Variables (PVs) from field primary Instrumentations / field sensors ie PT, TT, FT, LT, FBT, Switches etc, combines data altogether and transferring complete real time data to the existing fully functional redundant SCADA Data Servers installed at KPD Plant CCR for further processing, monitoring and control, Data base and permissive back to RTU for action to the final control element in case. For transmitting & receiving data back to RTU by using full Duplex license free UHF radio communication (Radio Transceivers) system.

The RTUs shall monitor, control, Gas volumetric measurement & shutdown respective KPD-TAY wellheads. In case of detection any abnormality locally, permissive generated from SCADA Data Servers from the Plant Central Control Room (CCR) during operation.

OGDCL is intending to transform eleven (11) manual wellheads into fully automation by installing Remote Telemetry Units (RTUs), Radio Data communication system and Primary & Secondary instrumentations at each well site. Detail is given as under.

- 1-** PD # 4
- 2-** PD # 5
- 3-** PD # 6
- 4-** PD # 7
- 5-** PD # 9
- 6-** PD # 10
- 7-** KD # 11
- 8-** KNR West-02

**9-** Saand # 01

**10-** Saand # 02

**11-** TAY SW-01

The Remote Terminal Units (RTU's) shall interface with field instrumentation, F&G detectors, Electrical Systems and sub-systems, solar power systems, UCP/LCPs, UHF radio communication equipment and all third party devices and provide the programming, logic, sequencing, view, monitoring and control capability for SCADA Operator and Engineering Workstations.

The existing SCADA & Telemetry system is fully functional installed for monitoring, controlling and metering of thirty (30) KPD-TAY well sites. The Master/ Base radio communication equipment resides in existing CCR of Plant connected with SCADA Data Servers redundant LAN in CCR

The UHF radio communication equipment at well heads shall reside in RTU cabinet.

The antenna tower for Master/ base radio is installed at the distance of approximately (01) one Km from CCR. The UHF radio communication equipment at well heads shall reside in RTU cabinet. The redundant Data Servers and Historian Server are connected with EWS and OWS, printers through centralized redundant Ethernet / LAN network.

The SCADA system have Operator and Engineering workstations for monitoring of all thirty (30) remote facilities full control installed at well sites, metering equipment etc. The SCADA Servers are redundant to each other. Due to real time redundancy of the systems, in case failure of any work station or SCADA Data Server the standby system will take over entire SCADA operation and provide bump less, Auto change from primary to Secondary,

All RTUs are communicating with SCADA Data Servers through license free full duplex FHSS radio with Ultra High Frequency Band.

## **6.2 SCADA & Telemetry System Core Functionality**

The SCADA system/ Telemetry shall be supplied with all typical functions including but not limited to the following:

- Data Acquisition from field instrument devices via Remote Terminal Units (RTU's).
- Data from well sites shall be gathered in redundant SCADA Data Servers for any interlock processing and to pass decision and monitoring with effective control and historian through EWS/OWS and Server respectively.
- Processing the data to monitor status, detect alarms / deviations and other significant process changes.
- Provision of real time live data of remote facilities to the Data Servers consistently

- Presenting the data of well sites and integrating with the existing Operator workstation and additional (01) Operator Workstation and Engineering workstation in form of easy to understand mimics, graphical displays with multitasking features, alarms, system standard faceplates, trends, groups, reports etc.
- Performing remote monitoring, control operations and shutdown of field devices.
- Performing system self-diagnostics and monitoring to detect failure of hardware and software and take appropriate actions including diagnostic facilities for troubleshooting by system experts.
- The system diagnostic features shall be comprehensive enough to carry out all regular troubleshooting and maintenance activities, without specialized technical expertise of SCADA Suppliers.
- Historical archiving of data for recent archives on the SCADA servers.
- Transfer real-time engineering data from RTU directly to and from the engineering workstation.
- Provide interfacing through multiple type selectable communication protocols i.e. MODBUS TCP, MODBUS RTU (RS-485 & RS-232), Foundation fieldbus and Profibus to the 3<sup>rd</sup> party systems for data acquisition at Well site RTU,
- Uploading/Downloading Local and Remote RTU configuration, programming from CCR The system must displays all Process Variables for proper monitoring and control, Trending, Reporting and for maintaining of Historian data in existing Historian Server and HMI
- Up gradation of system must be simple and contains built in product releases
- Performing raw gas flow Calculations through RTU based AGA 3 and AGA 8 based calculations etc.
- ESD and Safety/ Protection logic control
- Alarm Handling, Event Handling, Sequence of Events
- Development of HMI Operator displays of (11) wells for real time data monitoring, Control, maintenance /troubleshooting, trends, reports and graphs of Remote well sites in the existing HMI system.

### **6.3 Network Architecture**

The KPD SCADA system shall be designed for remote monitoring and controlling of (11) Wellhead facilities through SCADA / Telemetry system from Plant and to provide connectivity with the

existing Redundant Master (Base Radio system that s installed and functional for data transmission from 30 well site RTU and Production Database Management System (PDMS) details are given at **Annexure-A** .

The new proposed SCADA system shall be designed for three layers of control level  
SCADA Data server & Engineering /Operator Workstations which are installed at Plant CCR.

**6.3.1 RTU Level** – At this level, RTUs shall get data from the field instruments and the local controllers at the various remote sites. The RTUs shall manage communications with the Real Time redundant Data Servers, which will provide Real-time data for the whole system. The communication between RTUs and Master/ Base Radio shall be through license free UHF radio network. The remote sites will be powered by a solar system installed on each site. Both Radio System and Solar System are included in the Supplier / Vendor's scope of work.

### **6.3.2 Radio Communication system**

Radio communication system shall be using as communication medium between RTU at well site and Data Servers at Plant areas.

The Vendor /Packager shall provide License free UHF Radio technology for the SCADA system facilities

and shall be responsible to integrate with the existing redundant Master (Base radio) system installed for SCADA system. Detail specifications are placed at **Annexure-A** and Network Architecture at **Flag-A**

**6.3.3 Data Server & Engineering /Operator Workstations**– The Vendor/ Packager shall be responsible for well site data monitoring & Controlling of eleven (11) new well sites to be connected with the existing SCADA & Telemetry system installed at KPD-TAY Plant. Existing SCADA Data Servers, Historian, EWS, OWS and Master Radio system are installed in CCR at Plant area. All this control system equipment are fully functional for remote monitoring & controlling of (30) well sites. The Real Time Data Objects are stored in the SCADA server. The System is remotely monitored and controlled by operators via the OWS and EWS at the CCR. These workstations are providing the Human/Computer Interface for remote operation of the system. Existing The SCADA data Server, Engineering and Operator workstations are networked through redundant SCADA Ethernet layer (LAN) and receives all real time data from all remote facilities and Plant Gas Metering equipment.

## **6.4 System Software and Application Program**

Software for SCADA system and associated system shall be based on international standards and run under a field proven OS. Proprietary operating systems are unacceptable. The Operating system software and application programs shall be latest in all aspects. The preferred operating system shall be minimum Windows 10 or any other latest recommended by SCADA system supplied Vendor.

The computer operating system shall not be modified in any way in order to allow the SCADA software to run. A multiple protocols handling possibility is required for the system software. All software in the SCADA system shall allow for expansion in the future without requiring any reprogramming of software. It shall be possible to add software features on the operational system by running a command file. This should append the new software to the existing system without having to shut down the system and reinitialize it with the new software version.

All software shall be provided with life time license in favor of OGDCL. This shall be verifiable from OEM records as well.

## **6.5 Data Management Functionality**

The existing SCADA/ Telemetry system maintains a database of real-time data. The database allows on-line modification and requires changes to be made in one place only.

The Packager / Vendor shall be responsible for the database management of new SCADA/Telemetry system and & integration all data received from RTUs to maintain database of real-time data in a installed SCADA Data Servers

The database shall be ODBC compatible and be able to export data to personal computer PC applications.

The SCADA system shall also include a relational database in addition to the real-time database. This on-line relational database shall be used for reporting, trending, archiving, and exporting data to other applications. The database shall automatically archive data to storage device and purge the on-line historical data at the end of the user-configured period.

The SCADA system shall have the capability of logging alarms, events and historical data to file for future retrieval and trending. The data type and storage frequency shall be user defined without programming required.

## **6.6 Data Types**

The system shall be able to handle both integer and floating-point analog points at various levels of precision. Floating point numbers will comply with IEEE floating point standards. The following data types shall be included as a minimum.

- Discrete Inputs
- Discrete Outputs
- Analog Inputs
- Analog Outputs
- Compensated Flow Inputs
- Accumulator Inputs
- Calculated Analog Points
- Calculated Discrete Points

## **6.7 Data Structures**

The database and communication routines shall be able to handle various data structures including:

- Single point
- String
- Block
- List
- Array
- Stack
- Queue

## **6.8 Data Classification**

It shall be possible to classify the database point according to classification, e.g., area of responsibility, security etc. The classifications can be used jointly and independently to select, filter, display and report data. The system data classification can be used also for user's access control.

## **6.9 Historical Data**

The Packager / Vendor shall be responsible to configure complete well site data received from newly developed well sites SCADA/Telemetry system through RTU into existing SCADA Data

Servers & Historian of KPD-TAY SCADA system installed in CCR at Plant area by using existing software or any other environment (if required) utilizing full SCADA software features for database management, report generation, trending, alarms and reporting purposes etc. Historical data files should be maintained on the system hard disk and can be transferred to a tape or writeable CD. The data may be retrieved and displayed on either the workstation screens or the printers. It shall be accessible by other computer systems via the LAN.

The host system shall have the capability of logging any user-defined data to a file for later retrieval. The definition of points to be logged shall be possible without any programming.

A feature shall be provided to reduce the data stored by using averages, minimums, maximums and the times at which the minimums and maximums occurred, or other such methods as defined by the user. The required configuration of this feature in SCADA System shall be performed by the Packager / Vendor.

The historical data files shall be stored as:

- 48 hours of instantaneous data gathered once per minute;
- 100 days of hourly averages;
- 300 days of daily averages.

## **6.10 Data Archiving**

It shall be possible to archive the database to a file for later retrieval. The system shall store all events, alarms, reports and trend data. The system shall permit archived files to be kept on a system hard disk and can be transferred to a write-able environment.

## **6.11 Operator displays**

The Packager / Vendor shall configure and develop HMI for new (11) well sites in the existing installed HMI system. The HMI for new wells shall be in accordance with the existing HMI philosophy and system shall have a number of standard SCADA displays accordingly.

In addition, displays shall be dynamic in the way that the displays shall update whenever any of the associated data changes. The displays shall also have tooltip or info tip features.

The system shall come up with complete help features relating to all controls, alarms, etc. which can be easily called up and give information on the operation of the system and likely causes of problems.

Application developed for the addition of 11 new wells and existing application both shall also be downloaded and deployed to one new operator client workstation provided in the scope of this

project. New operator workstation shall have same features and functionality as of existing operator client workstations.

## **6.12 Graphics**

The operator interface shall support sophisticated graphics in a windowing environment. The operating system shall allow true multitasking, and allow at least four displays running applications at one time. The Operator interface shall be designed to make full use of the capabilities of the operating system.

Each operator workstation shall have the capability of driving two monitors. It shall be possible to generate and store schematic displays. The graphics displays shall use color and flashing attributes to represent various dynamic conditions of the associated data such as alarm conditions, valve position, invalid data, etc.

The Packager / Vendor shall supply complete graphic screens specific to the project.

## **6.13 Trends**

The system shall provide trend displays of live time stamped real time and historical data.

The SCADA software shall format and display the points relative to time. The time scale shall be operator adjustable. A minimum of four data point sets, identified by color, shall be displayed at one time.

The system shall display the actual value of a point on the trend curve selected by a cursor on the workstation screen. This information shall be displayed as a real number along with the engineering units, time of day, and date in an appropriate place on the screen. The sampling rates for trend data shall be adjustable from 0.5 second to 1 hour. The points to be trended shall be agreed between the Packager/Vendor and Company during detailed design as part of Packager / Vendor scope of work.

## **6.14 Faceplates**

The system shall come complete with predefined faceplates that display point information in a graphical manner. It shall be possible to display a faceplate by specifying the point's tag name.

## **6.15 Reports**

Report generation shall be provided for all current, trended, historical and archived data. The report formats can be generated by the user in a user-friendly environment without any system programming.

It shall be possible to output report to a selected printer, screen, computerized mimic panel, or ASCII disk file.



## **6.16 Time Synchronization**

All host peripherals that have a real time clock and all PLC/RTU shall be time synchronized with the main Host Control System / Data Servers. The main host shall act as a master clock and be responsible for synchronizing the rest.

## **6.17 Import/Export Formats**

The SCADA system shall have the ability to import and export data from the real time database. The Packager / Vendor shall be responsible to amend (if required) for the integration of new well sites in the existing SCADA Data Servers, Historian and HMI system and to provide export routines, which provide data in formats, which are compatible with the existing software environment.

The Packager / Vendor shall provide an import feature, which will accept ASCII or any other data as input and write data into the existing database available in existing installed SCADA system.

The use of the import and export routines shall be password protected.

## **6.18 Configuration Functions**

The new SCADA system shall provide efficient, user friendly, interactive utilities for the configuration of system data and resources including the following,

- Software and Hardware including RTUs, Server, Workstations and all peripherals
- Networking Equipment
- Communication
- Database
- HMI Screens
- Reports
- Synchronization of Data and Files

## **6.19 Security**

Security is required on access to the database, to SCADA functions, to files and to programs. Access to the system shall be controlled by password. Upon logging on to the system, users will be assigned to one or more groups.

The system administrator will control and can change the access rights for each group.

This groupings or levels of access are as follows:

- View Only;

- Operator Normal Functionality Level;
- Operations/Maintenance Supervisors Level;
- Engineering Level.

The security system shall be software driven using passwords, leaving an audit trail for all changes.

## **6.20 Diagnostic and Maintenance**

The Packager / Vendor shall provide Diagnostic software to generate, display and print diagnostic reports on all of hardware components of SCADA/Telemetry, Communication and Solar power system.

A comprehensive set of diagnostic facilities shall be provided along with following basic requirements:

- Software Fault, Error Detection and Reporting;
- Hardware Fault Detection and Reporting;
- Peak System Computer Loading Statistics;
- Data Communications Error Statistics.

Error conditions caused by either software or hardware shall be clearly distinguished. The system shall contain a comprehensive error detection configuration program shall ensure the reporting of detected errors and generation of an error message on the system.

It shall be possible to isolate and troubleshoot individual communication links and fault/error detected areas without impacting the operation of the rest of the SCADA system.

## **7. SCADA SYSTEM COMPONENT DETAILS**

Following sections provide list of components associated with required SCADA system. However, it shall be noted that SCADA system vendor shall be ultimate responsible for completeness of the system even if any components which are required for desired functionality are not mentioned here.

### **7.1 Remote Terminal Units**

#### **7.1.1 RTU Core Functionality**

The RTU shall be a powerful “intelligent device” specifically designed for integrated control system applications, well monitoring, control and measurement applications where, in addition to the

traditional RTU functions, enhanced communication capabilities mixed with high performance control strategies are required.

The RTU's control processors and I/o modules shall support all required functionality for proper process monitoring and control of primary and secondary instrumentations, on/off devices, and sequential control of all intelligent and third party systems, detection system along with safety and security systems etc.

### **7.1.2 RTU General Design Requirement**

The SIL-2 certified by TUV RTU shall be a microprocessor based Low powered consumption modular electronic control device equipped with I/O terminals suitable for connecting directly to the field wiring of analog and digital control and monitoring devices.

Communication link between individual RTUs and main SCADA server(s) shall be provided through License free two-way radio communication link, between each of the remote facility and CCR at Gas processing plant (included in Packager's / Vendor's scope of work).

Power Supply for RTU at wellheads shall be furnished through Solar Power Panels (which are also included in Packager's / Vendor's scope of work).

The RTU's shall meet or exceed the following features as a minimum:

- RTU's hardware shall be suitable for safety applications and shall be rated as SIL2 in accordance with EN/IEC 61508 and IEC 62061; SIL2 certificate shall be accredited by TUV. SIL2 certificate shall be submitted along with technical bid package of the bidder.
- The RTU's shall be designed for continuous monitoring and control field I/O, control Valves, ESD valves as well as On/Off and Sequential control of all intelligent third party devices like Fire & Gas detection and safety system.
- Expansion capability to support for more than 300 I/O points and up to 03 communication ports.
- RTU's must be modular in design to allow expansion of communications and I/O interfaces and capable of a variety of data transfer methods using various communications media and protocols; On board IO channels with CPU are not acceptable
- Support a range of communications port options that include: Isolated serial ports shall be configurable as RS232 / RS485 and Ethernet port for TCP/IP based communications, se published 'open' protocols for communications with host and local devices. Protocols should include MODBUS (RTU and ASCII).

- The RTU logic must allow the generation of ASCII command strings and the parsing of ASCII responses for development of simple ASCII interfaces.
- Ethernet (10baseT/100baseT/100baseFX) communications for inter RTU communication as well as third party devices communications specially UHF radio communication system
- Allow 'hot swapping' of I/O modules (i.e. change modules while in running mode) and under power conditions).
- **Report by Exception (RBE)** - where the RTU initiates messages and reports to SCADA master station only by change in parametric values;
- **Standard polling** - where the master station continuously requests some/all Real-time data values;
- **Select before Operate (SBO)** - where the RTU "selects" an output (Analogue/Digital) and locks out any other access to the selected output, before writing to it. This feature shall be implemented for all discrete as well as serial outputs, as it prevents inadvertent command actions on any given output from multiple command points in the SCADA system;
- **Peer to peer communications** - allowing RTU's to communicate with each other;
- **Store and forward communications** - allowing RTU's to store last set point and values downloaded from SCADA and operate as individual control system for remote site in case of communication failure;
- **Transparent port connections** - allowing RTU's to 'connect' ports between remote locations for the transfer of non-RTU data/messages. This requires the RTU to receive and send non-RTU message within a RTU message packet for transfer to another RTU location for output (the output message is stripped of the RTU message headers, CRC etc.);
- Receive Time synchronization from SCADA Data Servers
- Send periodic Time synchronization signals to all third party intelligent devices connected to it, via Ethernet as well through serial interfaces;
- Multi loop control, logic control and sequencing;
- Standard PID, feed forward, cascade, adaptive gain, ratio, override control, multivariable functions, selectors;
- Remote download/uploads of configuration, parameters and application software to/from RTU flash memory as well as remote restart/reboot of RTU's;
- Directly handle standard I/O modules and perform intelligent process control functions for applications requiring highly accurate measurement of process variables, closed loops

control, sophisticated algorithms, easy programmable through user friendly sequences configuration;

- RTU should be capable to calculate accurate AGA and API based flow/ Volume of Gas from each well head.
- Programming and configuration shall be IEC 61131-3 compliant;
- Power loss shall not result in previous data loss;
- On failure of the communication link and / or power loss with any RTU, an alarm signal shall be generated and passed to the Data Servers on a priority basis;
- RTU shall have a feature of Failsafe and automatic cold start: In the event of complete loss of communication the controller will adopt a user-defined failsafe mode and similarly instruct the I/O to take up user-defined failsafe values. In the event of power loss the RTU Controller will perform a cold restart, which restores the program(s) and assumes a predefined status.
- The RTU shall be configurable to manage network communications in slave mode, master mode or as a data concentrator (where a data concentrator operates in both slave and master modes);
- The RTU shall maintain 'images' of network data received from other RTUs to allow reference of such data (and its communications status) to be included in the RTU logic;
- Fault detection and Auto-diagnostics (local and remote);
- Certified for industrial environment (according to CE);
- Field terminations incorporating scaling resistors test and isolation links;
- Galvanic isolation on all I/O Modules
- Digital I/O configuration incorporating; Accumulators and status inputs
- Loop powered 4-20 mA analogue I/O;
- Plug connected terminations.
- The RTU hardware including I/O termination racks, radio communication equipment will be installed in one stand-alone enclosures and rated at least **IP65**;
- Each enclosure shall incorporate the specified RFI/EMI shielding control requirements.
- The RTU and components shall be connected to a secure earth ground. This shall be by the provision of an enclosure ground bar in RTU enclosure. The safety earth pit shall be provided for the same as required. Construction and finishing of safety earth pit will be done by

OGDCL; However, SCADA vendor shall be responsible to supply suitably size grounding cables and rods.

- It shall be possible to program the RTU by means of a laptop to locally monitor, configure, program the RTU and to simulate polling requests, functional commands such as shutdown from Plant CCR through software Master Controller developed in logics in Data Servers and indicate the status and integrity of all analogue/digital I/Os.
- This laptop with complete licensed software for configuration purpose shall be a part of SCADA supply.
- RTU scanning times of Input and Output points shall not be more than 10 msec specifically for critical loops. All Analogue and Digital input points shall be time stamped to a time resolution as indicated in this specification. The actual time stamp for each point shall be reported to the redundant SCADA Server when the RTU is polled;
- For digital points the time stamp shall occur when the change of state is first noted before the denounce timer starts. For analogue and pulse accumulator points the time stamp shall be the time when the RTU analogue point is polled.

### **7.1.3 RTU Controller / Processor**

The RTU shall be minimum 32-bit microcontroller, 04 MB (System Memory) microprocessor based modular electronic control device equipped with I/O terminal suitable for connecting directly to the field wiring of analog and digital control and monitoring devices.

The RTU Processor shall be capable of both modulating and sequential control. Packager / Vendor shall provide the Controller / Processor utilization details & graphs and other related parameters to HMI in Diagnostic option.

All control algorithms shall continue operating with the last valid information in the event of communications subsystem failure.

Processor module shall base on industry standard and having capabilities for Modbus TCP, Modbus RTU (both RS485 and RS232) and OPC as minimum,

RTU Controller / Processor shall have following features as minimum:

- Processor 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 etc.;
- Processor must employ online diagnostic routines for identification of failures throughout the system;

- Processor Modules shall be capable of stand-alone operation without the need of operating consoles / workstations, data highway or other support hardware except for power;
- Processor loading information shall be presented in percentage;
- Controller / Processor 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;
- 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;
- All cascaded loops shall support bump less transfer;
- Ladder diagram, function block and sequential function programming format shall be used. All Processor 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;
- Maximum program scan time shall be less than 500 milliseconds. The scan time shall not vary with input / output load and control configuration functional blocks;
- It shall be possible to put any individual control loop in the out of service;
- CPU module shall have capabilities of fuzzy control. Vendor shall also provide software modules and licenses for the fuzzy controlling;
- Vendor shall include the Power supply for CPU module as per their system requirement. CPU power supply shall be separate from field instruments power supply requirements;
- System shall be provided with lifetime software licenses for the maximum number of I/Os
- Packager / Vendor shall also take into account the following soft tags for required licenses and controller selection:
  - i. Soft Tags for Alarms (HH, H, L, and LL) shall be considered for all analog inputs;
  - ii. Soft Tags for Alarms (H, L) shall be considered for all digital inputs;
  - iii. Alarms and Events for data acquired from Third Party Packages through OPC and through MODBUS TCP / MODBUS RTU, Serial RS 485 shall be configured.

#### **7.1.4 External Communication Features**

The RTU's shall support 10/100Mbps Ethernet communication, for interfaces to intelligent devices etc. The RTU shall be designed to build up hierarchical data transport networks on diversified transmission media, supporting multiple communication protocols.

The RTU shall also be equipped with asynchronous and synchronous serial communication channels that can be connected to a wide range of different communication media,

- i. UHF radio networks through Ethernet TCP/IP.
- ii. Dedicated RS-232/RS-485 digital communication lines.
- iii. LAN (Ethernet) interface.

#### **7.1.4.1 RTU Protocols**

Protocols to be supported by the RTU shall be:

- 1) SCADA /RTU Communication Protocols
  - a) Modbus RTU
  - b) Modbus TCP
- 2) Field Protocols
  - a) Modbus
  - b) PROFIBUS
- 3) LAN Protocols
  - a) TCP/IP
  - b) Modbus TCP
  - c) UDP

#### **7.1.4.2 Local Communications**

The RTU shall support a number of device drivers that allow communications with local devices such as meters, PLC's, and other intelligent electronic devices.

These interfaces will typically operate on any of the RTU communications ports using data transfer protocols such as MODBUS, and ASCII.

#### **7.1.4.3 RTU Network Communications**

The RTU shall be capable of communications within a network of greater than 50 RTU's using industry standard SCADA protocols

The RTU shall be configurable to manage network communications in slave mode, master mode or as a data concentrator (where a data concentrator operates in both slave and master modes).

The RTU's shall maintain 'images' of network data received from other RTU's to allow reference of such data (and its communications status) to be included in the RTU logic.



### **7.1.5 RTU Performance**

RTU scanning times of input and output points shall be very efficient. All analogue and digital input points shall be time stamped to a time resolution as indicated in this specification. The actual time stamp for each point shall be reported to the SCADA Servers when the RTU is polled.

For digital points the time stamp shall occur when the change of state is first noted before the denounce timer starts. For analogue and pulse accumulator points the time stamp shall be the time when the RTU analogue point is polled.

### **7.1.6 I/O Circuitry**

The RTU shall consider all field instruments used at well site for designing of I/O circuitry.

I/O Circuitry shall meet the following requirements as minimum:

- It shall not be necessary to remove power or field wiring to replace input / output module;
- In intrinsically safe installations IS barrier shall be used
- Process I/O circuits shall be protected against common mode transient surges of up to 100 Volts. Such transient surges shall not cause damage or system performance degradation;
- All digital process I/O circuits shall be designed to ensure that accidental normal mode connection of up to 100 VAC/DC for an unlimited period of time shall not cause damage other than to the I/O module to which it is connected;
- 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;
- 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;
- Failure of I/O module shall not cause the failure / disconnection of field instrument power;
- All I/O modules shall have an auto sensing capability;
- All inputs / outputs to the field shall be individually fused. The RTU system shall be able to perform an integrity loop check and provide out of calibrated range indication;
- 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. Recalibration shall not be required when replacing any I/O card;

- 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;
- The system shall be capable of supporting electronic 4-20mA, 24VDC, 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;
- All analog instruments shall be loop powered 4 – 20mA, 24VDC, compatible;
- An LED indication of power, error condition, active and standby status shall be provided on each I/O module;

### **7.1.6.1 Analogue Inputs**

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

- 4-20mA at 24VDC
- 1-5 and 1-10 VDC
- Short circuit protection: Yes Through Fused TB
- A/D Resolution: 15 bit
- Full Scale Accuracy:  $\pm 0.1\%$
- Supported Device Wiring: 2 wire, 3 wire, 4 wire devices

### **7.1.6.2 Analogue Outputs**

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

- 4-20mA at 24VDC
- Output Type: Source
- D/A resolution: 13 bit
- Full scale accuracy:  $\pm 0.1\%$
- Short circuit protection: Yes Through Fused TB

### **7.1.6.3 Digital Inputs**

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

- Input Voltage range: 24VDC
- Input type: Sink (dry contact)
- Short Circuit Protection: Yes

- Filter: Yes

#### 7.1.6.4 Digital Outputs

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

- On/Off
- Output voltage range: 24 VDC
- Output Type: Sink (voltage free)
- Short circuit protection: Yes Through Fused TBRTU

Supplier shall provide 24VDC (SPDT relays) for all digital output circuits. The relay contacts may be used for 24VDC (1 Amp) to operate solenoid valves. Latching and non-latching momentary contact outputs shall be available.

#### 7.1.6.5 RTU I.O Capacity

S.NO.	Input- Output Type					Communication	
1	<b>I/O Type</b>	AI	AO	DI	DO	Modbus TCP Tags	Modbus RTU/ASCII
2	<b>Required I/O</b>	12	01	14	12	100	50
3	<b>Spare I/Os</b>	04	03	02	04	0	0
<b>Total Required I/Os</b>		<b>32</b>	<b>16</b>	<b>4</b>	<b>16</b>	<b>16</b>	<b>50</b>

#### 7.1.7 RTU Shelter

All RTU and associated system at KPD wells sites enclosures must be protected against harsh weather conditions such as direct sunlight, heavy rains, hail storms, strong wind / storms etc. RTU vendor shall provide a canopy type shelter over the main RTU enclosure. This canopy shall be reinforced enough to hinder all harsh weather effects to reach to main RTU enclosure. Construction of the canopy shall be coated carbon steel. Canopy shall be properly sized by RTU vendor to cover the RTU enclosure. Sizing should be done according to the size of RTU enclosure.

- The shelter gauge, shelter / shed design and construction must be as per AISC relevant codes and standard.
- The shed must be high enough for ease of access at man height without any bending involved from four sides.
- There must be over 1.5 meters of shed inclination from four sides to prevent sun light and rain over the equipment at an angle of not exceeding 25 degrees.

- The sheet, structure and assembled unit must be designed for 30 years of life. In rugged (60 °C and high wind velocities).
- Foundation for the RTU structure will be built by OGDCL as per SCADA system vendor's recommendations.
- The support structure that is angle iron must be of 2" x 2" at least with at least schedule 80.
- All items and structure shall be corrosion resistant hot dip galvanized with epoxy primer of 3 mm thick DFT at least.

### **7.1.8 RTU Enclosures**

The RTU and all associated hardware shall be mounted inside a suitable enclosure with plinth as specified herein. The enclosures provided shall accommodate the full extent of the future expansion (sufficient power supply capability, rack space, termination space, cabling space, bus slots, etc.) for the RTU's.

The RTU cabinet shall house the I/O modules, CPU modules, power supply units, communication switches, third party communication interfaces, radio communication equipment, solar power charger etc. and other relevant equipment.

All the equipment shall be housed in separate compartments in the same cabinet i.e. RTU shall be in separate compartment and solar equipment and radio equipment shall be in separate compartment.

In general there shall be three compartments in each well head RTU cabinet.

- i. RTU and I/Os
  - ii. UHF radio Equipment
  - iii. Solar Power Equipment
- The cabinet shall be of freestanding or pole mounted design and pre-wired and shall have minimum IP 65 environmental protection.
  - RTU enclosure and its accessories shall be constructed from Stainless Steel (SS304)
  - The terminal strips for termination of field instruments shall be screw type suitable for 1.5mm<sup>2</sup> cables. The arrangement and tagging of Terminal Blocks shall be according to termination drawings. Fused terminal blocks shall be used for each field signal.
  - 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.
  - 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 20 % minimum spare space. The vendor shall submit the complete cabinet sizing details.

- Ducting area in system cabinet shall not be more than 60% occupied by wiring.
- System cabinet shall be suitable for bottom cable entry, via suitably drilled gland plates.
- The enclosures should have proper lifting arrangements. Cabling, fastenings, fittings, screw-heads, nuts and bolts shall be compliant with International standard.
- RTU cabinet shall be provided with lifting eyes, ventilation fans, door locks and door switch operated lights.
- All wiring shall be ferruled at each end, using non-adhesive type wire markers in accordance with the wire numbers shown on drawings.
- Wire markers shall be slip-on, heat-shrink, permanently marked, sleeve type (or equivalent).
- Supplier shall provide 24VDC SPDT relays for all digital outputs signals. The relay contacts may be used for 24VDC (1 Amp) to operate solenoid valves or provided as per Vendors recommendations.
- RTU cabinet shall have wiring color-coded according to service and voltage. The intrinsically safe (I.S) and non-intrinsically safe (N.I.S) signals shall not running in the same duct.
- Marshalling cabinet shall have a continuous, pre-drilled copper earth bar in the cabinet for termination of instrument cable screens. It shall be insulated from the cabinet metalwork.
- Separate and segregated terminal strips shall be used for analog input, analog output, digital input and digital output circuits.
- The supplier shall provide end brackets, terminal strip markers and all other accessories.
- Drawing pockets for A3 size documents shall be provided in the system cabinets at rear and front doors.
- The enclosure design and construction must be as per AISC relevant codes and standard.
- The enclosure must be high enough for ease of access at man height without any bending involved from four sides.
- There must be lock and key door with two hooks for locks.

### **7.1.9 TUV certification**

Project scope includes F&G and ESD instruments and their interlocking with RTU and SCADA system therefore it is mandatory that RTU application shall be developed by TUV certified safety system engineer. TUV certificate of atleast (03) Engineers with their resume shall be shared at bidding stage for evaluation. Engineer holding the TUV certification shall be either employed by bidder or its local agent is not acceptable. Any freelance engineers or engineers employed by some entity other than bidder or local agent is not acceptable.

### 7.1.10 RTU Datasheet (Short Form)

Below data sheet shall be read in conjunction to detailed specifications in narrative form. Any conflict shall be brought in company notice by all bidders before submitting their bids.

<b>Controller</b>	
Processor	32-bit microcontroller,
System Memory	4 MB minimum
Non Volatile Memory	Battery Backed RAM for SD Card
External Storage	Extendable SD card port on CPU
Time stamp resolution	10 ms
Flow Calculation	AGA-3, AGA-8 and API based flow calculations
<b>Redundancy</b>	Simplex system  CPU, Power Supply, Communication at Well Site and IO modules shall be Simplex
<b>External Inputs / Outputs Requirement (Excluding spares)</b>	
Analog Inputs	4 - 20 mA
Analog Outputs	4 - 20 mA
Digital Inputs	24 VDC)
Digital Outputs	24 VDC)
Hot Replacement Under Power	Yes
Expansion and Scalability	In addition to IO count mentioned Offered RTU should have capability to add further IO modules
<b>Communications</b>	
Serial Ports	RS-485 (02 Ports)
Serial Protocols	Modbus RTU,
Ethernet Port	RJ45, 10BaseT (01 Ports)
Ethernet Port Protocols	Modbus TCP, Modbus RTU in UDP,
<b>General</b>	
Construction	Modular Construction (On-board IOs are not acceptable). Each IO module shall have its own terminal blocks
Enclosure Type	NEMA 4X / IP65, Stainless Steel SS304

	Installed under RTU Shed to avoid direct sunlight
Marshaling Accessories	IS Barriers (if required) Single Tier and Fused TBs (Two/three tier TBs are not acceptable)
Local HMI Display	No
Power Input:	11 - 30 VDC (Generated by Solar System)
Operating Temperature	0 to 60°C
Relative Humidity	5% to 95% RH (non-condensing)
<b>Certifications</b>	
Safety Integrity Level	SIL2 Certified by TUV (Certificate shall be submitted along with bid package)
Hazardous Locations	Suitable for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations

## 7.2 SCADA Data Servers

The Packager/ Vendor shall be required to review the details of existing SCADA Data Servers, architectural, design, specifications etc before designing of new SCADA/Telemetry system and its integration, Details of existing system are given at **Annexure-A**.

Generally, the current installed Redundant SCADA Servers are connected over a redundant minimum 100 MB Ethernet network; are being used for Database management, monitoring and recording of continuous graphs, Alarm & Events and to serve the stored data to all other connected workstation on the network'

**Note:** Vendor shall evaluate in terms of hardware/ software requirement in the existing SCADA Data Servers, , EWS & OWS installed in Plant CCR for the integration, of new SCADA/ Telemetry system of (11) nos. well sites for their development, modification in installed Software/ Application program which shall be necessarily required.

SCADA system vendor shall carefully examine existing system and study its limitations. It is SCADA system vendor's responsibility to add data of additional 11 wells to existing SCADA system Data Servers. Any software upgradation, addition of license, increase in capacity in terms of tags, displays etc., hardware upgradation or any other item etc. deemed necessary for desired SCADA system operation shall be responsibility of SCADA system vendor.

SCADA system vendor shall also provide 20% spare unused capacity in SCADA servers after complete data addition of 11 new wells in the system.

## 7.3 Engineering Work Stations

### 7.3.1 Existing Engineering Work Stations

The Packager/ Vendor shall be required to review the details of existing EWS, its architectural, design, specifications etc. before designing of new SCADA/Telemetry system and its integration, Details of existing EWS are given at **Annexure-A**.

Generally, the current installed EWS is connected over a redundant minimum 100 MB Ethernet network

The existing Engineering Workstation (EWS) is designed for minimum following features:

- The Engineering Workstation (EWS) is a programming and engineering computer station to be used as OWS and for the Software programming, uploading/ downloading, maintenance, diagnostics and troubleshooting of Data Servers, HMI, Master (Base) & remote radios and RTUs etc.
- EWS also be used for monitoring and control of SCADA system operation;
- EWS is protected by the user ID and passwords;
- The Engineering Workstation (EWS) supports the creation, loading, activation, deactivation and deletion of control strategies on-line;
- Engineering workstation is capable to capture the Alarms & Events and Continuous historian for the entire SCADA and associated systems operation.

OGDCL will allow the SCADA system vendor/packager to use existing EWS during site deployment of the project. However, before site deployment; all design, logic development and graphics designing etc. shall be done by vendor/packager by his own resources.

Existing Engineering Workstation is capable to configure/develop following items:

1. Existing SCADA Servers
2. Existing Historian Servers
3. Existing OWS Stations
4. Existing Master and Remote Radio Stations
5. Existing RTUs
6. Existing peripheral equipment

The Vendor/ Packager shall be responsible for the provision of configuration licensed software and integration of new SCADA / Telemetry system of new well sites with existing system.



### 7.3.2 New Engineering Work Stations

The Vendor/ Packager of SCADA system shall be responsible for the provision of configuration licensed software and integration of new SCADA / Telemetry system of new well sites with existing system.

**Note:** The Vendor/ Packager shall be responsible for the provision of (02) nos. of configuration machines/ Laptops with all configuration software of new SCADA / Telemetry system to be installed at 12 well sites accordingly with minimum following:

- 1) Utility programs access;
- 2) Graphics display generation and modification;
- 3) Control algorithm generation and modification;
- 4) Report generation and modification;
- 5) System access configuration;
- 6) File access;
- 7) Field device configuration, maintenance and diagnostic;
- 8) System Diagnostic;
- 9) View, Control and troubleshoot remote Radios, RTU and associated systems
- 10) Availability of configuration for UHF radio data communication system.
- 11) Application & Configuration software for RTU, Remote Radio Communication, Networking and associated sub systems;
- 12) Control algorithm generation, configuration and modifications software;

New Engineering Laptops (EWS) (Qty. 02) shall be equipped with lifetime licenses for all programming/ development software for RTUs, Remote radios, Primary & Secondary Instrumentations of newly developed (11) well sites etc.

## 7.4 Operator Work Station

### 7.4.1 Existing Operator Work Stations

The Packager/ Vendor shall be required to review the details of existing OWS, its architectural, design, specifications etc. before designing of new SCADA/Telemetry system and its integration, Details of existing OWS are given at **Annexure-A**.

Generally, the current installed each OWS & EWS is connected over a redundant minimum 100 MB Ethernet network;

The operator workstations are graphic stations, which provide the primary operator interface to the SCADA system.

The Packager/ Vendor shall be responsible to make amendments, integrate & configure existing Operator workstations with the new SCADA system minimum following functions:

- Overall individual well site monitoring operation and control;
- Operator Workstation shall operate individually for data monitoring and controlling;
- User configurable buttons or screen targets to select operational functions or displays with a single entry shall be provided;
- It shall be possible to change control assignments to allow control of any well site from any operator workstation and 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.
- The Operator Workstations shall be provided for the SCADA system shall support the Operator Interface functions for the SCADA system and the man-machine interface functions;
- The Operator workstations are functioning as the primary HMI interface for carrying out all Operator functions including:
  - i. Call up of Graphical displays of various sections as well as overviews showing the process conditions/status of the equipment installed for monitoring;
  - ii. Call up Trends/groups of selected process variables/control loops etc.;
  - iii. Call up Process/System Alarm Events displays for alarm management functions;
  - iv. Commands and controls access to change the operating state of the well site facilities such as opening or closing of valves;
  - v. Call up system/alarm summaries, logs and reports
  - vi. Call up System maintenance message displays, network status displays, device status displays and other system information, as required;
  - vii. Call up Intelligent Cause and Effect displays for the 'what-if' analysis;
  - viii. Call up ESD Displays;
  - ix. Call up F&G Displays;
  - x. Call up system diagnostics of the system up to card level & Instrumentation including system-malfunction indications;
  - xi. Call up Tuning displays;

- xii. Call up sequencing guides.

### **7.4.2 New Operator Work Stations**

The vendor/ packager shall add one new operator workstation at the SCADA system. New operator workstation shall have same capacity, features and capabilities of existing workstations. Additionally, new operator workstation shall also possess features mentioned in this specification document. New workstation will connect seamlessly with SCADA system servers, EWS station, Historian and all other peripheral equipment.

### **7.4.3 Operator Graphics Displays**

The Vendor/ Packager shall be responsible to design graphical displays for minimum (11) new wells in the existing HMI systems installed in Plant CCR in a same manner used for remote well sites monitoring, Control, alarms, reports and historian purposes.

### **7.4.4 Control Functions**

The Vendor/ Packager shall be responsible to design HMI in which the operator must be able to perform all the basic monitoring and control functions from graphic displays SCADA system of all newly developed well site. These functions shall include, but not be limited to the following:

- Changing process variables;
- Alarm logs;
- Set points;
- Switching control modes;
- Manually driving outputs or initiating maintenance bypasses for input points.

### **7.4.5 Control Strategies**

The Vendor/ Packager shall be responsible to design Control strategy and information of new Well sites displayed in such a way that the operator can determine what is being controlled, which control strategies are in service, which are out of service, and which are constrained or limited in some way. Displayed control strategy information shall be dynamic, reflecting the actual current state of the strategy.

The operator shall be able to manipulate the state of the control strategy from the control graphics. Controller modes shall be indicated on primary operating display.

### **7.4.6 Design Philosophy**

The Vendor/ Packager shall be responsible to design Operator displays in accordance to the existing philosophy or in a better way suggested by the Vendor. When designing operator displays, a consistent approach shall be used for the appearance (look-and-feel) and functionality.

The design approach shall include following standardized approach:

- Layout - line sizes, equipment representation, orientation, fonts, titles, etc.;
- Data representation - process values and alarms;
- Color choices - process lines, control lines, process equipment, titles, etc.;
- Display access and navigation;
- How options are chosen via switches;
- How control strategies are commissioned and decommissioned;
- How status pairs are defined (on/off, open/closed, start/stop, etc.);
- Control modes (manual/auto/computer etc.), either by color or by a small text next to the controller;
- Data validity (invalid, out-of-range, unknown status), either by color or by a small text next to the controller;

Wherever possible and practical, library elements, e.g., controller faceplate template, shall be used when assigning elements to a graphic. The template approach is preferred to ensure consistency between elements on graphics. Individual elements within a library element should be configured using agreed conventions. For example, if the background color of a process value indication in a controller element is specified to be flashing red for unacknowledged alarm condition, solid red for acknowledged alarm condition, and flashing background color for unacknowledged return-to-normal alarms, this behavior should be specified in a display convention file and the element linked to the display convention. This approach is preferred to ensure consistency between elements on a graphic and to facilitate graphic maintenance in the future.

### **7.4.7 Navigation through Displays**

The Vendor/ Packager shall ensure that any graphic display shall be accessible via no more than three operator actions. When a graphic display has an associated primary control display e.g., a group display, the graphic shall have a target that immediately calls up the associated control display. This target shall be located in the same location on every graphic that uses this feature.

When using a windows environment consideration must be given to prevent the Operator from opening too many windows and potentially masking important process information.

### **7.4.8 General Operator Graphics Requirements**

The Vendor/ Packager shall ensure that the all graphics shall include the following information in standard locations:

- 1) Title
- 2) Date and time
- 3) Display name

### **7.4.9 Colors**

The SCADA and Telemetry System package supplier shall be responsible for designs, Colors and other concepts symmetrical with the existing HMI graphics, designs and colors etc. The following guidelines on color usage shall be applied unless it violates the standard conventions designed into the system.

Bright colors shall be used to convey key information such as process and control information. Subdued (low intensity) colors shall be used for process vessels, process lines, and equipment labels.

Data representation of a specific type (alphanumeric, symbolic etc.) shall be displayed with the same color sets for specific conditions on all graphic displays.

### **7.4.10 Process and Control Lines**

Process and control line crossovers shall be minimized. Line breaks shall be used to indicate that crossing lines do not join. Main process lines for each graphic shall be bold with secondary lines being of finer width. Process lines shall either be drawn horizontally or vertically.

The format for display of all graphics on the existing EWS & OWS will be based on the following:

- 1) Process and Utility graphics;
- 2) Fire and gas detector locations on a fire zone basis. The zone displays will show the status of each detector including healthy / alarm / fault status;
- 3) Package Units based upon control panel HMI displays;
- 4) Electrical power distribution graphics based upon SLDs.

## **7.4.11 Alarms and Messages**

### **7.4.11.1 General**

Alarm and messages shall be configured to perform the following:

- To draw the operator's attention to abnormal conditions within his area of responsibility, both in the process (process alarms) under his control and in the control system equipment (system alarms);
- To provide information to facilitate the operator's rapid understanding of the abnormal condition;
- To provide rapid access to the tools needed by the operator to perform corrective action;
- To provide a comprehensive historical record, accessible to the operator and other plant personnel, of the information needed to assess such abnormal conditions;
- To prompt the operator or process engineer for feedback when approval for automated action or selection from among options is required;
- To give operators and other users the ability to enter messages useful to other operators and users;
- Controller errors;
- Alarms and messages shall be categorized as follows:
  - i. Process alarms & messages;
  - ii. System alarms & messages;
  - iii. Operator actions messages;
  - iv. Engineer actions messages.

### **7.4.11.2 Process and System Alarms**

Any alarm used shall be informative and demands an operator action.

Automatic alarm suppression shall be used to minimize nuisance alarms based on logic actions and/or events.

Four alarm levels shall be used as a minimum:

- i. HH - high high
- ii. H - high

iii. L - low

iv. LL - low low

These levels may be used in association with any category. However, HH and LL in general indicate an automatic shutdown response or imminent shutdown condition.

The "pre-alarms" shall be designated H (High) or L (low).

### **7.4.11.3 Visible Alarm Indication**

- Blinking Feature shall be reserved for unacknowledged alarm situations only. Blinking shall cease when the alarm is acknowledged.
- Alarms shall be invisible on the operator graphics, appearing only while an alarm is active.
- All alarms shall be displayed with a small red square or rectangular with its background flashing. The color-coded background shall remain while the alarm is active.
- Alarms shall be visually displayed and annunciated (blinking when unacknowledged) only on the workstation configured for those alarms.
- "Process Alarm Summary" display showing all active process alarms assigned to the workstation shall be provided. Accessing this alarm summary display from any other display shall require no more than one operator action. Alarms shall be grouped on this display to allow the operator to readily identify and respond to alarms and abnormal conditions in his area of responsibility (e.g., Sorted by priority, time).
- "System Alarm Summary" display showing all active system alarms shall be provided.
- Accessing this alarm summary display from any other display shall require no more than one operator action.
- Each alarm indication shall be shown on one of the two alarm summary displays and on another display which conveys the significance of that alarm in relation to the process or to the control system. The alarm indication on this display shall be positioned and grouped, if necessary, to clearly identify the exact nature of the abnormal condition causing the alarm.
- There shall be an indication of the overall process alarm status of the operator area assigned to each workstation regardless of which display is in use.

### **7.4.11.4 Audible alarm indication**

- Distinct audible tones shall be used to distinguish between the required alarms categories;
- A different audible tone shall be used to indicate system alarms;

- Audible tone frequencies shall be between 500 Hz and 3000 Hz to ensure that alarms are heard by operators who might have relatively poor hearing;
- Audible tone decibel levels shall be loud enough to be heard over normal control room background noise, but not so loud as to cause annoyance or discomfort to personnel. For these reasons, audible alarms should be approximately 25 to 30 dB above the normal "background" noise level;
- A variable, "warbling" tone shall be considered to help recognize priorities, especially for the highest priorities;
- The audible alarm signal for an operator console shall continue until either: a) a "horn silence" is initiated at the operator console or b) an active alarm is "selected" (on either alarm summary or other displays.);
- Silencing the horn shall not constitute alarm acknowledgment.

#### **7.4.11.5 Alarm Acknowledgment**

- Alarms may be acknowledged only at consoles configured for those alarms;
- It shall be possible for an operator to acknowledge any alarm configured at a workstation by no more than two actions;
- An alarm shall be acknowledgeable only if it is shown on an active display.

### **7.5 Human-Machine Interface (HMI)**

The SCADA Human-Machine Interface (HMI) is the interface where people and technology meet. This people – technology interface can be as simple as grip on a hand tool. HMI shall allow operator to view the state of any part of equipment installed on field facilities. Alarms shall be automatically detected abnormal condition of the Equipment; HMI shall display sensor / devices information in its physical context within a graphical depiction of the piping or electrical system in which they reside.

The Vendor/ Packager shall be responsible for designing, development, configuration and integration of eleven upcoming KPD wells into existing HMI system in a same manner as in existing HMI system.



### **7.5.1 General Features of HMI**

The Packager/ Vendor shall be required to review the details of existing HMI system designs and algorithm before designing of new HMI and its integration with existing HMI graphics. , Details of existing HMI system '

The HMI package displays shall be based on the P&ID diagram with dynamic displays of valve status, pressures, temperatures, detected HC level, chemical tank level, system health status, all primary & secondary instrumentation etc.

The HMI Package for new (11) well sites must have the following features:

- ODBC compliant -Provide corporate connectivity for multiple remote masters (servers). This would provide a corporate database that would be automatically updated for selected fields and newly created data points in the remote masters, providing true global data point additions.

### **7.5.2 Historian Server**

- Historian Server is installed in existing SCADA system. All exiting operator workstation can access the historian server for following:
- The SCADA historian server is used provide storage of historical data;
- The SCADA historian server is used to archive selected data files to permanent storage;
- The permanent storage medium used is Server Hard Disk, Compact Disc, Flash drive and Web archive;
- The data is archived on DVD ROM disk for short term backups and for long term historical storage held on SCADA historian server is archived.
- The archive system allows the transfer of archive data in text format to other computer based systems, and also allows hard copy printouts of archive data;
- The archive system archives the required data files daily;
- The system verifies the correct receipt of archive data. In the event that data cannot be archived satisfactorily the archive system generates an appropriate message and hold the data until the next archive period or until a manual archive command is initiated.

Data held in the historical log include:

- i. All status changes
- ii. All calculated and real analogue data
- iii. All alarms

- iv. The History is user configurable depending on snapshot of parameters to be taken as well as sampling rates.

SCADA system vendor shall carefully examine existing system and study its limitations. It is SCADA system vendor's responsibility to add data of additional 11 wells to existing SCADA system Historian Server. Any software upgradation, addition of license, increase in capacity in terms of tags, displays etc., historian client, hardware upgradation or any other item etc. deemed necessary for desired SCADA system operation shall be responsibility of SCADA system vendor.

SCADA system vendor shall also provide 20% spare unused capacity in SCADA historian server after complete data addition of 12 new wells in the system.

## **7.6 Radio Communication System**

This Specification covers the UHF Radio System for Telemetry purpose that shall be installed at well site and establish connectivity with existing installed Redundant Master/ Base Radio at Plant area.

UHF radio communication system shall be used as part of the SCADA system to enable process and safety signal communication between remote wellhead and Master Radio at Plant area.

The Vendor /Packager shall provide License free UHF Radio technology for the SCADA system facilities incorporating the latest and state of the art Frequency Hopping Spread Spectrum (FHSS). This is to be noted that a redundant UHF Master Radio System for the SCADA system is installed at Plant area, fully functional, communicating with the thirty remote KPD-TAY well sites and serving the purpose for data transmission for existing SCADA system.

The Vendor /Packager must read the Details of existing SCADA system, Master Radio and other associated systems are placed at **Annexure-A** for ready reference.

The Vendor /Packager/Manufacturer shall be responsible for Engineering, Designing, Procurement, Installation and Commissioning of all remote Radios for eleven new remote well sites & design operational philosophy to establish data communication link for data transmission with the existing Master (Base) Radio system

The UHF remote radio system shall be configurable through SCADA Data Server/Engineering Workstations.

The primary function of the UHF Radio System is to provide a facility for SCADA data communications through a safe and reliable communication network operable during normal as well as emergency situations.

The Vendor shall conduct a UHF Path Profile Study prior to design of the system. Radio Repeater Stations may not be employed until there is a stringent requirement as per the UHF path profile study; it shall only be considered after the written approval of Company/. This will also require satisfactory documented evidence.

### **7.6.1 UHF Radio System Core Functionality**

An independent fault tolerant UHF Radio System shall be design to meet data communication requirements for remote facilities i.e. well sites RTUs for 11 nos. of Well sites.

Vendor to provide preliminary UHF Radio Communication System sample architecture Diagram for general understandings of the project at the time of Bid documents. Provision of final layout and architectural drawing shall be submitted by vendor/ supplier for approval after finalization of UHF Path Profile Study.

The Radio system network shall be provided with license free remote site radios at well-sites with antennas & self-supporting towers of adequate height. There may be repeater stations if required to meet the radio coverage requirements between the Wellheads to Plant. Network types supported shall be point to point, to multipoint, forward, mesh etc. must be vendor recommended.

Mode of data transmission for remote well site shall be Full Duplex and Full Duplex radio transceiver shall be used

Radio communications shall have enough bandwidths to accommodate data with 50% free spare bandwidth.

### **7.6.2 Codes and Standards**

The VENDOR shall comply with all International Design Codes and Engineering Standards, minimum following standards shall be complied:

API RP 552:	Transmission Systems
ISO 9001:	Quality Management Systems – Requirements
EN 61000 4-1:	Electromagnetic compatibility (EMC).Testing and measurement techniques
EN 61000 4-3:	Immunity to radiated radio frequencies
CISPR 61000 6-2:	Electromagnetic Compatibility (EMC) – Part 6 Generic Standards - Section 3
CISPR 61000 6-3:	Emission Standard for residential, commercial and light industrial environments

IEC 255-5:	Electrical Insulation coordination for measuring relays and protection equipment -Requirements and tests
IEC 255-4:	Electrical Isolation
IEC 529-1:	Degrees of Protection provided by Enclosures
IEC 60255-26:2013	Electromagnetic Compatibility (EMC) Requirements-Electrical disturbance tests for measuring relays and protection equipment
IEC 60079:	Electrical Apparatus for Explosive Gas Atmospheres – Intrinsic Safety ‘i’
ANSI/NFPA 70:	National Electrical Code (NEC)-Installation and removal of electrical conductors, equipment, and raceways; signaling and communications conductors, equipment, and raceways; and optical fiber cables
ANSI/NFPA75:	Standard for the Fire Protection of Information Technology Equipment
IEEE 829:	Software Test Documentation
EN 301 489:	Electromagnetic Compatibility and Radio Spectrum Matters (ERM)
EN 62311:	Assessment of Electronic and Electrical Equipment Related to Human Exposure Restriction for Electromagnetic Fields (0 Hz ~ 300 GHz)
EN 60950:	Information Technology Equipment – Safety – Part 1: General Requirements
ETS 300 119-2	European Telecommunication Standard for equipment practice-Engineering requirements for racks and cabinets

### **7.6.3 EMC Compliance**

The UHF Radio System and all its components shall be immune to interference from electromagnetic radiation. It shall be possible to operate radio transmitting equipment without effecting the operation of the other equipment. The equipment shall be tested to IEC 255-22-3, Electrical Disturbance Tests for Measuring Relays and Protection Equipment, Test Severity Class II and Test Method C.

### **7.6.4 Design Requirements**

- The design of the UHF Radio System shall be based on a 24 hour per day, 365 days a year operations at all manned and unmanned locations. Wellheads. It shall have capability to provide communication system to SCADA with coverage area for Plant
- The Radio Communication network design shall operate within the Ultra High Frequency Range;

- The primary function of the Remote Radio communications system to be installed at Wellheads is to provide wireless data communication to the existing base station at manned facility and to enable safe, secure and efficient transmission of Well site process data between wellheads RTUs and SCADA system at CCR;
- The system shall be based on point to point to multipoint star topology, where the remote well sites shall be designated as nodes and the plant CCR as hub / master station;
- The UHF radio system shall operate on license free frequency band (PTA approved ISM band) of **2.4 GHz (2.4735 – 2.4835 GHz)**
- The Vendor shall conduct a UHF Path Profile Study prior to design of the system;
- The proposed UHF Path Profile Study shall consider complete coverage of the flow lines, and Plant through the geographical topography of the terrain considering presence of Land depressions, hills and non-availability of line-of-sight or dead spot;
- The farthest well site is located at a line of sight distance supposed to be approx. 20 Km from master station. However, the system shall be designed to provide a coverage of minimum 25-30 Km radius around master station. Although, for such distances, use of repeater stations are not foreseen, however, in view of any restriction posed by line of sight (LOS) consideration, or signal strength, repeater Station may be employed. Such requirement shall be established by Packager / Vendor through a UHF path profile survey / study. It shall only be considered after the written approval of Company/. This will also require satisfactory documented evidence; OR
- In the event where the radio repeater stations are to be installed at remote areas where wellheads stations are unavailable, the VENDOR shall consider solar power panels and battery backup banks for the power requirements as the appropriate power supply design. (Refer Specification for Solar Power System);
- Passive Shelters for housing all radio equipment as well as its required power supply units, etc. must be considered by the Vendor for all repeater sites.
- Repeater frequencies shall be auto arranged to prevent excessive co-channel or adjacent channel interference;
- Support CIR to guarantee minimum bandwidth to users and PIR to control maximum bandwidth to users to support tiered services.
- Provide support for optical-line-of-sight (OLOS) and non-line-of-sight (NLOS) capabilities.

- Provide support for transmission maximum packets per-second (pps) without loss of data while passing both small and large packets.
- Support latency less than 12 msec for PMP systems.
- The Remote radio communication equipment at well heads shall reside in RTU cabinet;
- Remote terminals shall support both integrated and external Antennas.

### **7.6.5 System Availability**

UHF Radio communications system shall be designed to meet the overall availability criteria of 99.99%. All single points of failures shall be avoided where reasonably possible, for critical subsystem components.

Confirmation of the availability shall be the responsibility of the awarded/selected UHF Radio VENDOR.

### **7.6.6 Service Availability**

The radio system at any site shall be considered to available provided that:

- Inbound and outbound radio data communication is possible within the normal coverage area for the respective site, with radio signal strength;
- The equipment used within the system shall demonstrate reliability performance consistent with industry current best practices and radio transceivers shall be safe to avoid the failure of a radio transceiver or its associated antenna, feeder and RF filters shall not result in a service failure.

### **7.6.7 Design Life**

The UHF Radio communication equipment and components will be suitable for continuous design duty operation for a period not less than 20 years, without the need for system revamp due to technological obsolescence

### **7.6.8 Power Supply**

The radio system is crucial to the safe operation of wellhead facilities, especially during plant upsets. It shall be assured that the system will continue to operate in the event of a main failure.

Detail is given as under:

S.No.	Power Supply	Location	Remarks
1	24 VDC	Wellhead Station / Repeater Sites	24VDC (will be derived from the Solar Power Unit) MCB outlets will be provided at one point by VENDOR. Further distribution shall also be done by System VENDOR.

The UHF Radio equipment shall have the capability of accepting and acting on communications from the power supply as indicated above. On communication of a low battery alarm, the UHF Radio System shall shut down in an orderly fashion.

At remote well sites, power for RTUs / communication equipment shall be supplied through Solar Power System which is also included in Packager's / Vendor's scope.

### 7.6.9 Design Features

The primary function of the Radio communications system is to provide wireless data communication between base station at manned facility and remote stations (i.e. Wellheads) to enable safe, secure and efficient transmission of Wellheads and flow line process data between wellheads RTUs and SCADA system at Plant CCR.

Confirmation of the availability shall be the responsibility of the awarded/selected UHF Radio VENDOR/ Packager.

### 7.6.10 Standardization of Equipment

All equipment and components for the UHF Radio Data Communication System shall be standardized wherever possible to ensure:

- Minimized training required on same purpose equipment;
- Greater economies for maintenance and servicing support for installed equipment. The UHF Radio Data Communication System across the facilities shall, wherever possible, use the same Original Equipment Manufacturer (OEM) and models of equipment/subsystems;
- The UHF Radio Data Communication Systems described in this document shall have a uniform set of licenses/software/hardware/firmware used for the entire field ensuring uniform system upgrades in future;
- The selection shall likewise ensure that the hardware components used, follow the best current industry practices in easy configuration, monitoring, performance, networking, distribution and considering all aspects of operation and maintenance.

### 7.6.11 Radio Communication System Equipment

Packager's / Vendor's scope of supply for UHF communication system shall include but not limited to following major components.

1. Radio transceivers at remote well sites (11) (and repeater stations, where required)
2. Antennas (unidirectional) as per Vendor recommendations. Remote stations installed at the wellheads should have options with integrated and external antennas.
3. Self-supporting communication mast / towers complete with mounting and support structure for antennas, lighting arrestor, air craft warning lights
4. Radio system installed at the wellheads must be **ATEX certified**
5. Radio system installed at the well heads shall be ruggedized and reliable.
6. Lighting protection system on each communication tower if necessary or as per Vendor recommendations.
7. Complete cabling of the system including but not limited to:
  - CO-axial cable for antennas
  - Serial interface cabling Ethernet / LAN cabling
  - All AC and DC power cabling.
8. Passive cooled equipment shelter at well sites and repeater station.
9. Power distribution Boards for Radio and accessories.
10. All other active and passive devices / accessories required for system completion and integration.

Apart from the above components, all other equipment and accessories required for system integration and completion shall be identified by Packager / Vendor and all such requirements shall deemed to be included in Packager's / Vendor's scope, whether or not explicitly stated in tender documents.

The above scope shall be read in conjunction with main Scope of Work document and other specification included in the tender document.

#### 7.6.11.1 Radio Modems/ Transceivers

The UHF Radio Modems/Transceivers shall have following features as minimum:

- Modems / transceivers shall operate within PTA's approved ISM band of **2.4935-2.4835 GHz** frequency.



- Modem / transceivers shall support data transfer rates of 115200 bps. Actual rate shall be user selectable as multiple of 10 Kbps up with option to go up to aggregate 150 Mbps throughput.
- For well sites (and repeaters), full duplex modem with transceiver shall be used.
- Well sites radios should be all indoor /outdoor and one box solution.
- Modem / transceiver shall have Modbus RS 232 / 485 serial data ports as well as 10 / 100 Base IEEE 802.3 Ethernet ports;
- Modems / transceiver shall be able to provide a coverage range (at mentioned data rate) of minimum 20 km;
- Modems / transceiver shall be rack mountable units;
- For standalone (outside panel) mounting in hazardous area, the modem / transceivers shall be suitable for class I, Zone 2.
- Modem / transceivers shall include local display facility to provide an indication of operational and alarm status. Access ports shall be provided for programming, network configuration and testing of the transceiver through local and EWS / HMI. Configuration should be via windows based software.
- Be compliant with National Institute of Standards and Technology FIPS 140-2 Level 2 standard.
- Support security for management access using SSH and HTTPS.
- Modem / transceivers shall incorporate WPA (WI-FI Protected Access) or equivalent security with AES encryption with 128 & 256-bit key level options.
- Modem / transceivers shall provide diagnostic information including signal strength and SNR (signal to noise ratio) via Software to allow proper antenna installation.
- Modem / transceivers shall support point to point, to multipoint communication modes.
- Modem / transceivers shall employ from BPSK to 256 Modulation
- All modems / transceivers shall employ ARQ or HARQ as error correction method.
- All the radios shall have built in spectrum analyzers.
- Modem / transceivers shall incorporate frequency stability technique to achieve  $\pm 2.5$  ppm or better frequency stability.
- Modems / transceiver shall utilize transmitter power generally upto 22 dBm with Better Voltage Standing Wave Ratio (VSWR). Higher wattage transmitters may be employed also by Packager / Vendor, as required.
- Radio transceivers and associated antennas and coaxial cable feeders, RF branching, and power conversion equipment

- Ethernet Connectivity to SCADA System and RTUs,
- Radios shall support complete redundancy.
- Radios shall support from 1.25 MHz to 20 MHz channel sizes.
- The proposed radio system must support as low as -105 dBm receive sensitivity using the minimum selectable channel size.
- Modems / transceiver shall have rugged, metal enclosure, resistant to temperature, vibration and shock.
- Provision of equipment racks, DC power, cable and wiring distribution frames, cable trays and patch panels and any accessories required for mounting inside the cabinets.
- Facilities for programming and configuration of equipment including software applications, cables and adaptors through SCADA EWS/HMI.
- The transceiver shall incorporate self-protection measures to avoid damage arising from impedance mismatch at the transmitter output, excessive temperature, and reverse polarity or excessive voltage applied to the DC power input.
- All the radios should support Full and Half Duplexing with minimum 100 Mbps Fast Ethernet port.

## Performance Specifications

The transceivers shall meet the following requirements:

General	
Frequency Range	UHF 2.4 GHz (2.4735 – 2.4835 GHz)
Operating Conditions	Refer Site & Environmental Data
Modulation	BPSK,QPSK, 16QAM, 64QAM and 256QAM
Maximum Power Output	> .15 Watts ( $\pm 22$ dBm),
Data Rate	minimum 3 Mbps @ -96 dBm
Receive Sensitivity	minimum -105 dBm @ 1.25Mhz
Selectivity	> 50 dB

### 7.6.11.2 Communication Towers

- The Communication towers shall be a square (four legged) self-supporting tower at each location to support the proposed antennas and feeders. The actual tower height will be dependent on the results of the Path profile study/ RF coverage survey; however the tower height shall be kept a minimum;
- All towers shall be galvanized, bolted self-supporting structures with a minimum face width of 1 meter measured between leg centers. Lattice towers of the tension braced type (i.e. where

the use of compression members is avoided by provision of a set of tension bracing members) shall not be used;

- It is preferred that the tower design, materials and assembly practices are such that towers can be disassembled and relocated anywhere easily;
- Towers shall be designed to carry as a minimum twice the overall load produced by the antenna systems (immediate and planned) combined with associated antenna feeders, lightning protection systems, and any other attachments such as aircraft obstacle warning systems. Anticipated load shall be determined during the detailed design phase;
- Typical immediate and planned loads that may need to be considered are listed in the table below;
- Reserve capacity shall be considered within the design as twice the individual load components;
- Tower Load details are provided below for each base as well as local stations along the flow line:

Item no	Description	Qty	Location
1	Radio system primary antennas including feeders	1	VENDOR TO ADVISE
2	Aircraft Obstacle warning lightening and cabling	1	VENDOR TO ADVISE
3	Lightning protection air termination	1	VENDOR TO ADVISE

- Foundations shall be designed in accordance with established principles of soil mechanics; Soil parameters used for the foundation design shall be consistent with the actual material upon which the foundation bears, and shall be derived from soil investigation data to be collected by Supplier. Foundation drawings shall state the soil parameters assumed; **OR**
- Alternatively, Vendor may propose other types of antenna tower designs that have technological commercial advantage that are collapsible self-standing type design.

#### **7.6.11.2A Outdoor:**

- The first task after tower installation should be the installation of the antenna structure according to desired antenna heights as per terrain (Path) Profile Study and also installation of the antennas;
- Once the structure is accomplished antennas could be installed on it. The next step is feeder cabling. Feeders are vertically fixed in place with feeder clamps all the way from the antennas to the tower basement. As the feeders reach the feeder ladder they are appropriately bent to fit into the feeder window;

- After the accomplishment of all above, tower grounding must be pursued. Tower grounding is aimed to connect the entire tower to the ground.

#### **7.6.11.2B Indoor:**

- After the foundation phase, tower installation and outdoor tasks Radio Transceiver installation works shall be started.
- All the indoor equipment shall be installed in the RTU cabinets at wellheads.
- Cables shall be routed through adequate trays or trenches ;
- Antenna Support Structures;
- Towers shall be designed in general accordance with EIA TIA-222-G, "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures". The design parameters to be applied for wind and earthquake loads shall be determined from the relevant PTA standards;
- In determining the design parameters, the structure shall be classified as critical such that the most stringent design criteria are applied;
- The following loads shall be considered in the design of towers:
  - i. Dead loads
  - ii. Wind loads
  - iii. Seismic loads
  - iv. Live loads (movable loads such as personnel, erection tools and the like)
- Design loads for the strength and stability limit states of the towers shall be the combinations of factored loads that produce the most adverse effect on the structure using multiplying and importance factors in accordance with EIA TIA-222-F;
- Foundations shall be designed to resist all load combinations applied to the structures in both vertical and horizontal directions combined with bending moments where appropriate;
- Foundation designs shall consider both short-term and long-term loading and possible variations to soil properties, such as water content, soil movement, changes to water table etc.

#### **7.6.11.2C Earthing and Lightning Protection**

- Towers shall be provided with a grounding system designed to provide protection to personnel and equipment from the effects of lightning.
- Each leg of the tower shall be grounded to sufficient earth electrodes (driven stakes) to achieve a minimum resistance of 25 ohms. Interconnection between the earth electrodes and the respective tower legs shall be galvanized steel strip not less than 40 mm x 5 mm in section which shall be generally buried at a minimum depth of 500 mm. The steel strip shall be bolted to the mast above the concrete footing;

- The overall resistance of the tower ground system shall be less than 5 ohms or better prior to connection to the site grounding system;
- The tops of all ground elements shall be in accessible pits with covers;
- All connections to the ground elements shall be performed with clamps which shall be coated with bit mastic paint;
- The tower shall be bonded to the internal communications earth bar (within the equipment room) with an insulated stranded copper cable at least 35 mm<sup>2</sup>;
- All structures shall be equipped with an air termination suitably positioned to intercept lightning discharges and thereby provide a zone of protection for antenna equipment and other fittings attached to the structure;
- The air termination shall extend a minimum of three meters above the top of the structure and provide a minimum shielding angle of 45° to any antenna;
- The air termination shall be directly bonded to the tower;

#### **7.6.11.2D Structure Facilities**

##### **Antenna Access**

- All towers shall be equipped with an internal enclosed climbing ladder extending from ground level to the top of the tower. Access points from the ladder shall be provided at work platforms;
- The tower shall be equipped with a work platform at suitable height to provide access for maintenance of the antenna and obstruction lights. The climbing ladder shall be equipped with a fall arresting system in the form of a climbing cage or a fall arresting rail and safety harness.

**Note:** Civil works & earth pits will be under OGDCL responsibility. This means that contractor will provide the design / drawings of all bases like RTU base, Solar structure base, poles & towers base etc. OGDCL will construct the bases (only civil related) as per vendor design. Supply and Installation of all equipment, material, Towers, structure, poles etc. will be vendor scope and responsibility.

##### **Transmission Line Bridge**

- An independently supported transmission line bridge shall be provided between the structure and the equipment building;
- The height of the transmission line bridge shall be such that all feeder cables can be readily installed to transit the building feeder entry window without excessive or unnecessary bending of cables;

- The width and depth of the transmission line bridge shall be such that twice the volume of current and planned antenna feeders and ancillary cables (i.e. 100% reserve capacity) can be accommodated and individually fixed to the feeder support brackets;
- Feeder support brackets shall be provided within the horizontal transmission line bridge at suitable intervals that shall not exceed 500 mm to provide mechanical support for feeder cables. A protective cover shall be provided on the upper face and sides of the transmission line bridge to prevent damage to feeder cables from falling objects.

### **Vertical Feeder Support**

- Towers shall be provided with feeder brackets at a maximum spacing of one meter to support vertical feeder runs;
- Feeder brackets shall commence at 2.5 meters above ground level and continue to the top of the structure;
- Feeder brackets shall be internally mounted such that the feeders and ancillary cables are protected by the tower members;
- Feeder brackets shall be sized such that twice the volume of current and planned antenna feeders and ancillary cables (i.e. 100% reserve capacity) can be accommodated in a single layer.

### **Obstacle Marking and Warning**

- The tower shall be equipped with a minimum of a double obstruction light at the top of the tower. Additional lights as required by local and international standards shall be provided;
- The obstruction light shall be controlled by a UL or CSA approved rain-tight photoelectric controller and flasher;
- All wiring associated with obstruction lighting system shall be enclosed within a threaded metal conduit.

## **7.6.11.3 Antennas and Coaxial Cable**

### **Antennas**

- Antennas shall be installed on the antenna support structures which shall be provided at all locations to provide the required coverage;
- The radiation pattern of the antennas shall be optimized to achieve the desired coverage and interference protection;

- The antenna shall be mounted such that interference from the tower structure does not affect the radiation pattern. Towers shall not be used for radiation pattern shaping;
- The antenna gain shall be selected to provide the highest permitted radiated power acceptable to authorities so that radio coverage is maximized;
- Antennas and antenna mechanical support assemblies shall be suitable for operation and survival with wind speeds and loads relevant for the location determined according to Pakistan Telecommunication Authority (PTA) standards;
- The antenna shall be capable of continuous operation;
- The radio system antenna shall be a DC-grounded design to minimize potential damage from lightning strikes;
- The spacing between antennas shall be chosen to provide sufficient isolation to avoid generation of intermodulation and to prevent desensitization for the receiving equipment;
- Antennas shall be installed such that a minimum 45 dB of isolation between antennas is achieved.

#### **Antenna Mounting Hardware**

- Antenna mounting hardware shall be provided by the Vendor to attach the antenna to the structures;
- Antenna mounting hardware shall be attached to the structure using clamps or similar devices. No drilling of the structure shall be permitted;
- Mounting arrangements shall be sufficiently robust to prevent misalignment of antennas under the design gust wind speeds adopted for the design of the structure;
- Antennas shall be directly and effectively earthed to the antenna support structure via the mechanical mounting arrangement;
- In the event that the antenna support structure is coated for purpose of corrosion protection or environmental compatibility, suitable installation practices shall be adopted to achieve necessary earth connection, and maintain coating integrity.

#### **Feeder Cables /Coaxial Cables**

- The final connections to the antenna and to the radio transceiver equipment shall use high a flexibility cable.
- Jacket material for all coaxial cable shall be polyethylene that is weather and ultraviolet resistant;

- Antennas should use LMR240 406 mm (16 in) jumpers terminated N(f) 90-degree connectors
- The lightning arrestors shall be bonded to the base/repeater station earth bar.

#### **7.6.11.4 Repeater Station Equipment**

The repeater station and its equipment are envisaged only if found necessary after Path Profile Study by VENDOR for providing adequate radio coverage.

The following equipment are envisaged to be supplied and installed by the VENDOR as a part of repeater station equipment as a minimum:

- i. Self-supporting radio mast tower
- ii. Antennas, feeders and lightning arrestors
- iii. Data radio transceivers and RF filters confirming to PTA requirements and complete with all accessories and DIN mounting Brackets.
- iv. Passive Cooled Shelter.
- v. Solar Power System (including backup batteries)
- vi. DC power conversion equipment, if required.
- vii. Equipment racks and accessories including distribution panels.

#### **7.6.11.5 DC Power Conversion Equipment**

- All local radio station equipment shall operate from the DC solar power system provided at respective Stations by supplier/ vendor. Suitable power conversion equipment (where required) shall be provided to allow the radio equipment to be operated from the site DC supply.
- If repeater sites are envisaged, vendor shall provide a complete DC power system for radio equipment, including Solar panels with battery backup, power stabilizer units etc. with any required DC power conversion equipment.
- DC Converters shall be dimensioned as required to meet the specific power consumption of the supplied equipment.
- The power conversion equipment shall be capable of operation with input supply voltage variation between +20% and -20%.
- The Line and Load regulation of the power conversion equipment shall be < 1%.
- The power conversion equipment shall be protected from damage resulting from any combination of the following conditions:



- i. Variation of the DC voltage outside the limits specified above
- ii. Reversal of power supply voltage
- iii. Excessive current draw
- The power conversion equipment shall measure input voltage, load voltage, and internal temperature. Alarms shall be initiated in the event when measured values are not within specified performance range.
- The power conversion equipment shall include local display facilities to indicate operational and alarm status. The load voltage shall be numerically displayed.

### **7.6.12 Installation Description**

Packager / Vendor shall provide On-site installation, acceptance and commissioning of towers, antenna systems and radio equipment etc. all include, but not limited to:

- Fabrication of communication towers complete with antennas, lighting arrestors, air craft warning light, etc.
- Installation of complete cabling system including all cable tray / conduits, etc. This includes cable laying, termination, tagging, dressing glancing, etc.
- Installation of communication panels either as standalone panels (As part of RTU panel (in case of well sites).
- Complete grounding of communication system equipment. This also includes grounding of communication tower structure, as well as grounding of lighting arrestor to achieve LP grounding.

### **7.6.13 Radio Coverage and Frequency Planning**

#### **7.6.13.1 Radio Coverage Design**

During System Engineering stage of the project, VENDOR shall perform a detailed radio coverage design for all the remote & repeater radios, and shall submit drawings/maps indicating the coverage area for the entire plant and well sites to the Company for approval.

VENDOR shall conduct the preliminary coverage design shall be performed using computer software modeling in combination with site surveys of all remote radios & repeater locations, during which field measurements shall be taken to verify the validity of the prediction.

Radio coverage prediction shall be performed to determine the antenna height required to achieve the desired coverage, and thereby determine the required height for the towers at base stations as well as all the repeater sites.

Proposed communication tower positions shall be determined and identified within the design report.

The prediction shall be performed using digital terrain data and shall use the frequency plan that is expected to be used in service. The prediction shall provide the following:

- Coverage area boundary contour for terminal equipment based on recommended antenna mounting height;
- Identify any areas where co-channel interference is within 10 dB of design limits;

The preliminary coverage design shall produce the following deliverables:

- Statement of all assumptions and parameters used in the prediction model;
- Comments regarding results of analysis of the trade-off between antenna mounting height and resultant coverage and interference. This analysis shall provide justification for the recommended antenna mounting height;
- Contour plots of expected field strength at each repeater site overlaid on scaled topographical maps;
- Plots of co-channel interference levels overlaid on scaled topographical maps.
- Radio signal strength measurements at each remote site to verify the accuracy of the coverage prediction;
- UHF Radio coverage is required to be continuous along the length of well sites. The objective for the radio coverage design shall be to maximize radio coverage while minimizing interference levels and maintaining reasonable tower heights (wherever required).
- UHF frequencies shall be used to enable greater coverage with reduced antenna mounting height.
- Antenna radiation patterns shall be designed to provide radio coverage according to the following priorities:
  - i. At the base stations and surrounding areas of access and plant areas around base stations.
  - ii. Entire flow line routes between wellhead stations/UPL SGM Station to Plant CCR as well as all repeater stations along this corridor.

- The radio coverage area for a radio repeater station is considered as the area bounded by the contour line at which the radio receiver (base or terminal) reliably receives an excellent signal. Reliable reception is considered as receiving the required signal strength 90% of the time at 90% of the locations along the contour line;
- The system design shall utilize the highest permissible radiated power acceptable to the licensing authorities so that radio coverage is maximized;

### **7.6.13.2 Frequency Planning**

A suitable frequency plan shall be designed and utilized that is consistent with local regulatory requirements, RF branching and filter requirements, system performance objectives, and ensures electromagnetic compatibility with other wireless communications systems within the plant facilities.

Operation in the UHF ISM (2.4735 – 2.4835 GHz) band is preferred by OGDCL as they are already communicating data within this band and do not require licenses to operate within these UHF band radio frequencies from the Pakistan Telecommunication Authority (PTA).

Modem / transceivers shall support data transfer rates of 115200 bps. Actual rate shall be user selectable as Multiple of 10 Kbps up with option to go up to aggregate 150 Mbps throughput Packager / Vendor shall be responsible to verify the above mentioned data rate requirement and shall propose greater data rate, if necessary.

UHF radio system shall support a minimum RF data communication rate of 115,200 bps. Actual rates shall be selectable as 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps and 115200 bps.

Packager / Vendor shall be responsible to verify the above mentioned data rate requirement and shall propose greater data rate, if necessary.

Repeater frequencies shall be auto arranged to prevent excessive co-channel or adjacent channel interference.

- The equipment used within the system shall demonstrate reliability performance consistent with industry current best practices.
- The DC power shall be distributed between the transceivers and transceiver changeover equipment such that failure of a single DC conversion device shall not result in a service failure.
- Status and control interfaces to the Network Management System shall be fully functional.

## **7.6.14 Duty Cycle**

The system design shall be based on transmit/receive duty cycle of 20/80 averaged over a 24 hour period and a peak transmit/receive duty cycle of 50/50 averaged over a 1 hour period.

## **7.6.15 Security**

Data traffic should be transported in a secured VPN. Minimum encryption for data traffic should be AES encryption with 128 & 256-bit key level options or equivalent WPA (WI-FI Protected Access). Keys should be changeable via RF connection.

All encryption functions are preferred to be performed without use of external device.

## **7.6.16 Hazardous Location Installation**

The communication equipment placed in hazardous classified area shall be suitable for **Class I, Zone II classified** areas with minimum protection of **IIC, T3**.

## **7.6.17 Configuration & Diagnostics**

Diagnostic information including signal strength and signal to noise Ratio shall be provided via a windows based software to allow proper antenna installation.

## **7.6.18 Grounding System**

### **7.6.18.1 Remote Station site grounding system**

To provide completely safe environment for Engineers/Technicians in the site and protect the sensitive equipment from unwanted voltages like lightning, electrical shocks in power distribution network and static electricity; a grounding system is needed in the site place.

This system will direct the unwanted currents form conductive bodies of equipment, towers and shelters to the ground with minimum possible impedance.

There are 3 grounding systems implemented on the remote Station sites (Wellheads and Repeater):

1. Grounding system for lightning protection
2. Grounding system for protecting feeders
3. Grounding system for protecting tower, shelter and equipment

The main part of each grounding system is the grounding bars that include some electrodes that have direct contact to the earth.

At all Station sites it's necessary to have ground impedance less than 3 ohms and all 3 systems should exist and be connected to each other in the ground or should have the same grounding bar.

#### **7.6.18.1A Lightning protection grounding system:**

Consists of 3 major parts

1. Lightning arrestor bar
  2. The connector cable
  3. The ground bus bar
- Lighting lightning arrestor bar shall be made of pure copper, at least 16 mm in diameters and should be connected firmly to the tower. It should be long enough so the imaginary line connecting the head of it to the ground should cover all the equipment with a 35 degree angle. If the equipment on the site is far apart, an exclusive lighting should be used for each part.
  - The connector cable shall be 50 mm in diameter, has minimum bending of the cable through the path and bending with at least 30 cm radius, should be connected to the tower in the 1.5 meters distance. Better to be connected to the earth without bus bar should be separated form feeders.

#### **7.6.18.1B Feeder grounding system:**

- The cables should be connected to the bus bars and to the feeder with grounding kits.
- The bus bars should be connected to the tower near grounding kits (1m distance). 1 to 1.5 meters below the waterproof bounding below the antenna, 1 to 1.5 meters above the waterproof bounding at the bottom of tower. If the tower is more than 30m there should be an extra one at the half length of tower below the feeder window (0.8 m distance).
- A bus bar under feeder window with a 35 mm cable that goes out of shelter. The Indoor equipment and metal structures should be connected to the main grounding bus bar with a 25mm cable directed to the main grounding bus bar with a PVC cover.
- For battery rack 35mm cable should be used. Each of the grounding cables of equipment should be connected to the main grounding bus bar separately and should be in one piece.

#### **7.6.18.1C Tower grounding system**

The tower pieces and related parts should be connected firmly.

At least two of the main foots of tower should be grounded with 35 mm cable.

### **7.6.18.2 Grounding bar: Vertical bar & Horizontal bar**

- One or several bars rods or copper ropes that are buried in the depth of 0.5m to 1m (this system used when the impedance of earth is more than usual or when digging in high depth is impossible).
- Vertical copper plate (500\*500\*5) mm, that is buried in the ground and the well depth should at least be 3m and should reach the permanent moisture of earth.
- Several grounding well is needed when one cannot reach the necessary impedance.
- Chemical materials should be employed around the grounding bar so it will reduce the ground impedance.
- After implementing the grounding and connecting it to the ground bar the impedance should be checked with megger to make sure it is less than 3 ohms (zero ohms is ideal).

### **7.6.19 Radio Communication Software**

Software interfacing shall be available at SCADA Engineering workstation / Data server with AES Encryption. The salient features as minimum shall be:

- Network Management and Remote Diagnostic
- Network wide operation
- Non-intrusive protocol
- SNMP Access to Radio Diagnostic
- Spectrum Analysis
- Diagnostic Parameter e.g. Transmitter Power, Receiver Signal Strength, DC Supply Voltage, Received Frequency Error, Radio Temperature, etc.

### **7.6.20 Equipment Racks and Accessories**

#### **7.6.20.1 Racks**

The Vendor shall provide equipment rack enclosures or cabinets to accommodate rack mounted equipment items I,e RTU, Radio and Solar controllers etc at Wellheads Sites

The rack, enclosures, cabinets shall be Vendor recommended standard sizes, Footprint and be of standard height. Rack, enclosures shall include all fittings necessary to support mounting of 483-mm (19") equipment, based on ETSI standard ETS 300 119, at the front and rear of the rack;

- The racks shall include suitable fittings to allow hinged doors to be fixed to the front and rear of the rack. Fittings shall also be provided to allow mounting of side panels to racks;
- No equipment shall be installed within the equipment racks closer than 300 mm to floor level;
- Racks shall have at least 30% of the useable installation area reserved for future expansion.

#### **7.6.20.2 Accessories**

Racks shall be equipped with accessories to allow termination, interconnection and physical support of cables and other items. Accessories provide shall include items such as:

- DC distribution panels
- Distribution frames for data and signal cables
- Cable ducting and/or tray
- Power sockets
- Earth bar

### **7.7 Solar Power System**

This specification defines the minimum requirement for the design, manufacturing, inspection, testing and supply of Solar Power System with redundant main / Charge Controllers to cater the power requirements of all equipment, accessories and associated systems of all wellhead facilities like RTU System, primary, secondary instrumentation, Solenoid valves, ESDV, Control valves, radios, FHSS UHF Radio Repeater sites (if required), other field instruments and system/ packages etc. installed at (11) nos. Well Sites.

The supplier shall supply 24 VDC solar power system with redundant Charge load Controllers along with auto & manual charging/ discharging, voltage cut off, current, voltage controller along with the material, batteries, solar panels, battery charger cables, enclosure etc. and proper safety, security along with live monitoring of all solar power parameters on HMI and effective control through RTU. The supplier shall supply solar power system complete in all respect and sized to cater all load requirement of remote site.

This is typical specification for supply of (11) eleven numbers solar systems, one at each wellhead.

The vendor shall make an unequivocal statement that the equipment offered complies in all respects with this specification and in conformity with **IEC / BS standards**. Any deviation (i.e. falling short of the requirement) shall be listed with reference to the relevant IEC/BS standards

clause numbers and with reference to the clause number of this specification. Otherwise company will accept the vendor's bid assuming that the vendor understands and can fully satisfy the requirements.

Compliance with this specification, codes and standards does not relieve the VENDOR of the responsibility for supplying equipment of proper design and construction which is fully suitable for all specified operating conditions.

The solar power system shall be of manufacturer's standard offering and of proven design for the application specified. No prototypes are accepted.

Vendor shall fully confirm the requirements of this specification and other relevant specification (Refer to Specification for SCADA RTU, Primary & Secondary Instrumentation and Specification for UHF Radio Data Communication System on a specified paras).

Since Solar Power System is part of a single package of SCADA and Telemetry System, therefore complete harmony in design and selection of equipment shall be observed.

### **7.7.1 Codes and Standards**

The Solar Power System design and installation shall comply with the latest edition of the following codes and standards:

1. International Electro Technical Commission Recommendations (IEC)
2. European Standards published by CENELEC

IEC 60068:	Basic environmental testing procedure
IEC 60146:	Semi-conductor converters
IEC 60227:	PVC insulated cables and conductors of rated voltage up to and including 450 / 750 V
IEC 60255:	Measuring relays and protection equipment
IEC 60269:	Low Voltage Fuses
IEC 60332:	Tests on electric cables under fire conditions
IEC 60439:	Low voltage switchgear and control gear assemblies
IEC 60445:	Basic and Safety Principles for Man-Machine Interface, Marking and identification - identification of Equipment Terminals and of Terminations of Certain Designated Conductors, including, General Rules for an Alphanumeric System.



IEC 60446:	Basic and Safety Principles for Man-Machine Interface, Marking and identification - identification of Conductors by Colors or Numerals.
IEC 60478:	Stabilized power supplies DC output
IEC 60502:	Power cables with extruded insulation and their accessories for rated voltage from 1 kV up to 30kV.
IEC 60529:	Degrees of Protection provided by enclosures (IP code)
IEC 60904:	Photovoltaic Devices
IEC 60947:	Low voltage switchgear and control gear
IEC 61000:	Electromagnetic Compatibility
IEC 60896:	Stationary Lead-Acid Batteries, General Requirements and Methods of Test
IEC 61215:	Crystalline Silicon Terrestrial Photovoltaic (PV) Modules –Design Qualification and Type Approval
IEC 61646:	Thin-film Terrestrial Photovoltaic (PV) Modules-Design Qualification and Type Approval
BS 6290:	Lead Acid stationary cells and batteries
ASTM A36:	Standard Specification for Carbon Structural Steel
ASTM A123:	Standard Specification for Zinc (Hot Galvanized) Coating on iron and steel Products
UL 1703:	Flat-Plate Photovoltaic Modules and Panels
NEMA ICS 6:	Enclosures for Industrial Controls and Systems Enclosures
NFPA 70:	National Electrical Code

### **7.7.2 General Design Requirements**

The solar power supply arrangement at each of the installations shall be based on one (1) solar power array system rated to cater for 130% of the total load. The solar system including batteries capacity shall include 30% spare capacity. This shall include, but not be limited to, the following at each location;

- i. Photovoltaic (PV) module array
- ii. Redundant Charge/ Load Controller
- iii. Lead acid batteries
- iv. Power Distribution Board
- v. Indication lights, meters and signals
- vi. Enclosures for charge controller and batteries

- vii. Support structure
  - viii. Any other equipment required for safe and continuous trouble free operation of the system.
- The high operating temperature and strength and frequency of storms must be considered in the design;
- Arrays, batteries and controller shall be designed and laid out to provide easy extension for future requirements;
- The solar power system shall comprise PV module sub-arrays (used to convert sunlight directly into DC electrical energy), power regulating system equipment including batteries to store power to compensate for power requirements under situations when the solar array output is inadequate, electronic controller charge regulators and associated control, protection, monitoring and alarm systems. The complete system and all its subsystems shall be:
  - i. Capable of operation in an unattended mode continuously without any operator intervention.
  - ii. Extremely reliable and free from internal faults.
  - iii. Simple to maintain
  - iv. Long Life durability
- Photovoltaic cells shall be high quality poly crystalline silicon construction.
- The photovoltaic cells within the photovoltaic module shall be encapsulated between sheets of UV stabilized ethyl vinyl acetate (EVA) and tempered glass. Individual panels / modules shall be electrically and mechanically interchangeable. The solar modules, sub-arrays supporting structure and skid shall be designed to withstand air velocity of approximately 45 m/sec for both vertical and horizontal direction;
- The solar cell arrays shall be designed and constructed to meet the environmental conditions listed above. The solar cell array and complete system shall be re-assembled and skid mounted to install the appropriate location without any obstruction;
- The solar cell arrays shall be mounted and supported by galvanized and epoxy painted carbon steel support structure to point the arrays in proper solar orientation for maximum solar radiation collection over the entire year;
- The VENDOR, based on their software calculations, shall design the optimum tilt angle. The tilt angle shall be fixed to maximize the solar array output during the month of lowest solar insolation;

- The support structure must be of sufficient strength to safely support the solar cell arrays during worst-case environmental conditions. All such solar sizing and battery sizing calculations shall be submitted to the COMPANY for approval;
- All outdoor located electrical equipment enclosures and junction boxes exposed to the atmosphere shall be weather and water proof and shall be protected against ingress of dust, windblown sand, etc. The enclosure shall be weatherproof and shall have a minimum ingress protection class of **IP- 65** except battery enclosure. A lower protection (**IP-23**) may be accepted for application such as battery enclosures for the purpose of achieving better ventilation and for safe escape of gases. All IP protection provided for all equipment shall be subjected to COMPANY approval, prior to final procurement by the VENDOR;
- In order to avoid bird droppings, flexible spikes shall be mounted on the upper edge of solar modules;
- Status monitoring of battery Voltages on the RTU and SCADA HMI
- The system shall be capable of supporting the surge current due to starting of the motor/ actuator (If any) without activating low voltage battery alarms caused by the transient voltage dips when the motors / actuators are started.
- The nominal supply power voltage for the loads and instrument equipment shall be 24V DC. The 24V DC power supply operating voltage shall be harmonized with the instrumentation load requirement.
- A power distribution boards shall supply the loads, which shall be protected through circuit breakers.
- The batteries shall be specially adapted and sized to photovoltaic applications type and provided and housed in non-corroding, robust, **IP-23** ingress protected as a minimum, The batteries shall be supplied for an expected service life of eight years under the service conditions stated herein. The batteries shall not degrade more than 20 percent of full capacity over their service life.
- The battery box shall be ventilated to enable gases to escape. It shall be possible to remove each battery at a time for maintenance purpose. The batteries shall have an arrangement, such that the batteries can be easily pulled out for maintenance;
- Isolation facility shall be available to maintain any component without affecting the system operation. Equipment design shall consider that maintenance on energized compartment is allowed only if there is no live part / connection. This shall include two pole isolation between

solar array and DC distribution bus-bar High speed DC circuit breaker shall be provided for each battery bank;

- System design shall include lightning protection;
- Structure support posts to include method for fastening on a flat concrete base (Fastening design recommendations to be included in proposal);
- The units shall be designed for fixed installation.
- Each unit shall be capable of supplying continuous power within the limitations of available solar radiation and the storage battery bank capacity;
- To achieve the power requirements, the solar array may be arranged in several modules to be interconnected in parallel-series combinations. All systems shall be designed for an operational life of 15 years in a harsh, unattended, remote environment without structural corrosion and significant degradation;
- The equipment shall be designed for minimal maintenance
- Any other equipment required for safe and continuous trouble free operation of the system.
- The design of the solar cell generator unit shall be the specific responsibility of the Packager / Vendor and shall comply with current best available technology.
- The Packager / Vendor shall demonstrate compliance with this Specification, Codes, and Standards to meet functional, safety and maintenance requirements of the equipment.

### **7.7.3 Sizing of Equipment**

The solar power supply system shall be sized based on the following:

- i. RTUs with processor, power supplies, communication and I/O modules
- ii. Local Radios / UHF Radio Data Communication System
- iii. Repeater (if any)
- iv. All Electrical and associated sub systems
- v. Emergency well site lighting system
- vi. Well Head Control Panel (SOVs and Limit /valve positioning switches)
- vii. Field Instruments in accordance with P&ID / I/O Capacity
- viii. Fire & Gas Detectors and associated system
- ix. Field Devices (Push Buttons etc. in accordance with P&ID / I/O Capacity
- x. Solenoid Valves / Limit Switches in accordance with P&ID / I/O Capacity
- xi. Security/Telecommunication system

xii. Beacon lights/ Hooters and associated systems

xiii. Factor for future loads (30%)

The Vendor shall design the solar power system and provide exact load list as per actual requirement, which shall be based on the above loads and specific requirements covered in this specification.

Final load list shall be provided by vendor incorporating all above loads. Equipment layout drawings shall be submitted along with the bid.

#### **7.7.4 System Components**

Generally, each solar cell generator unit shall be consisting of minimum following components

- Solar power panels.
- Photovoltaic Generator
- Redundant Charge / load Control Module/ Main controller
- Charging storage batteries
- Power distribution board with breakers terminals etc.
- DC to DC Converter for regulated DC Supply for the Electronic Equipment.
- Solar Panel and Battery Isolators.
- Weather Shade.
- Casing, Support Structure/ Mounting accessories.
- Voltage to current converter for battery voltage monitoring (AI to RTU)

#### **7.7.5 Solar Power Panels**

The front panel shall consist of a toughened glass having a high light transmission coefficient, Packager / Vendor shall state the standard value used for glass type and light transmission coefficient. The solar cells shall be completely encapsulated.

The solar power panels shall be designed to resist atmospheric agents, humidity, erosion, corrosion and damage occurring from mechanical stresses such as impacts, bending and vibrations.

Each panel shall incorporate an electrical connection junction box containing both positive (+) and negative (-) terminals, panel interconnection wiring and by-pass diode.

The box shall provide a dust tight and rain tight environment (**IP 65 as a minimum**) between the panel connections and the feed through wiring to the solar cells.

The panels shall be electrically and mechanically interchangeable with each other. Individual panel removal and replacement shall be easily accomplished under field conditions without special tools or materials.

The support structure of the power panels shall consist of prefabricated aluminum ready for being assembled on site, detailed assembly / fabrication drawings and installation procedure shall be provided by Packager / Vendor with the supplied package.

The solar power unit support structure shall provide a mounting location for each of the solar power panels and shall be adequately designed to withstand the environmental and site conditions.

The support structure shall be fully adjustable for tilt angle of the solar cell panels from the panel position of **30 degrees to 60 degrees** above horizontal. Design shall allow bolted field assembly and angle adjustment without special tools or drilling.

Tilt angles shall be permanently labeled for identification. The structure shall be designed to support the solar panels, the bottom of which must be at a minimum height of 0.8m from ground level at a **35-degree** tilt angle.

The support mechanism shall allow tilting of solar panels to clean solar panels from ground level. All solar panels shall be mounted on the ground and face due south.

Civil foundations for the solar system will be constructed by OGDCL according to design documents and drawings provided by the contractor.

### **7.7.6 Photovoltaic Generator**

Photovoltaic generator shall be sized according to the following requirements:

- i. Number of modules connected in series and parallel to meet the daily energy demand;
- ii. The desired autonomy of battery;
- iii. The required power for permanent consumption i.e. the internal power consumption for solar power supplies system;
- iv. The battery daily and full recharge float charging current, in addition to load current consumption;
- v. 80% depth of discharge;
- vi. Simultaneous battery charging (after battery autonomy) and supply of load power shall be possible.

Following coefficients and de-rating shall be considered for Design:

- i. Meteorological uncertainties;

- ii. Ambient temperature;
- iii. Characteristic dispersion of the modules;
- iv. Losses induced by dust or sand on front face & bird droppings, at least 10% of maximum output shall be applied as de rating factor for effect of sand;
- v. Offset from the ideal or optimum directions of true south;
- vi. **15 years'** lifetime with predicted electrical degradation of less than 10% of rated output over the array;
- vii. Efficiency of various components of solar system;
- viii. Any shading during sunrise or sun set.

**Note:** VENDOR shall list all the above de rating factors during the bid stage.

### 7.7.7 Solar Cell Arrays

High Efficiency Cell Modules	:	Efficiency to be advised by VENDOR in w/m2 for 24V DC unit, under site condition.
Cell Protection :	:	Hardened glass (should be capable to withstand air velocity as specified)
Cell Superstructure	:	Stainless steel or Aluminum frame (which withstand to environment conditions)
Cell interconnection	:	Only in Sealed connection box onto the frame
Insulation rating	:	600V DC as a minimum
Cell finish	:	Anti-reflective coating
Array Modules	:	Series parallel combination of modules to provide required voltage & current

### 7.7.8 Array Combiner Box

- Combine groups of PV modules into a common output.
- Varistors shall be used to protect the circuit against lightning surges at the array.
- Low voltage drop diodes shall be provided to isolate each array string and prevent reverse current flow from the battery.
- Test point for array current & voltage measurement are provided.
- Construction is such that it is possible to disconnect the individual array groups for maintenance, testing, repair and replacement.

### **7.7.9 Redundant Charge / Load Controller**

- The solar power unit shall have redundant, automatic main battery charging controller with negligible power dissipation and designed to control the current coming from the solar array to the battery bank and output control center.
- The system redundant main controller/ Battery charging regulator shall be micro-processor based with the following functions as a minimum:
  - i. The redundant main controller shall be auto changeable in case failure of primary Controller
  - ii. Both main and redundant pair of charge/load controllers shall be working on load sharing principal. However suitably sized charge/load controllers shall be provided for this purpose. Each controller shall be sized in such capacity to take full charging/loading (including spare capacity) of complete system even if the other controller is out of service.
  - iii. Charging control algorithms for maximum battery-charge efficiency with PV arrays;
  - iv. Automatically regulated voltage output matched with the battery bank requirements;
  - v. The charging voltage shall be temperature compensated using temperature sensors located in the battery enclosures;
  - vi. The heat generated inside the enclosures shall not cause thermal runaway or thermal built-up to cause premature failure of electronic cards / components.
- Supplier shall be responsible to supply Industrial grade components. The charge controller / regulator shall effectively control the power to the storage batteries to prevent overcharging or uneven charging. A green LED shall indicate the charging mode and a red LED shall indicate anytime battery bank voltage drops, Module with LCD display is preferred.
- External heat sinks for the charge regulator shall be used where needed to reduce internal heat build-up. If external heat sinks are used, they shall be designed to contain all electronic components and connections within the enclosure. Power transistors and other high power dissipating devices which introduce excessive voltage drops if mounted on plug-in circuit cards shall be conveniently located inside the control enclosure to external heat sinks and hard-wired.
- The charge controller shall be adequately rated for continuous reliable operation in an ambient temperature specified.



- The main charge controller/ regulator shall incorporate a means to sense battery temperature and prevent accidental overcharging. The battery charge voltage shall be temperature compensated. The charging regulation shall include as a minimum the following components as appropriate:
  - i. Solar Array Input Ammeter
  - ii. Output Ammeter
  - iii. Output Voltmeter
  - iv. Output Disconnect Link Bar
  - v. Battery Storage Bank Terminals
  - vi. Battery Storage Bank Fuse
  - vii. Output Terminals
  - viii. External Mounting Provisions
  - ix. Alarms for High Voltage, Low Voltage and fault conditions.
- The charging regulator enclosure shall be installed under solar array with bolts on frame. The enclosure shall be securely bolted in place and positioned for easy access by maintenance and operations personnel at a convenient height for monitoring and maintenance. Enclosure rating of charge controller box shall be IP65 and this enclosure shall be made of SS304 material.

#### **7.7.10 Batteries System**

Under normal operating conditions, power shall be supplied from solar array via the battery charger to the connected load.

The system shall be capable of operating continuously without operator. It shall be reliable, free from internal faults and simple to maintain.

The Battery shall be capable of deep discharge, frequent cycling and high efficiency (Minimum 1200 cycles at 80% Depth of Discharge).

Batteries shall be of industrial heavy duty type maintenance free, sealed lead acid, valve regulated gas recombination type in accordance with BS 6290 Part IV. Batteries shall be of type designed for and proven in solar power applications VENDOR shall state any limitation of the offered battery.

The battery shall normally be continuously float charged. The float voltage shall be set just below the gassing voltage and as per manufacturer's recommendation.

Cell interconnection shall be carried out using insulated tinned solid copper links and/or

flexible insulated and tinned stranded copper cables. Bare copper cable lugs or connector shall not be acceptable. Rubber terminated shrouds shall be provided. Individual terminals shall be provided for all wires and conductors for external connection.

All material shall be resistant to electrolyte or electrolyte vapor.

### **7.7.11 Storage Batteries**

The battery bank circuits shall be provided with circuit breaker located in the charging regulator enclosure with easy access.

Type	Sealed maintenance free type lead acid for specified ambient temperature
Cell Container	Thermoplastic Charging Capability: High charge rates without excessive temperate or out Gassing (state maximum rate for above)
Direct Charge	Designed for deep cycle
Life Expectancy	Five years as a minimum for specified maximum and Minimum ambient temperature

Batteries shall be maintenance free type. Packager / Vendor shall state the maintenance requirements under the utilization conditions. Minimum life requirement is **five (05) years** under the system operation and the environmental conditions. The Packager / Vendor shall select the most economical, efficient and maximum "life" battery type suitable for the environment. The batteries shall be Sealed Lead Acid type, valve- regulated, suitable for deep discharges and daily cycling with storage capacity calculated to drive the load continuously for **two (2) days "No Sun" condition**.

The storage battery shall include the following special features to accommodate the unique application and environmental demands:

- Self-discharge rate not to exceed 3 percent per month at **25 degrees C**
- Lifting handles or similar devices to facilitate removal of the battery with minimum back strain. Handles or devices shall be constructed of a material which is unaffected by the battery electrolyte or its fumes and shall easily support the battery mass including electrolyte. Handles shall not lift the batteries by the terminals. One lifting device per solar cell generator unit is adequate if individual battery handles are not provided
- Electrolyte shall be per battery manufacturer's specification for hot or tropical climates and consist of only Industrial Grade sulfuric acid for lead acid batteries;

- All batteries interconnection terminals, bus bar, etc., shall be tin coated copper
- The batteries shall be presided in weather proof enclosure **IP 23, SS 304**, Lockable, suitable for outdoor installation below the solar array.

#### **7.7.11.1 Battery Sizing**

The storage battery shall be sized for:

- Battery autonomy of 02 Days i.e., **48 hours**).
- A maximum battery depth of discharge of 80% of the nominal capacity.
- A battery ageing factor (0.8).
- The load voltage tolerance. The battery end cell voltage shall be based on the load voltage tolerance.
- To account for the type of float and high rate charges selected.

The battery sizing shall take into consideration the maximum and minimum voltage tolerance of the load: +10% and -10%. The end cell voltage shall be based on above voltage tolerance. Largest battery cell shall be suitable for removal the assembly by one man. Sufficient spacing should be allowed between the batteries for expansion of batteries during charging.

#### **7.7.11.2 Cells conditions for dispatch**

Unless otherwise stated, cells should be delivered fully charged and filled-in. All connections shall be adequately protected. All necessary tools and tackles shall be provided for the maintenance of batteries.

#### **7.7.11.3 Battery Installation**

Location:	Separate enclosures located under the solar array modules.
Mounting:	Battery cells shall be well arranged. It will be made up of support rack(s) to allow service, inspection or replacement with removal of faulty battery unit only

#### **7.7.11.4 Daily Battery Recharge**

Battery capacity restoration after 02 days operation under "No Sun" condition.

Packager / Vendor shall specify the expected battery restore time under the following conditions:

Best / worst solar radiation condition with no de-rating applied on solar array output;

Best / worst solar radiation condition with maximum expected de-rating applied on solar array output after 10 years operation.

### **Battery performance requirement**

DC Voltage Output:	Nominal 24V DC - Negative (-ve) earthed.
Batteries:	24V DC +/- 10%
Battery autonomy:	Battery banks shall be sized for charged batteries at rated minimum of 02 days (i.e. 48 hours). Autonomy period continuous load specified.
Maximum time to charge:	to be advised by VENDOR.

### **7.7.12 Power Distribution Board**

A DC power distribution board shall be provided to distribute the power supply to the load. Quantity and nominal rating of the various circuit breakers installed shall be as required by the loads. (20% spare breakers to be provided as well).

#### **7.7.12.1 Distribution Switch Board**

The 24 V DC Distribution board shall be fed from the solar cells power generator system and shall supply the consumers, and shall be negative (-ve) earthed.

The Distribution Switchboard shall have the following features:

- Tropicalized, and shall be of moisture and fungus proof construction.
- Ingress protection of IP 65 (minimum).
- Bottom cable entry.
- Front access by opening the hinged door.
- Adequately rated fully shrouded/insulated, high conductivity, tinned copper bus bars with adequate short circuit withstand rating.
- All bolted connection shall be provided with high tensile corrosion protected bolts, nuts and locking washers.
- Earth bus-bar along the full length of the switchboard.
- Terminals shall be provided for the connection of all incoming and outgoing cable earth conductors. The main frame work and all barriers etc. shall be bonded to the earth-bar as required. In addition to these protective earthing facilities, two external earthing terminals shall be provided on the enclosures.
- The enclosure shall be suitable to accommodate all components according to temperature rise.
- A sign stating -"Negative (-ve) Bus to be Earthed" shall be provided.

- The Distribution Switchboard shall comprise of miniature circuit breakers for all incoming & outgoing feeders.
- In addition to the outgoing circuits required to fulfill the requirements of the project, at least 25% spare fully equipped feeders shall be provided to cater the future requirements.

### **7.7.13 Wiring and Termination**

- All internal cubicle wiring shall be flexible stranded copper conductor. PVC or XLPE insulated, 600/1000 Volt, flame retardant.
- Minimum wire size for control wiring shall be 1.5 sq. mm and for power and current transformer wiring it shall be 2.5 sq. mm.
- All wiring shall be neatly arranged and clipped in groups and protected by flexible conduit or channels with covers.
- Each conductor and its terminations are to be identified and marked with numbered and/or lettered ferrules in accordance with the related wiring diagrams.
- As far as practicable, signal conductors shall be segregated from power wiring. All live terminals are to be shrouded.
- Wiring to equipment mounted on doors shall be carried out through flexible conduits, or spiral wrap.
- Small wiring terminations for control connections shall be of the non-loosening spring loaded type, shall be readily accessible with a minimum spacing of 150 mm between adjacent rows. Each terminal shall be adequate to terminate 2 x 2.5 sq. mm conductors. Not more than one wire shall be connected to any one terminal.
- All power connections shall be by bus-bar connections, provided with stud type terminals complete with nut and locknuts.
- The VENDOR shall supply all cables, glands and lugs for incoming and outgoing feeder cables from the distribution board. All cables shall be steel wire armored. Positioning of cable termination shall avoid obstruction of other cable terminations; removable covers etc. and provide easy access for terminating cables.
- The VENDOR, to avoid undue strain on the cable termination, shall provide Cable supports. Termination chambers shall be arranged to take due regard of the minimum radii of the cables.

- All terminal blocks shall be shrouded or provided with transparent covers, Barriers shall segregate circuits and terminals operating at different voltages or performing different functions.
- All terminals and exposed conductors that may be live when cubicle doors are open for routine setting up or maintenance functions shall be fully shrouded. Terminal shrouds shall be such that the removal of shrouds associated with one circuit shall not expose terminals associated with any other separately isolated circuit. At least 25% spare terminals shall be provided in each control and indication terminal block.

#### **7.7.14 Power and Interconnecting Cables**

Cables shall be copper conductor, XLPE insulated, steel wire armored and PVC sheathed. Cable installation shall be in conduits (PVC pipes and closed trenching) to prevent cable damage. No outside cable shall be exposed. All required material shall be Included. All cables shall be terminated at shelter through double compression cable glands.

#### **7.7.15 Circuit Protection**

Circuit protection shall be provided in all instances where transient or steady state overload conditions may exist and could damage circuit components. Device coordination and short circuit fault current calculations shall be made for each circuit to insure selective tripping and clearing of protective devices.

##### **Circuit Breaker / Isolated Box**

The battery bank circuits with Double pole circuit breakers shall be provided.

The circuit breaker isolator box shall have the following features: Circuit breaker shall be located in the charging regulator enclosure with easy access.

#### **7.7.16 Reverse Current Blocking Device**

A reverse current blocking device shall be used to prevent the batteries from discharging through the photovoltaic panel.

#### **7.7.17 Earthing and Grounding**

Earthing for all components of the solar cell generator unit system shall be provided. Each enclosure and support structure in the system shall be provided with an externally mounted mechanical connection by 35 mm<sup>2</sup> minimum tinned copper ground conductor. Ground conductor

will be provided by contractor. However, all civil work (including construction of grounding pit) will be done by OGDCL.

### **7.7.18 Terminals**

Terminals shall be properly and clearly identified

### **7.7.19 Wire Identification**

Each conductor shall be identified by the color of the thermoplastic insulation and permanent wire markers within 25 mm of each termination. Each conductor shall have a number and color identifying it, which corresponds to the operating manual schematic diagram for simplified troubleshooting and repair. Adhesive type wire markers are not acceptable unless secured by transparent heat-shrink tubing.

### **7.7.20 Cable Terminations**

Cable terminations on wiring shall be made with crimped lugs connectors appropriately sized for the conductor. Spade-type terminations are not acceptable.

Large current carrying conductors over 70 mm<sup>2</sup> may terminate at tinned or silver coated crimped-type lugs located in the respective enclosures. Split-bolt connectors are not acceptable

### **7.7.21 Electrical Requirements**

#### **7.7.21.1 General**

Each unit shall have an over-load rating of 10 percent at ambient specified temperature. The equipment shall be of a standard design which ensures maximum safety to personnel, maximum service reliability and economic operation for an operational lifetime of at least **20 years**. Design and construction shall be simple and shall provide good accessibility to component and parts.

All equipment material and parts shall be brand new and unused, of modern design and of the highest industrial grade, free from all imperfections that might affect the performance.

#### **7.8.22.2 Voltage Quality**

- Output voltage: 24V ± 1V for remote terminal unit
- Max. Voltage deviation: 1 V of no-load voltage from no load to full load;
- Upper transient voltage: 1 V of no-load voltage deviation on loss of full load;

- Harmonic content: Harmonic content should not be in any case more than 2%.

The unit shall operate satisfactorily in the presence of RF interference. The voltage quality shall be suitable to use for Field Instruments work smoothly and there shall be minimize harmonic level in charging hours. If it is not possible than vendor shall provide separate harmonic filter.

The photovoltaic power supply unit shall incorporate the following protective features.

#### **7.7.21.2 Under Voltage**

The load shall be disconnected from the power supply unit when the voltage of the battery falls below the stipulated minimum voltage level.

#### **7.7.21.3 Over Charge**

The photovoltaic array shall be switched over to trickle charge mode whenever the battery voltage reaches its fully charged state to prevent overcharging of the batteries. After a specified time delay, the array shall once again be connected to battery for boost-charging thus utilizing the photovoltaic energy available to the maximum extent.

#### **7.7.21.4 Over Current**

The unit shall be provided with over current protection facilities to protect against sustained over loads. In the case of sustained short-circuit condition; the unit shall be protected through appropriate protection mechanism.

#### **7.7.22 Remote Monitoring**

The solar power units shall include provision for the transfer of signal to the SCADA system. The signal to be transferred shall include, but shall not be limited to:

Low or high output voltage (potential free contact);

Battery Low voltage (potential free contact);

#### **7.7.23 Marking**

The equipment shall be provided with a one-word nameplate made of SS316 and affixed to a non-removable part of the equipment. The following information shall be indelibly marked in English language.

- i. Year of manufacture
- ii. Name and address of manufacturer



- iii. Type and serial number of unit
- iv. Nominal input current / voltage
- v. IP classification according to IEC 60529
- vi. Equipment tag number and purchase order number

All other nameplates required for the components shall be 3-ply, laminated phenol (white-black-white) and engraved to the black lamination. Nameplate shall be attached using nuts, bolts and washers.

Self-tapping screws shall not be used. All marking shall be in the English language.

## **7.7.24 Cabinets, Enclosure and Junction Boxes**

All enclosures materials shall be of SS304. All junction boxes, equipment enclosures and system cabinets shall be fabricated to provide complete mechanical and environmental protections. Adequate means shall be provided to prevent accumulation of condensation. Isolators, battery charger, voltage limits, distribution boards and their interconnecting cables shall be mounted on a frame of sufficient strength to support all items, without visible deflection and shall be housed within suitable enclosure. The enclosure shall be designed for easy removal for maintenance access. The battery enclosure shall be fabricated from stainless steel.

Modules and interconnections shall be arranged to allow easy replacement of faulty modules under field conditions and shall be mechanically and electrically interchangeable.

Undrilled, removable, gland plates or predrilled holes with removable **IP-65-hole** plug shall be provided for cable entry.

Cabinets and enclosures heavier than **35 kg** shall be provided with four, removable, lifting eyes.

### **7.7.24.1 Power Distribution Board Enclosure**

The power distribution panel enclosure shall be designed to be installed in the weather proof **IP- 65** and made of SS304.

### **7.7.24.2 Charging Regulator Enclosure**

The Solar power main controller enclosure shall be designed to be installed under solar array. It shall be weather proof IP 65, SS material with lock provision.

## **7.7.25 Solar Power Unit Support Structure**

The support structure shall be elevated 1 meter above ground level and shall be designed for

mounting on a flat, concrete base. The support should be 1.2m high at the short side of the inclined panel (approximately 30 degrees).

The VENDOR shall determine the optimum declination for mounting the array. The mounting shall be adjustable about the determined angle by  $\pm 10$  degrees. VENDOR shall specify support structure. This shall be adequately designed to withstand the environmental conditions, details of which are as follows:

Construction: Galvanized and painted carbon steel

Coating: Hot dipped galvanized after fabrication and epoxy painted as per specification.

Design Criteria: To withstand environment conditions listed above, to safely support required solar cell arrays.

A roof shall be provided, unless the equipment will be mounted in the shade of the solar array, in order to protect the control equipment and the batteries from direct sunlight.

All civil foundations will be built and constructed by OGDCL according to the design documents and drawings provided by contractor.

### **7.7.26      Array Support Structure**

The array support structure shall provide a mounting location for each of the photovoltaic panels and shall be adequately designed to withstand the environmental and site conditions. The structure shall be suitable for installation on the concrete pad facing south.

**Note:** All civil foundations will be built and constructed by OGDCL according to the design documents and drawings provided by contractor.

#### **7.7.26.1    Construction Dimensions**

The Vendor shall provide construction dimensions in a clear, easy-to-read format explaining foundation requirements and recommendations for anchoring the array, support structure, and batteries.

### **7.7.27      Solar Power System Documentation**

VENDOR shall submit all documents related to design, inspection test and as per requisition for review/comments/approval and incorporate all comments made by them. Manufacturing shall not proceed without incorporating the comments made by COMPANY on the drawings, failing which any delays, losses etc. shall be borne by the VENDOR without any prejudice to the COMPANY.

Following drawings and data to be furnished with the bid:

- i. Predicted system performance calculation. .
- ii. Detailed drawings of all equipment supplied showing their requirements, which are indicated.
- iii. Make, Place of manufacturing, Place of testing and catalogue reference of all Item.
- iv. Calculation note of the battery bank, solar arrays, and selection criteria.
- v. All assumptions and basis of assumptions for the calculation shall be clearly mentioned.
- vi. Battery charging & discharging curves.

**Note:** All calculation furnished during the bid stage shall be only for information.

These shall be revised and verified during detailed engineering stage. Any change in size of battery, solar controller, solar panels, arrays, etc. resulting from revised calculation shall be done without any price implication and time delays.

Following drawings and data to be furnished after award of the contract as part of document deliverable:

- i. Outline general arrangement drawing of solar array, batteries, isolators, distribution boards and controllers showing disposition of cable, connections, weight, etc.
- ii. Load evaluation and solar module, battery, sizing calculations.
- iii. Detailed single line diagrams.
- iv. Main and control circuit schematic diagram including connection diagrams.
- v. Complete loop wiring diagram from Field equipment to RTU Controller clearly showing path of cable & termination via J.Bs
- vi. Cable schedule & M.T.O.
- vii. Make and bill of material for each component of solar power supply system.
- viii. Detailed calculations to verify suitability of support structure to withstand wind velocity.
- ix. Testing and inspection procedures / details.
- x. Installation drawings, Installation & Operating and Maintenance Manuals.
- xi. Pre-commissioning & commissioning manuals.
- xii. Final copies of drawings to be provided as per Packager / Vendor drawings and documents enclosed along with requisition.

### **7.7.28 Predicted System Performance Calculation**

Detailed theoretical system performance prediction calculations shall be provided at tender stage, based on regional solar statistics, including depth of battery discharges to be experienced and time required to recharge batteries, over typical yearly periods of fluctuation. A computer sizing analysis to calculate the path of the sun, in a typical day, for each month of the year is required. Array outputs shall be indicated and de-rating for site conditions.

### **7.7.29 Load List for Solar System Design**

SCADA system vendor / packager shall be responsible for complete solar system design and calculation according to the load of the equipment provided by SCADA system vendor / packager and considering all design requirements as mentioned in above sections.

All structural work shall be adequately protected against corrosion.

## **7.8 Field Instrumentation**

Field Instrumentation are required at each well site. All instruments on each well-site shall be connected to its respective RTU. These Instrument shall include process related primary instrumentation i.e. Pressure, Temperature, Flow and Voltage transmitters etc. as well as F&G detection system for monitoring, control and safety of well site through RTU from Plant CCR.

### **7.8.1 Static Pressure Transmitter (PT)**

The static line pressure of well pipeline shall be measured by an electronic series static pressure transmitter with HART protocol with signal 4-20 mA. Pressure Transmitter shall have an integral local LCD indicator meter with scale in engineering units. The static pressure transmitter associated shall be mounted on a pipeline. A multiport gauge and bleed/ 3- valve manifold shall be provided to isolate the transmitter for calibration and maintenance purposes. The manifold and transmitter shall have a pressure rating equal to or greater than the process piping design pressure.

**Specification:-**

<b>SMART Family 2-wire Gauge Pressure transmitter with LCD display</b> <ul style="list-style-type: none"> <li>• Suitable for corrosive Gas H<sub>2</sub>S contents minimum 10 PPM</li> <li>• The Power Advisory Diagnostic Feature for Troubleshooting</li> </ul> <b>Quantity=25 (11 wells + 03 Gathering area+ 11 Instrument air)</b>	
1	Case Material = Baked Epoxy Coated for anti-corrosion
2	Mounting=1-2",Pipe, Pipe Mounting Bracket= 1-2" with Pipe mount Bracket
3	Power Supply = 10.5-55 VDC
4	Output Signal = 4-20 mA
5	Element Type = Diaphragm
6	Process Connection = 1/2 inch NPT
7	Accuracy: $\pm 0.04\%$ of the span
8	Stability: <b>0.2%</b> of the URL for 10 years
9	<b>Transmitter Range: minimum 0-2000 psi (Quantity=14) and minimum 0-450 Psi (Quantity 11)</b>
10	<b>Operating Range: 1400-1450 psi (for transmitters of min.0-2000 Psi range )</b>
11	<b>Calibration Range: 0-1450 Psi (for transmitters of min. 0-2000 Psi range ) and 0-150 Psi (for transmitters of 0-450 Psi range )</b>
12	Electrical Classification = Flame Proof EExd CExI Approval
13	Area Classification=Class 1 Div 1
14	Remote Communication = Via HART Protocol Universal Communicator
15	Diaphragm Material = 316SS
16	Fill Fluid = Silicone Oil
17	Gasket Material = PTFE
	<b>Standard Accessories (Minimum):-</b>
i	3-Valve Manifold = Required (SS-316)
ii	Cable Gland Size = 1/2" NPT Female
iii	Local Display = Digital Display

**7.8.2 Temperature Transmitter (TT)**

The process stream temperature shall be measured by a RTD temperature element inserted in a properly sized raised face flange thermowell with insertion length equivalent to  $\frac{3}{4}$  of the

6" pipeline size.

The sensor shall be platinum RTD calibrated to 100 Ohms at 0°C.

The temperature transmitters shall have an integral local LCD indicator meter, scale in °F.

The temperature transmitter shall be 24 VDC, and support the HART Protocol with 4-20mA output shall be wired to the RTU/PLC.. The accuracy of the temperature measurement shall be equal or better than  $\pm 0.1\%$  of calibrated span and the corresponding readout should have a resolution of at least **0.5°F**.

**Specification:-**

<b>SMART Family 3-wire Temperature Transmitter with LCD display</b>	
<ul style="list-style-type: none"><li>• Along with Thermowell (SS-316) material</li><li>• Suitable for corrosive Gas H<sub>2</sub>S contents minimum 10 PPM</li><li>• The Power Advisory Diagnostic Feature for Troubleshooting</li></ul>	
<b>Quantity=11 (01 for each well)</b>	
1	Case Material = Baked Epoxy Coated for anti-corrosion
2	Mounting=1-2",Pipe, Pipe Mounting Bracket= 1-2" with Pipe mount Bracket
3	Enclosure Class = IP65/66/67
4	Power Supply = 10.5-55 VDC
5	Output Signal = 4-20 mA
6	Element Type = PT100
7	Transmitter Range: 0-200° F
8	Operating Range: 0°F to + 150°F
9	Calibration Range = 0°F to + 150°F
10	Accuracy: <b><math>\pm 0.04\%</math></b> of the span
11	Stability: <b>0.2%</b> of the URL for 10 years
12	Remote Communication = Via HART Protocol Universal Communicator
13	Area Classification=Class 1 Div 1
14	Approvals = UL/ATEX / IECEx / Class 1 Div 1, FM Explosion proof, dust ignition proof
15	Power Advisory Diagnostics feature for troubleshooting purpose
<b>Standard Accessories (Minimum):-</b>	
i	Cable Gland Size = 1/2" NPT Female
ii	3-Valve Manifold material SS-316
iii	Thermowell SS-316) material <b>1½"</b> flanged raised face with ANSI rating
iv	Local Display = Digital Display

### 7.8.3 Thermowells

Thermowells shall be tapered **316 stainless steel 1½"** flanged raised face with ANSI rating equal to piping rating. Thermowells provided without instrument shall have a stainless steel plug and chain.

Thermowell shall protrude into the pipe to at least one half the nominal pipe diameters and shall normally be installed in the vertical position (top of pipe).

### 7.8.4 Flow/ Differential Pressure Transmitter (FT/DPT)

The Gas flow of well site shall be measured by an electronic FT/ Differential Pressure Transmitter with HART protocol with signal 4-20 mA. Pressure Transmitter shall have an integral local LCD indicator meter with scale in engineering units. The differential pressure transmitter associated shall be mounted on a mounting panel. A 5 - valve manifold shall be provided to isolate the transmitter for calibration. The manifold and transmitter shall have a pressure rating equal to or greater than the process piping design pressure.

The pressure transmitter shall be of an accuracy equal or better than  $\pm 0.05\%$  of the span at reference conditions to be used and have internal span and zero adjustments. The pressure transmitter output signal shall be wired to the RTU/PLC.

#### ***Specification:-***

<b>SMART Family 2-wire coplanar Flow/Differential Pressure Transmitter with LCD display</b> <ul style="list-style-type: none"><li>• <b>Suitable for corrosive Gas H2S contents minimum 10 PPM</b></li><li>• <b>The Power Advisory Diagnostic Feature for Troubleshooting</b></li></ul> <b>Quantity=11 (01 for each well)</b>	
1	Case Material = Baked Epoxy Coated for anti-corrosion
2	Mounting=1-2",Pipe, Pipe Mounting Bracket= 1-2" with Pipe mount Bracket
3	Enclosure Class = IP65/66/67
4	Power Supply = 10.5-55 VDC
5	Output Signal = 4-20 mA
6	Accuracy: <b><math>\pm 0.04\%</math></b> of the span
7	Stability: <b>0.2%</b> of the URL for 10 years
8	Element Type = Diaphragm

9	Process Connection = 1/2 inch NPT
10	Transmitter range = 0-300 inches of H <sub>2</sub> O and 0-20 MMSCFD
11	Flow range of D.P cell 0-300 inches of H <sub>2</sub> O at Operating pressure= 0-2000 psi
12	Approvals = UL/ATEX / IECEx / Class 1 Div 1
13	Remote Communication = Via HART Protocol
14	Diaphragm Material = 316SS L
15	Fill Fluid = Silicone Oil
16	Gasket Material = PTFI
	<b>Standard Accessories (Minimum):-</b>
i	5 valve Manifold material SS-316
ii	Cable Gland Size = 1/2" NPT Female
iii	Local Display = LCD

### 7.8.5 Voltage Transmitter (VT)

The Voltage Transmitter (VT) shall be required for the monitoring Voltage of Solar power system and viewing performance of all batteries. VT shall be configured with the respective RTU/PLC for monitoring, trending, reporting and further utilization with ESD logic. The Solar Voltage transmitter output signal shall be wired to the RTU/PLC.

#### Specification:-

<b>Battery Voltage Transmitter</b>	
<ul style="list-style-type: none"> <li>• <b>Best suitable for Solar Power Voltage transmitter to RTU</b></li> <li>• <b>Suitable for corrosive Gas H<sub>2</sub>S contents minimum 10 PPM</b></li> </ul>	
<b>Quantity=11 (01 at each well)</b>	
1	Case Material = Baked Epoxy Coated for anti-corrosion
2	Mounting=1-2",Pipe, Pipe Mounting Bracket= 1-2" with Pipe mount Bracket
3	Enclosure Class = IP65/67
4	Power Supply = 10.5-55 VDC
5	Output Signal = 4-20 mA
7	Accuracy: <b>±0.04%</b> of the span
8	Stability: <b>0.2%</b> of the URL for 10 years
9	Transmitter Range Input): minimum 0-60 VDC



10	Calibration Range: 0-60 VDC
11	Electrical Classification = Flame Proof EExd CExI Approval
12	Area Classification=Class 1 Div 1
	<b>Standard Accessories (Minimum):-</b>
i	Cable Gland Size = 1/2" NPT Female
ii	Local Display = Digital Display

### 7.8.6 Hart Communicator & Pressure Calibrator

Supplier to provide (03) nos. Latest version of HART Communicator (Emerson 475 or equivalent) (compatible with the installed equipment) & (03) mos. Pressure calibrators with pressure modules (Fluke 725 or equivalent) for the maintenance & calibration of transmitters & pressure gauges.

### 7.8.7 Pressure Gauge

The Local Pressure Gauges are required for local monitoring of line pipe pressure and Instrument air pressure of well site

#### **Specification:-**

<b>Pressure Gauge liquid Filled suitable for corrosive Gas H<sub>2</sub>S contents minimum 10 PPM</b>	
<b>Quantity=55 (05 for each well)</b>	
1	Explosion proof Class 1 Div 1 / ATEX Ex II 2G Ex d IIB / UL / IECEx
2	Size 5-6 inch ( <b>Quantity 44</b> ) and 4 inch ( <b>Quantity 11</b> )
3	Enclosure Class = IP65/67
4	<ul style="list-style-type: none"> <li>Pressure Range 0-10000 Psi, <b>Quantity 11 (01/well), Size 5-6 Inch</b></li> <li>Pressure Range 0-2000 Psi, <b>Quantity 33 (03/well), Size 5-6 Inch</b></li> <li>Pressure Range 0-450 Psi, <b>Quantity 11 (01/well), Size 4 Inch</b></li> </ul>
	<b>Standard Accessories (Minimum):-</b>
i	Isolating valve manifold material SS-316

### 7.8.8 Fire & Gas Detection

Minimum of one (01) IR Flame and one (01) HC detectors will be supplied and installed near the wellhead, classified area, and wired into the RTU/PLC. The alarm beacon light will be energized upon detection of fire or gas leakage, at well site, outside acceptable limits set in the local RTU/PLC. SCADA Control Station can reset or over-ride the alarm or alarm limits.

<b>Combustible Gas Detector &amp; Transmitter</b>	
<b>Specification:-</b>	
a	Sensor Type = continuous Diffusion, low temperature catalytic bead

b	Measuring Range = 0 to 100% LEL
c	Measuring Resolution = 1% LEL
d	Supply Voltage = 12-24 VDC
e	Indications = 3 Digit Display
f	Output = Digital & Analog outputs (user selectable) 4-20 mA
g	Application = Hazardous Area
h	Operating Temperature = -10°C to +70°C
i	IP Class = IP65/67
j	Termination = EExd II Terminal blocks

IR Flame Detectors	
Specification:-	
a	Sensor type = Digital Frequency IR Detector
b	Range = 60 Meter
c	Supply Voltage = 12-24 VDC
d	Output = Digital outputs (user selectable)
e	Area Classification = EExd IIB +H2 T6, IP67
f	Operating Temperature = -10°C to +70°C
g	IP Class = IP65/67

### 7.8.9 Modifications in Existing Hydraulic Wellhead Control Panel.

To operate / link existing W.H.C.P with RTU and give ESD signals for activation of ESD command generated by SCADA system, Vendor/packager shall be responsible for all modifications/ installation if required in existing Hydraulic Wellhead Control Panels which are installed at each well site.

Any services, work effort and supply of material related to required Hydraulic wellhead panel modifications are SCADA system packager/vendor responsibility and shall be supplied accordingly. Schematic of existing WHCP is attached with this ITB.

## 7.9 Integration with Production Data Management System (PDMS)

OGDCL has installed a fully functional production data management (PDMS) system. Servers and Dashboard stations of this system are installed at OGDCL Head Office, Islamabad for remote monitoring and data retrieval for further processing by different Departments. Layout of OGDCL PDMS system is placed at **Flag-B** for reference.

Bidder/Contractor of SCADA system shall be responsible to integrate the SCADA system with OGDCL PDMS system in this regard any hardware / software / license required at SCADA system

shall be supplied, installed, configured and commissioned by SCADA system bidder/contractor. However, it shall be noted that OGDCL will be responsible for any hardware / software / license required at PDMS system. SCADA system vendor/bidder is expected and liable to extend full technical support to OGDCL for any technical support required by OGDCL.

Cyber data and system security shall be specially taken care of when designing the network architecture to connect SCADA system and Kunar Gas field with PDMS system at OGDCL headquarters Islamabad. Any network/cyber security equipment required to be installed at SCADA system for security purpose (including but not limited to firewalls, DMZ, managed switches / routers etc.) shall be supplied by SCADA system contractor.

## **8. PACKAGING, PRESERVATION AND PREPARATION FOR SHIPMENT**

VENDOR shall be responsible for the design, supply, assembly and application of all preservation and packaging required for the shipment, handling and storage of all equipment supplied under the order to the final destination as specified in the purchase order.

The preservation and packaging shall comprise all that is necessary to permit the safe transportation by land and sea, and additionally storage of the equipment.

Each individual carton or box shall be marked with the Project Name & Code, Purchase Order No., Tag No. and COMPANY Name and Address, on the top and side of the carton / crate.

VENDOR shall be entirely responsible for any claim arising, which is attributable to defective and / or insufficient packing.

### **8.1 Packaging**

Preparation for shipment shall be in accordance with the Packager's / Vendor's standards and as noted herein. Packager / Vendor shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to materials and application, and to provide equipment at the destination in ex-works condition when handled by commercial carriers.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the job site.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to the account of the Packager / Vendor. All equipment shall be packed with moisture desiccant and moisture detection strips installed in all packed equipment. These shall be inspected after installation and previously established testing/ replacement policies will be implemented these procedures will be prepared by the Packager / Vendor and approved by Company.

Equipment shall be packed, securely anchored, and skid mounted when required. Bracing, supports, and rigging connections shall be provided to prevent damage during transit, lifting, or unloading.

Separate, loose, and spare parts shall be completely boxed. Pieces of equipment and spare parts shall be identified by item number and service and marked with Contractor's order number, tag number, and weight, both inside and outside of each individual package or container. A bill of material shall be enclosed in each package or container of parts.

## **8.2 Preservation and Storage**

Equipment and materials shall be protected to withstand ocean transit and extended period of storage at the job site for a minimum of 18 months. All supplied items shall be protected to safeguard against all adverse environments, such as: humidity, moisture, rain, dust, sand, mud, salt air, salt spray, and sea water.

All equipment and material shall be preserved and export packed in accordance with requirement defined by Company.

## **8.3 Shipping**

Each unit shall be covered with polyethylene sheeting and crated prior to shipping regardless of the intended type of transportation. Instruments relay enclosures, ducts or other heavy items shall be provided with additional bracing to prevent them from breaking loose during shipment. All supports which will be in contact with the unit, instruments or other items shall be adequately padded to prevent contact damage to any finished part of the panel or instruments. Adequate desiccant shall be provided within the panel to allow for 8 weeks shipping.

Packager / Vendor shall ship each unit with all permanently-mounted devices installed and securely mounted. The original Packager's / Vendor's shipping stops, if any, shall be used and

additional protection shall be provided to prevent damage to the devices. Items shipped separately inside the unit crating shall be appropriately packaged and securely fastened to a supporting base member.

The VENDOR shall be responsible for both physical and weather protection of the equipment. Every precaution shall be taken to prevent the ingress of moisture and dust. The VENDOR shall inspect and approve the loading and bracing to ensure that no damage occurs during transit.

Prior to packing, all material must be suitably sealed to prevent ingress of dust and moisture. Equipment shall be for transit and exposed storage under adverse conditions.

The VENDOR shall advise, if there is any special storage requirement.

## **9. INSPECTION AND TESTING**

Inspection & testing shall be divided into below mentioned areas:

- i) Intermediate Acceptance during execution of project / Progress Review Meeting
- ii) Factory Acceptance Test (FAT)
- iii) Site Acceptance Test (SAT)
- iv) Sustained Performance Test (SPT)

### **9.1 Intermediate Acceptance during execution of project / Progress Review Meeting**

To review the project execution as per agreed standards and procedures, One OGDCL representative will visit vendor foreign facility. This visit will be conducted on invitation from Vendor. Ideal time for this visit shall be after completion of logic / and graphics development and completion of panel drawings but before start of panel integration. OGDCL representative's suggestions during this visit shall be incorporated to fine tune logic/graphics and in construction and integration of control panels and auxiliary equipment.

It is the responsibility of the vendor to make all the arrangements for the OGDCL representative participating in this meeting including Visa, Air travel, Boarding & Lodging, Foods, and local commuting in the city of meeting etc.

Meeting shall be commenced for at least three (03) working days excluding traveling period for (01) One OGDCL official. However, if SCADA system manufacturer/packager deems, the duration can be extended beyond three (03) working days as per recommendations.

All expenses related to OGDCL presence should be included in the base cost of SCADA system.

This shall cover as minimum following items:

1. Visa Expenses and Approvals

2. Air Fare from Pakistan to meeting site and back
3. Boarding & Lodging / Hoteling and Transportation of One OGDCL official at meeting city
4. Expenses against TA/DA which shall not be less than US \$350/day/person  
for minimum 05 days (03 working + 02 travelling days).
5. Meeting and Inspection facility etc.

## **9.2 Factory Acceptance Test (FAT)**

The supplier shall submit a complete plan and relevant certified documentation of the Factory Acceptance Test (FAT) to OGDCL. This plan must be complete and have sufficient detail to indicate the exact nature of each test, expected results and systematic procedure. The plan shall be submitted at least 30 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 OGDCL Engineers/Professionals.

FAT shall be carried out at SCADA and Telemetry Vendor's foreign facility. Acceptance of all equipment shall be subject to inspection by OGDCL nominated representatives. Inspection shall include verification of the equipment and its functionality dimensions, examination and checking of the documentation.

The FAT shall be conducted in accordance with the Packager / Vendor standard QA procedures.

The Packager / Vendor shall be responsible for generating the FAT procedures.

The pass / fail criteria shall be 100% correct performance otherwise the faulty item shall be rectified or replaced at the Packager / Vendor cost.

The FAT shall include the testing and acceptance of both hardware and proprietary system software. All proprietary system software shall be complete and resident in the SCADA prior to the start of FAT. All documentation and listings must be free of mark-ups.

All hardware diagnostic programs shall be run at the start of FAT. These shall be the diagnostic programs which have been used for processing the system in the Packager / Vendor factory.

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

During the FAT, the SCADA shall be made available to the inspector for sufficient periods to verify satisfactory performance. The inspector will reserve the right to witness the entire FAT as a non-participating observer. The FAT procedure will be signed off by the Packager / Vendor and the inspector and a copy of the signed off FAT procedures and related printouts shall be furnished to

the inspector at the successful conclusion of the FAT. However, the FAT is not an inspection and test hold point.

### **9.2.1 FAT Criteria**

The factory acceptance tests shall be conducted in two phases.

The first stage shall test all the I/O facilities of every wellhead, this shall include all RTU, Solar, Instrumentation and radio system etc.

The second stage will test the full SCADA system completely assembled in the manufactures works, fully configured with all hardware and software facilities using communications to emulate the actual digital communications network.

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

- Assembling sequence, including inspection and testing.
- Proposed check of system architecture against approved for construction documents.
- Proposed physical inspection of equipment.
- Proposed check of documentation.
- Simulation and observation of 100% inputs/outputs (including used and spares) to confirm operation of SCADA and Telemetry system in accordance with the P&ID's, Control Philosophy, Cause and Effect matrices, Logic Diagrams and I/O Schedule.
- Confirmation of correct functions of all communication links.
- Confirmation of availability of all specified screen functions and Operator Interface functions, including a proof test of automatic switchover to the Redundant Hardware Equipment.
- Verification of UHF radio communication link with RTU and Master/ Base radio station.
- A radio interference test shall be carried out or certification shall be provided in compliance to standard industrial requirements.
- Verification of installation of required software.
- Verification / Confirmation of correct functions of all communication links and protocol such as:
  - i. Serial Interface and Communication.
  - ii. PLC / Unit control system (shall be simulated using Modbus slave simulators. Vendor to arrange all equipment to carry out the test).
  - iii. Communication protocols including HART (shall be simulated using Hart simulator).
- Supplier shall be responsible for providing all simulation systems at its own cost during FAT.

- HMI operation testing
- FAT shall also include 48-hours soak test, graphics & data base verification, logic / cause & effect verification, verification of AGA calculation etc.
- UHF radio data communication link.

### **9.2.2 Pre-requisites**

The following conditions shall be satisfied prior to the commencement of any Factory Acceptance Tests.

The equipment shall be fully pre-tested with results fully documented.

Personnel used to demonstrate the tests shall be competent and fully conversant with the equipment and associated software.

All necessary test and simulation equipment shall be supplied prior to the commencement of the tests. The availability and calibration of the required test equipment shall be demonstrated.

### **9.2.3 Structured and Unstructured Testing**

Structured testing is that testing which is in accordance with the agreed and approved test specifications.

Unstructured testing is that testing that shall be requested which may not be included within the approved test specifications. Such tests may be random in nature but shall be bound by the application specifications and project definitions.

All unstructured testing shall be recorded and incorporated into the appropriate acceptance specification.

### **9.2.4 Reliability Testing**

During all stages of the Factory Acceptance Tests full records shall be kept of all failures and rectifications. During the final FAT stages, a reliability test shall be conducted whereby, for an agreed period, the fully configured SCADA system shall operate without fault or failure of any hardware or software elements.

### **9.2.5 RFI Test**

Where specified a selected RTU and MTU equipment shall be subjected to Radio Frequency Interference Tests in accordance with agreed and approved procedures. Both the RTU and the MTU shall be powered up and operating.



The selected equipment shall be exposed to RF frequencies in the range of 27 Mhz to 1 Ghz of an amplitude in accordance with the agreed procedures. This shall be implemented with the equipment doors closed and open as appropriate.

### 9.2.6 Test Documentation

The Test Documentation shall comprise of a schedule of agreed and approved tests. All test specification documentation shall comprise two sections.

1. **A narrative Section**, this shall detail the aims and objectives of the test, how the test is to be implemented and what test results are anticipated.
2. **A results section**, this shall document all stages of the test and the results obtained. Each stage shall be signed off by the test witness as appropriate.

### 9.2.7 Test Duration

It is the responsibility of the vendor to make all the arrangements for the personals carrying out FAT including Boarding & Lodging, Foods, and Travelling etc.

FAT shall be held in manufacturers/Packager's foreign facility. FAT shall be commenced for at least ten (10) working days excluding traveling period for (02) Two OGDCL Engineers However, if SCADA system manufacturer/packager's deems, the duration can be extended beyond ten (10) working days as per recommendations.

All expenses related to two (02) OGDCL team's presences at FAT should be included in the base cost of SCADA system. This shall cover as minimum following items:

1. Visa Expenses and Approvals
2. Air Fare from Pakistan to FAT Site and Back
3. Boarding & Lodging / Hoteling and Transportation of two officials at foreign FAT Site
4. Expenses against TA/DA which shall not be less than US \$350/day/person for minimum 10 **working days and travelling time** (10 working + 02 travelling days).
5. FAT staging facility etc.
6. Presence to competent vendor personnel to carry out the FAT

### **9.3 Site Acceptance Test (SAT)**

The supplier shall submit a complete plan for the Site Acceptance Test to Client. This plan must be complete and have 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:

- A complete repeat of the FAT.
- Full loop tests of all input / output to the field equipment. Supplier's responsibility limited to functional test for SCADA and Telemetry system or limited to Supplier Scope of Supply.

### **9.4 Sustained Performance Test (SPT)**

A Sustained Performance Test (SPT) for the system shall be conducted by the Vendor. 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 the problem in a timely manner. The tests commence when the systems start to control and monitor a portion of the process.

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 not more than one 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. It is compulsory for vendor's engineers to be present at site during at least one third of the SPT duration. However, in case of any fault, Vendor will immediately mobilize his engineer to site for rectification of the problem.

## **10. TRAINING**

### **10.1 OEM Basic to Advance level Training**

It is the responsibility of the vendor to make all the arrangements to carry out Basic to Advance level training to OGDCL Engineers. The trainer shall provide hands on training in English. The training shall include engineering, design, software/ configuration development, modification,

operation and maintenance/ troubleshooting procedures of SCADA and Telemetry system.

Training contains minimum following fields:

- Engineering and Designing concepts of SCADA & Telemetry systems;
- Software development skills of RTU, Radios, MTU, Server, Networking;
- HMI Development;
- Solar power system operation and maintenance;
- Integration of SCADA & Telemetry system philosophy;
- Overall software and hardware configuration, maintenance and troubleshooting;
- Interfacing of primary & secondary instrumentation;
- And 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.

Engineering training shall be provided to allow engineers to maintain and fault-find the SCADA system at both the hardware and software level.

Outstation hardware training shall be to board level diagnostics and replacement, the training shall encompass demonstrations and workshop practical.

This training shall be conducted at OEM well established and fully equipped with training resources foreign training center. OGDCL keeps the right to accept the suggested training center or to direct vendor/packager to comply with required standards.

OGDCL will send selected three (03) SCADA / Telemetry Engineers who shall be trained on the SCADA system and other associated systems of same type or equivalent SCADA system Simulators. It shall be noted that vendor shall submit the training schedule well before commencement of training.

Vendor shall include all training costs in the price for SCADA system. Training duration shall be of at least two (02) weeks or 10 working days excluding travelling time.

All costs related to training should include (but not be limited to) following items as minimum:

1. Visa Expenses and Approvals
2. Air Fare from Pakistan to OEM/vendor foreign Training Site and Back
3. Boarding & Lodging/ Hoteling and Transportation at Training Site
4. Expenses against TA/DA which shall not be less than US \$350/day/person for minimum 10 working days and travel time (10 working + 02 travelling days + any holidays during the stay).
5. Training facility etc.

6. Presence of competent trainer to carry out the training

## **10.2 Training at Site**

The Packager / Vendor shall provide the on-site training services for operation and maintenance for all required disciplines to OGDCL personnel. The training shall include both class room and on-field modules. The Packager / Vendor shall submit the on-site training for at least 05 working days. The Packager / Vendor shall submit the price in commercial proposal on lump sum basis. The Packager / Vendor shall provide the training details with bid document.

## **11. SCADA SUPPORT AND AFTER SALES SERVICES**

The SCADA and Telemetry supplier shall guarantee the confirmation of the availability of SCADA and Telemetry hardware / software support regarding technical services and spares for at least Ten (10) years.

SCADA and Telemetry vendor shall provide the full support during Engineering, configuration, commissioning phase.

SCADA and Telemetry vendor shall provide support for the full operation of the SCADA and Telemetry system as per the satisfaction of Client.

Any up gradation in software, hardware and firmware shall be providing free of cost within a warranty period and SCADA and Telemetry vendor shall also provide assistance for the implementation of upgrading the system.

SCADA and Telemetry vendor shall also ensure the availability of 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 system.

### **11.1 Commissioning Support and Site Services**

The Vendor shall provide the service for the system installation, start-up, pre-commissioning, Commissioning, testing, troubleshooting and successful handover of the system.

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

### **11.1.1 Commissioning**

The Vendor shall prepare a commissioning procedure to be issued to Company for review and approval.

Commissioning shall include, but is not limited to, the following:

1. Loop testing
2. Systems power up and functionally tested with appropriate test equipment;
3. Field instruments shall be powered up and checked out with diagnostic routines;
4. Communications shall be established between all components of the systems and tested.
5. Vendor shall provide any special tools required for installation and commissioning.

SCADA vendor/packager shall be responsible for complete functionality of the system as desired.

All services to make the system functional will be the responsibility of SCADA system vendor/packager irrespective of whether those services are specifically mentioned in this document or not mentioned.

### **11.1.2 Site Services**

The Packager / Vendor shall install, test and commission the system.

Packager / Vendor shall provide all the necessary tools, test equipment, consumable, installation, testing and commissioning of the system. Packager / Vendor shall perform the system acceptance test in the presence of Company's representative.

Packager / Vendor shall submit to Company a comprehensive field acceptance test plan at least 14 days prior to commissioning. The plan shall include but not be limited to details of test to be conducted, test equipment required and test data to be recorded.

An acceptance test report complete with details of all tests performed, faults encountered taken shall be submitted to Company within 2 weeks after the commissioning of the system.

## **11.2 Final Acceptance**

The system shall be accepted when the equipment is complete in every detail including spares and documentation, and the Company's site resident engineer is satisfied that the equipment has met the requirements of this specification through the completion of the sustained performance tests.

## **12. WARRANTY**

Supplier shall have final and total responsibility for the Design, Engineering, Procurement, Installation, Commissioning and performance of the SCADA, Telemetry, associated systems and sub systems supplied under EPC Contract. Supplier shall warrant the designing, materials, construction and performance of the SCADA, Telemetry, associated systems and sub systems.

The supplier shall have to provide the warranty/guarantee for faultless functioning of the unit of Twelve (12) months from the date of commissioning or 18 months from the date of supply whichever is earlier that covers "Free of cost repair/maintenance or procurement and installations of parts/ equipment/system.

The supplier shall be responsible for 100% warranty/guarantee for replacement of any part/ equipment/ system or any other associated equipment become faulty or out of order during installation, commissioning, performance testing or during specified warranty/guarantee time period.

## **13. DIAGNOSTIC**

Diagnostic of system and related equipment & accessories shall be available to Engineering Workstation and Data Servers.

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. SPARE PARTS**

The supplier shall provide all required spares for successful commissioning of SCADA & Telemetry system.

### **14.1 MINIMUM INVENTORY SPARE HARDWARE**

Following minimum spares should be provided with the system. Lump sum price offered by SCADA system vendor/packager shall include these spares (Total financial price will be calculated including the price of commissioning spares and minimum inventory spares).. It should be noted

that these spares are required by OGDCL to maintain its own inventory. These spares shall not be confused with start-up & commissioning spares and two years operational spares.

#### **14.1.1 Wellhead Hardware:**

<b>Sr. No.</b>	<b>Required Spare Hardware</b>	<b>Quantity</b>
1	DI Module	04
2	DO Module	04
3	AI Module	04
4	AO Module	04
5	Communication Module (Each type)	04
6	Processor (Pre-programmed with complete Project applications)	04
7	Power Supply	04
8	Solar Charge/ load Controller (Pre-configured)	08

#### **14.1.2 Radio Hardware:**

<b>Sr. No.</b>	<b>Required Spare Hardware</b>	<b>Quantity</b>
1	Remote Radio Transceiver (Wellhead) (Pre-programmed with complete Project applications)	03

### **14.2 Start-Up and Commissioning Spares**

The Vendor shall supply spare parts for start-up and commissioning. These will be required in order to avoid un-expected delays in project commissioning. The Vendor must take into consideration the remoteness of Site when deciding which spares and what quantities are offered. It shall be noted that these spares are in addition to minimum hardware spare which are mentioned in the section above.

Start-up and commissioning spares are part of the project and their price shall be included in lump sum price offered by vendor/packager.

### **14.3 Two Years Operational Spares**

The Vendor shall submit in his bid a separately itemized price list of recommended spares for two (2) years operation along with all the necessary information including part numbers, serial & model nos. etc. Same will not be included in financial evaluation.

Price of two years spares should be quoted as optional. OGDCL reserves the right to make the decision about the purchase of two years operational spares (Total financial price will be calculated including price of commissioning spares).

### **15. BOQ LIST FOR SCADA SYSTEM**

Following is tentative BOQ for overall SCADA system. However, this BOQ is for indicative purpose only. SCADA system vendor/packager shall be responsible for providing all equipment which deemed necessary for a fully functional SCADA system. However, all equipment shall be complied with the guidelines and specifications mentioned in this document.



S.No	DESCRIPTION	Unit	Qty.	Unit Cost	Total Cost	Vendor Compliance (Yes/No)
<b>CCR Setup for SCADA Control system</b>						
<b>1</b>	<b>All necessary licensed software including (but not limited to;</b>					
1.1	Addition of Tags in Existing Redundant SCADA servers. OEM order code for additional 1000 tags license is 3BSE061236R2	Nos.	02			
1.2	Addition of Tags in Existing Historian Server OEM order code for additional 1000 historian tags license is 3BSE061267R1.	Nos.	01			
1.3	OPC Server Software for integration of new RTUs with Existing SCADA Layer OEM order code for additional OPC Server license is 3BSE061242R1.	Nos.	01			
1.4	Addition of One new OWS in existing SCADA Layer OEM order code for one additional OWS license is 3BSE061255R1.	Nos.	01			
1.5	Software for 02 Portable Configuration Machines / EWS Laptops	Package	02			
1.6	Software (if required) for radio communication equipment (to be integrated with existing base radio)	Package	01			
1.7	Software for configuration/calibration of field instruments	Package	01			
1.8	Latest OS and Anti-Virus (to be supplied with each new Server/workstation/laptop)	Package	01			
1.9	Office tools and Adobe PDF for One new OWS	Package	01			
1.10	Any other software required for complete and desired functionality of SCADA system	Package	01			
<b>2</b>	Portable EWS / Configuration machines (Laptop) Core i7 (7th Gen or better) 2.1GH RAM 08 GB Storage: 500GB 7.2k rpm SATA with minimum 17" full HD Color LED Display.	Package	2			

<b>3</b>	<p>Workstation Machine for One new Operator workstation (OWS)</p> <p>Intel Xeon E5-1607v3 3.1GHz, 10 MB/1866Mhz 4C</p> <p>RAM: 8 GB DDR4</p> <p>2 x 500GB 7.2k rpm SATA</p> <p>Default RAID 1. Mirrored Array Configuration</p> <p>9.5mm Slim SuperMulti DVDRW</p> <p>01 Nvidia Quadro K620 2GB DL-DVI+DP (Enables usage of 2 displays)</p> <p>Enclosure: Tower</p> <p>Integrated Intel I218LM PCIe GbE, 1P RJ-45 NIC (1 Port)</p> <p>External NIC: 1 x Intel Ethernet I210-T1 PCIe NIC (1 Port)</p> <p>6 USB 3.0 Ports</p> <p>Key Board: Yes</p> <p>Mouse: Yes</p>	Package	1			
<b>4</b>	<p>Server Machines for Two OPC/PLC Connect Servers</p> <p>Intel i7</p> <p>RAM: 8 GB DDR4</p> <p>500GB 7.2k rpm SATA</p> <p>SuperMulti DVDRW</p> <p>01 Nvidia Quadro K620 2GB DL-DVI+DP (Enables usage of 2 displays)</p> <p>Enclosure: Rack Mounted</p> <p>Integrated Intel I218LM PCIe GbE, 1P RJ-45 NIC (1 Port)</p> <p>External NIC: 2 x PCIe Dual Port Gigabit NIC (2 Port)</p> <p>6 USB 3.0 Ports</p> <p>Key Board: Yes</p> <p>Mouse: Yes</p>	Package	2			
<b>5</b>	<p>Network Cabinet for new OPC/PLC Connect Servers, with PDU</p> <p>(Complete with all accessories)</p>	Package	1			
<b>6</b>	<p>Networking Equipment at CCR:</p> <p>Ethernet Switches</p> <p>Additions/Modifications in Server Cabinets</p> <p>Network Cable / Cords</p> <p>Networking Accessories (as required)</p>	Package	1			
<b>7</b>	<p>Cyber / Network security equipment required to connect SCADA system with PDMS as required (including but not limited to firewall DMZ, Managed switch/ router etc.</p>	Package	1			
<b>Remote Terminal Units</b>						

8	Complete RTU/PLC (Remote), SIL 2 certified by TUV, equipped with CPU (04 MB), Power Supply, I/O modules, communication module, featured with AGA-3 calculation etc. Input Voltage 24V DC, Approved for Class I Division 2 Group A,B,C,D Hazardous Locations, Temperature: 0 °C to 60 °C (For more detail please see para 7.1)	Package	11			
9	RTU Enclosure with Door Handle and Lock, Door Pocket, Door Switch, Panel Light, Mounting Frame Material: Stainless Steel (SS-304), Degree of Protection: IP 66 / NEMA 4X. (For more detail please see para 7.1.8)	EA	11			
10	RTU Panel shelter, mounting frames and installation material (For more detail please see para 7.1.7)	EA	11			
9	Bulk material for RTU Panel installation, Accessories (Panel wirings/ terminations, MCB, Lugs, Rails, Single Tier Fused and Feed Through Terminal Strips, Relays for complete DO channels, Tags, Ducts etc.).	EA	11			
11	Ethernet switch 04 Ports, DIN Rail Compatible Temp: -10 C to 60 C	EA	11			
12	Emergency field mounted explosion proof 24 Vdc LED light fixtures for RTU sheds to provide adequate light for troubleshooting night time jobs.	EA	11			
<b>Radio Communication Equipment</b>						
13	Wellsite Radio transceiver, along with Software	EA	11			
14	Radio Transceiver Antenna and Respective Cable (from Antenna to Transceiver)	EA	11			
15	Poles/Towers including any support accessories for Radio Transceiver (Height of Poles/Towers will be as per Radio study done by contractor)	Package	11			
<b>Transmitters / Sensors</b>						
16	<b>Static Pressure transmitters</b> , Pressure Range <b>0~2000 psi</b> , Output = 4–20 mA with Digital Signal based on HART Protocol, Process Connection Wetted Parts Material = 316L SST, LCD Display, Mounting Bracket for 2" Pipe, Complete with 2/3- Valve Manifold. (For more detail please see para 7.8.1 )	No.	14			
17	<b>Temperature Transmitter</b> with RTD sensor transmitter and Thermo well, Range: 0-200°F Output= 4–20 mA with Digital Signal Based on HART Protocol, Product Certifications=FM Explosion-Proof; Dust Ignition Proof, LCD Display, calibration certificate, Thermo well material: SS-316, Thermo well immersion length: vendor recommended for 4" Pipeline Complete with 3-Valve Manifold. (For more detail please see para 7.8.2 )	No.	11			

18	<b>Gas Flow/ Differential Pressure Transmitter</b> , Transmitter Type = Coplanar Pressure Transmitter, Differential Pressure (DP) Range = <b>0- 300 in H2O</b> at O.P=2000psi, volumetric Flow 20 MMSCFD. Transmitter Output 4–20 mA with Digital Signal based on HART Protocol, LCD Display, Mounting Bracket for 2" Pipe, Product Certifications FM Explosion-Proof, Dust Ignition-Proof, Complete with 5-Valve Manifold. (For detail please see para 7.8.4 )	No.	11			
19	<b>Instrument air pressure transmitters</b> , Pressure Range = <b>0-450 psi</b> , Transmitter Output = 4–20 mA with Digital Signal based on HART Protocol, Process Connection Wetted Parts Material = 316L SST, LCD Display, Mounting Bracket for 2" Pipe, Complete with 2/3-Valve Manifold. (For more detail please see para 7.8.2)	No.	11			
20	<b>Pressure Gauge</b> Range <b>0-10000 Psi</b> , liquid Filled with Isolating valve/ manifold, Explosion proof, material 316 SS for wetted parts, 304 SS for case and bayonet ring (NACE compliance) Class 1 Div 1 / ATEX Ex II 2G Ex d IIB / UL / IECEx, Gauge dial Size 5-6 inch. (For detail please check para 7.8.7 )	No.	11			
21	<b>Pressure Gauge</b> Range <b>0-2000 Psi</b> , liquid Filled with Isolating valve/ manifold, Explosion proof, material 316 SS for wetted parts, 304 SS for case and bayonet ring (NACE compliance) Class 1 Div 1 / ATEX Ex II 2G Ex d IIB / UL / IECEx, Gauge dial Size 5-6 inch. (For detail please check para 7.8.7 )	No.	33			
22	<b>Pressure Gauge</b> Range <b>0-450 Psi</b> , liquid Filled with Isolating valve/ manifold, Explosion proof, material 316 SS for wetted parts, 304 SS for case and bayonet ring (NACE compliance) Class 1 Div 1 / ATEX Ex II 2G Ex d IIB / UL / IECEx, Gauge dial Size 4 inch. (For detail please check para 7.8.7 )	No.	11			
23	<b>Low Pressure pump</b> Ametek Model T-965-CPF or equivalent Pressure range – <b>25 IWC to 30 psi</b> along with all connection sizes BSF, NPT standards, Hose pipe, Bonded seals, O-Ring lock up clips, protective Vinyl cap and accessories.	No.	05			
24	<b>High Pressure pump</b> Ametek Model T-620-CPF or equivalent Pressure range – <b>25 IWC to 30 psi</b> along with all connection sizes BSF, NPT standards, Hose pipe, Bonded seals, O-Ring lock up clips, protective Vinyl cap and accessories.	No.	05			
25	<b>Solenoid Valve</b> 3 way SOV, 3 port 3/8" with 24 VDC coil, explosion proof, For SSV S/D (For detail please check para 7.8.9)	No.	11			

26	<b>Fire (IR Flame) Detector</b> , Maximum Range: 60m, Sensor Type: Multi-Spectral IR (MSIR) Sensor, False alarm immunity, Input Power: 20 ~ 36 VDC, IP Rating: IP66/67, Alarm Output = Dual Modbus - 0-20ma/ Relays, W/Mounting Bracket, Approvals CSA/FM/UL/ATEX/IECEX (GMIL), Class I, Div 1, Groups B, C, D & Class II, Div 1, Groups E, F, G (Temp = -10°C to +70°C)	No.	11			
27	Calibration Torch for Fire (IR Flame) Detector (Complete with all calibration accessories)	No.	1			
28	<b>Combustible Gas Detector</b> , Sensor Type: Continuous Diffusion Low Temperature Catalytic Bead, Three-Digit LED Display With Gas Concentration, Measuring Ranges: 0 ~ 100% LEL, Input Power: 24 VDC, Class I, Division 1, Groups B, C & D; (Temp = -10°C to +70°C)	No	11			
29	Calibration Gas Cylinder for Combustible Gas Detectors (Complete with all calibration accessories)	No	1			
30	<b>Beacon Light</b> , Color: Red, Voltages DC: 24 VDC, Approval: Flameproof/Exd/Zone 1 & Zone 2, Ingress protection: IP66, Glass lens & Stainless Steel Guard complete with installation and mounting.	No.	11			
31	<b>Sounder</b> , Voltages DC: 24V DC, Ingress protection: IP66/67, Color: Red Housing, Multi-tone, Approval: Flameproof/Exd /Zone 1 & Zone 2 complete with installation and mounting	No.	11			
32	<b>Hand-Held HART Communicator</b> latest Emerson Model 475 series or equivalent with touch screen Wide Screen LCD, Certified for Intrinsic Safe (Exia) areas according to ATEX, FM, UL for SMART field instrumentation (PT., TT & FT/DPT) shall be supplied with this package for configuration, maintenance and troubleshooting	Set	3			
33	<b>Pressure Calibrator</b> , Fluke 725 or equivalent multifunction calibrator or equivalent, with Pressure Modules (Range: 0 PSI to 10000 PSI), Hydraulic Test Pump (10,000 psi) with Hydraulic Test Hose and Pressure Relief Valve Kit.	Set	5			
34	Poles (complete with all accessories) for installation of F&G detectors / Sounders / Beacons (Height: At least 12 feet above civil foundation) (Sounder and Beacon will be on same pole)	EA	33			
<b>Solar Power System</b>						
35	Complete Photovoltaic solar power system including PV module array Array size calculation will be based on load calculation and spare capacity (For more detail please see para 7.7 )	Package	11			

35	Redundant Solar Charge Controller / Load Controllers, Charge Mode: 4 Stage (Bulk, Absorption, Float, Equalized).	Set	11			
36	24 VDC maintenance free dry batteries for Solar backup power, 48 hour backup time (Set)	Set	11			
37	Battery Box, Degree of Protection: NEMA 12, with Heavy Duty Key Lock and Ventilation/ Breathing Glands	Package	11			
38	Solar Power Voltage Transmitter Output = 4–20 mA Input = 20-30 VDC (For more detail please see para 7.8.5 )	EA	11			
40	Array Combiner Box with NEMA 4X Enclosure	EA	11			
41	NEMA 4X SS Enclosure for Charge & Load Controllers	EA	11			
42	Metallic Solar PV Module Frame, Size: As per Solar PV Modules Dimensions (including all mounting accessories) Drawing will be approved by OGDC prior to construction.	Package	11			
43	Power Distribution Board with associated wiring & Accessories with protection system for Solar System		11			
44	Certifications: ISO9001, OHSAS18001, ISO14001	Set				Complete compliance
<b>Cables &amp; Accessories</b>						
45	12 Pair Armored Control Cable for Connecting Field JB (Digital) to RTU / PLC, Panel. Class 2 Stranded Plain Cu 1.5mm <sup>2</sup> , Cable Construction: XLPE/IAM/CAM /LSZH/SWA BLACK 500V Conductor Pairs shall be as per standards and As build wiring diagrams.	Meter	1100			
46	12 Pair Armored Control Cable for Connecting Field JB (Analog) to RTU PLC Panel. Class 2 Stranded Plain Cu 1.5mm <sup>2</sup> , Cable Construction: XLPE/IAM/CAM/LSZH/SWA BLK 500V	Meter	550			
47	Single Pair Armored Control Cable for Connecting Process instruments to Digital and Analogue JB. Class 2 Stranded Plain Cu 1.5mm <sup>2</sup> , Cable Construction: XLPE/IAM/CAM/LSZH/SWA BLACK 500V Conductor Pairs shall be as per standards and As build wiring diagrams.	Meter	4400			

488	02 Pair Armored Control Cable for Connecting F&G instruments to Digital and Analogue JB. Class 2 Stranded Plain Cu 1.5mm <sup>2</sup> , Cable Construction: XLPE/IAM/CAM/LSZH/SWA BLACK 500V Conductor Pairs shall be as per standards and As build wiring diagrams.	Meter	1500			
49	6-AWG (13.3 mm <sup>2</sup> ) high-strand-count wire Instrument Grounding Cable, PVC insulated	Meter	275			
50	Complete Set of Electrical Cables for Power Requirement (Solar System and RTU Power Cables)	Meter				As per drawing/ Vendor recommend ed lengths
51	Explosion proof Cable glands/Stopping plugs, Terminal block conduits (Lot) /accessories	Lot	1			
<b>SS Tubing , Fittings, Connectors</b>						
52	S.S Tubing, Size: 1/4" T X 0.065" WT, TP316L/316 S.S, Seamless to ASTM A-269	Meter	500			
53	S.S Tubing, Size: 3/8" T X 0.049" WT, TP316L/316 S.S, Seamless to ASTM A-269	Meter	500			
54	S.S Tubing, Size: 1/2" T X 0.049" WT, TP316L/316 S.S, Seamless to ASTM A-269	Meter	500			
55	Miscellaneous Connectors, Fittings with ferule/accessories, high pressure material SS-316 various sizes (1/4", 3/8", 1/2")	Lot/ Nos.	500 each			
56	Isolating valves / block valves various sizes (1/4", 3/8", 1/2") high pressure, material SS-316	Lot/ Nos.	150 each			
57	Instrument air High Pressure regulators Input range 0-3000 Psi, Output range 0-1500 psi	EA	11			
58	Instrument air Low Pressure regulators Input range 0-1500 Psi, Output range 0-500 psi	EA	11			
<b>Explosion proof S.S Terminal Junction Boxes</b>						
59	Explosion proof S.S Terminal Junction Boxes (Separate for Digital and Analogue Signals) Size: 300 W x 300H x 150 D (mm), Approval: ATEX Approved /Class I, Division II, Group G. Hazardous Area, Material: SS-304, IP 66. Complete with all Accessories (TBs, DIN Rails, Glands, Markers, Tags etc.) (For more detail please see para )	EA	22			
60	Mounting Structure and All Accessories for Installation of JB's	Lot	22			
<b>Spares</b>						
61	Commissioning Spares	Package	1			
62	Minimum Inventory Spares (For more detail please see paras 14)	Package	1			
<b>Services</b>						

63	Configuration, Settings, Programming, Application Preparation, Graphics and Logic Services, Integration Settings, Implementation of Control Strategies /C&E, (and other desired services) for SCADA System at CCR and remote 11 wells including (but not limited to): SCADA Redundant Servers /OWS Stations /EWS Stations /Historian Station /Networking Equipment /Existing Master Radio Additional OWS/Additional Redundant OPC Servers RTUs, Solar Systems, Remote Radio Systems Field and F&G, Field Instrumentation, Any other associated systems detailed at <b>Annexure-Z</b> regarding Scope, Specification & T&C .	L.S.	1			
64	Preparation (including all required revisions) and Approvals of Complete Project Documentation	L.S.	1			
65	Completion Installation Services at CCR and well sites (including Mechanical, Electrical works, Cabling Laying & Terminations etc.) for complete SCADA/ Telemetry system at CCR and well sites	L.S	1			
66	Required modifications in existing WHCPs	L.S	1			
67	Commissioning, Integration, Troubleshooting, Startup, Inspection and Handover, SAT and any other required) Services	L.S.	1			
68	Performance Testing (for at least 72 hours)	L.S.	1			
69	Intermediate Project Progress Review Meeting: Meeting Location: Vendors foreign facility FAT Duration: 03 Working Days (excluding travelling time and holidays), Witness by 01 OGDCL Professionals (For more detail please see para 9.1 )	L.S	1			
70	<b>Factory Acceptance Test:</b> FAT Location: Vendors foreign facility FAT Duration: 10 Working Days (excluding travelling time and holidays), Witness by 02 OGDCL Professionals (For more detail please see para 9.2.1 )	L.S	1			
71	<b>Advance level Training for 03 OGDCL Engineers,</b> at Vendor's foreign facilities, Training Duration: 10 working Days (excluding travelling time and holidays) (For more detail please see para 10.1)	L.S	1			
72	<b>Training at Site:</b> Operational & Maintenance Level on-Site Local Training, Duration of Training: 5 Days for 10 OGDCL officials (For more detail please see para 10.2)	L.S.	1			



## **16. DOCUMENTATION**

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

The Packager / Vendor must provide the following documents as minimum at different stages of Project as mentioned below:

### **16.1 Documents to be submitted with Technical Bid:**

Packager / Vendor shall submit minimum following documents in the technical bid:

Literature and detail specification of offered SCADA & Telemetry systems including PLC/RTU Controllers, Radio, Communication equipment, Solar power system, Configuration machine/Laptop, I/O modules, Field instrumentation, Junction boxes, Panels, Conduits, connectors, Cable glands, Antenna, tower, Cables etc. and associated equipment to be installed at Well sites.

1. Design & Functional strategies of complete SCADA & Telemetry systems;
2. Equipment Datasheets with Make, Model & Ordering Codes;
3. Integration philosophy for complete SCADA & Telemetry System;
4. Details / C.V and TUV Certification of TUV Certified professionals who are on payroll of the bidder (or its local agent) and will be involved in RTU application development and site commissioning.
5. Literature and detail specification of offered SCADA & Telemetry systems Programming and configuration software;
6. Literature and detail specification of offered Primary/ Field Instrumentation;
7. Detailed Bill of Material (BOM) of all SCADA components;
8. Provision of general concept in terms of System PFD, Control System Architecture drawing, of the SCADA and Telemetry System;
9. Details for RTU cabinets (Dimensional Drawings, layouts,
10. Load List of well site equipment to be powered by solar power (approximate);
11. Project tentative schedule in which all project related activities should be covered;
12. List of Deviation (if any).

## **16.2 Documents to be submitted after Award of Project**

Packager / Vendor shall submit the following minimum documents for approval during Project review meetings:

1. Complete Project Schedule;
2. Details / C.V and TUV Certification of TUV Certified (at least 03) professionals who are on payroll of the bidder (or its local agent) and will be involved in RTU application development and site commissioning.
3. System Architecture Layout;
4. Single/ one line diagrams
5. Installation, Operation and Maintenance Manuals;
6. Pre-commissioning & commissioning manuals;
7. Literature and details of offered SCADA/ Telemetry hardware components.
8. Literature and details of offered SCADA software functionality /capabilities;
9. Cable sizing calculations;
10. UHF Radio Communication system layouts and Antenna, Tower arrangements;
11. Solar Power system layouts and arrangements;
12. Outline general arrangement drawing of solar array, batteries, isolators, distribution boards and controllers showing disposition of cable, connections, weight, etc.;
13. Load evaluation and solar module & battery sizing calculations;
14. Final Electrical Load List with equipment and system level segregation;
15. Loop/ IO wiring diagrams (from field to marshalling / controllers);
16. Power Distribution Drawings;
17. Termination Drawings;
18. Testing and inspection procedures/details;
19. System Generated Controller Loading Report;
20. HMI Snapshots;
21. Installation drawings;
22. Enclosures, Shelters, Panel Dimensional Drawings;
23. Control Panel General Arrangement Drawing;
24. Panel Internal Wiring Drawings;
25. Tagging details;
26. I/O Schedules details;

27. Logic Diagrams as per standard format;
  28. Electrical equipment and cable layout drawings;
  29. Detailed calculations to verify suitability of support structure to withstand wind velocity;
  30. Recommended spares list for 2 year operation;
  31. Other documents as per enquiry requisition;
  32. FAT procedure;
  33. SAT Procedure;
  34. Training Schedule;
  35. After successful completion of project, provision of Final version/ as build drawings \
- Final versions of application programs, Configuration files and complete backup of Project software.

## **17. OGDCL TERMS & CONDITIONS / INSTRUCTION TO BIDDER (ITB)**

### **17.1 Supply (Delivery) & Commissioning**

This contract is EPCC type, therefore Packager/Vendor shall supply (deliver) complete SCADA/Telemetry system, radio communication system associated systems, sub systems, Solar power systems, Field Instrumentation, Hardware, Software, Networking systems. Accessories, supplies and documentations in accordance with this Tender document. Detail of other relevant provisions of the contract are given as under:

- Supply (delivery) of SCADA / Telemetry system shall be made when it arrives at Karachi Sea Port / Project Site and all documentation specified at **para 16** shall be submitted to OGDCL.
- SCADA / Telemetry shall remain at the risk of the Packager/Vendor, until delivery has been completed.
- The Packager/Vendor shall provide complete project development plan, Installation & Commissioning, Testing and Training schedules before mobilization of Teams.
- The Packager/Vendor shall be responsible for the arrangements of preliminary Project review meetings well before starting of Project.
- The Packager/Vendor shall be responsible for the integration of proposed SCADA/Telemetry system with the existing SCADA system & equipment installed at Plant CCR. detail of existing system is given at **Annexure-A**.
- Packager/Vendor shall be responsible for installation & Commissioning of communication system at well sites and integration with existing Master (Base radio system) detail of

existing system is given at **Annexure-A**.

- Packager/Vendor shall be responsible for development, configuration and integration of logics, philosophies, HMI etc. for new SCADA/Telemetry system into existing SCADA & Telemetry system
- The Packager/Vendor shall be responsible for the arrangements of FAT, SAT, start-up, Sustained Performance Test & Trainings on lump sum basis. Every activity shall be clearly defined in numbers by the bidder in technical & financial bids.

**Note-1:** Civil works & Earth pits will be under OGDCL responsibility. This means that contractor will provide the design / drawings of all bases like RTU base, Solar structure base, poles & towers base etc. OGDCL will construct the bases (only civil related) as per vendor design. Supply and Installation of all equipment, material, Towers, structure, poles etc. will be vendor scope and responsibility.

**Note-2:** All proper sized mechanical tapping points for inline and online instruments will be provided by OGDCL..

**Note-3:** The supplier shall be responsible for any vehicle/machinery/equipment/tools required for proper installation of all equipment including in SCADA system. This also includes crane, excavator, fork lifter etc. Supplier should be foreseen and cost all such items in the lump sum price.

- The Packager/Vendor shall provide Statement regarding on time arrangements of expatriate by the bidder required for installation, commissioning, start-up & training activities.
- The Packager/Vendor shall provide Statement that the goods are "Brand New" (with OEM certificates. The old, obsoleted and refurbished supply will be rejected and all cost have to bear the bidder).
- Supplier shall clearly state how site support will be provided during the warranty period (Min. 12 months from Commissioning) and how long term service will be provided for the installed system.

**Note:** OGDCL shall provide boarding/lodging and foods at field to supplier's expatriates/specialists/engineers (only) involved in pre-commissioning, commissioning, startup, testing work and training at site of SCADA /Telemetry System.

- Whereas Supplier shall be responsible for boarding/lodging, foods and transport for pick & drop and other purposes etc. of their man power/ labors involve in the Project at site.

- OGDCL will provide security arrangement to the best possible extent accordingly, supplier in this connection will ensure OGDCL for on time arrangements of their expatriates, without making any arguments for security reasons.

## 17.2 Delivery Period

The timely delivery shall be the essence of the Contract, as OGDCL has to meet its obligations for completion of the Project. Accordingly, the Supplier is required to complete the Engineering, Design, Manufacturing, procurement and Supply Supervisory Control & Data Acquisition (SCADA) and Telemetry System within **five (05) months** for all the items on at Karachi Sea Port / Project Site on CFR Karachi basis from the date of establishment of letter of credit by OGDCL.

**Note:** Bidder shall mention firm delivery period and submit schedule with target delivery date(s) with work/delivery schedule starting from the date of establishment of L/C.

The Packager/Vendor shall also complete the Installation & commission the SCADA / Telemetry system along with all associated systems, sub systems within period of three (03) months after project site made available by OGDCL. OGDCL in this connection shall issue a notification and Supplier will mobilize within two (02) weeks' maximum time of this notification at Project Site for starting of installation & commissioning of SCADA & Telemetry system activities.

## 17.3 Eligibility Requirements

- Bid must be prepared carefully in accordance with the complete Tender document and ITB
- Compliance to the tender scope of work by providing clause-by-clause commentary on the Technical Specifications.
- The Bidder (Foreign or Local Entity, to whom contract will be awarded) / Packager/Vendor must have Eligibility, **technical qualification, experience, certifications** and capabilities in **EPCC type** contract or Engineering/ designing installation and successful commissioning of complete SCADA / Telemetry systems in all aspects
- Bid package must accompany bid bond in original. Bids without bid bond will be rejected.
- The Bidder must be registered with PEC (Pakistan Engineering Council) in category:
  - Local Entity: C4/O4 or above
  - Foreign Entity: FC1 or above.
- The Bidder (Foreign or Local Entity, to whom contract will be awarded) / Packager/Vendor must have supplied, installed and commissioned five (05) similar capacity SCADA or Control System projects of worth Rs. 25 Million or Above in last 10 years. Bidder must submit relevant client information and documentary evidence in this regard e.g. P.O, Contract or Final

Acceptance certificate etc. on specified format placed at **Flag-C** Projects without documentary evidence shall not be considered.

- The Bidder (Foreign or Local Entity, to whom contract will be awarded) must possess at least **10 years** of total experience in business (in similar nature of projects) specially with renowned and leading E&P companies.
- Bidders Letter of incorporation must be submitted with the bid package.
- Previous track record of the bidder / Packager and performance of equipment(s) will also be considered for technical evaluation.
- The Bidder (Foreign or Local Entity, to whom contract will be awarded) / Packager/Vendor shall possess following mentioned certificates in its own name and these must be submitted with technical bid in order to prove its commitment and knowledge of industrial automation and standardized project execution. CSIA certificate shall be verifiable online.
  - i. CSIA certified member certificate
  - ii. ISO 9001 Certificate
  - iii. ISO 14001 Certificate
  - iv. OHSAS 18001 Certificate
- Project scope includes F&G safety instrument and their interconnection with RTU and also Emergency Shutdown of the wellhead both locally and from remote SCADA control room therefore it is mandatory that application development of RTU should be done by TUV certified safety system engineer. **TUV certificate** of at least (03) Engineers with their resume shall be shared at bidding stage for evaluation. Engineer holding the TUV certification shall be either employed by bidder or its local agent is acceptable. Any freelance engineers or engineers employed by some entity other than bidder or local agent is not acceptable.
- All RTUs shall be **SIL-2** certified. In this regard, bidder to submit TUV SIL-2 certificate of quoted model in technical bid.
- Packager/ Supplier shall provide **Original Authority/Support letters** issued by the manufacturer to bidder and to local agent, not only for quoting their product but also for declaration of back-up services regarding repair & maintenance, trouble shooting and supply of optional accessories or spare for quoted product.
- Bid must be prepared carefully in accordance with the complete Tender document and ITB
- Compliance to the tender scope of work by providing clause-by-clause commentary on the Technical Specifications.

- Bid must be quoted for complete scope of supply as per **para 4** of this tender document.
- Bidder / Packager/Vendor must have Eligibility, technical qualification, experience, certifications and capabilities in **EPCC type** contract or Engineering/ designing installation and successful commissioning of complete SCADA / Telemetry systems in all aspects.
- Bidder / Packager/Vendor shall be responsible for compliance of the Codes & Standards as per tender document used for the Engineering, Manufacturing, Installation & Commissioning of complete SCADA / Telemetry system such as **ISO, API, ISA, IEC, etc.**
- Quality of proposed Project Execution organization and resource plan as per **ISO, API, ISA, IEC** & other certifications/accreditations.
- Bidder / Packager/Vendor Profiles and List of Customers/Buyers.
- Bidder / Packager/Vendor shall provide Technical details of Testing Facilities. Pre-Shipment Inspection and packing material details.
- Bidder / Packager/Vendor shall provide Project installation, Commissioning schedule.
- Bidder / Packager/Vendor shall be responsible for Warranty/Guarantee of whole SCADA / Telemetry and associated systems.
- Corporate and Financial information of Bidder / Packager/Vendor. Bidder to submit last 03 years financial statements with the bid on a specified format given at **Flag-D**. Average turnover of the bidder for last 03 years shall not be less than Rs.50 Million.
- Bidder / Packager/Vendor shall provide after sales Technical Support Capabilities.
- The equipment to be supplied under the Contract must be produced in and supplied from a country maintaining bilateral trade relation with the Islamic Republic of Pakistan.
- Bidder should not have been involved in any litigation or arbitration with Government of Pakistan or by any Public-Sector organization in which the final decision was against the bidder.
- Bidder should not have been black listed by Government of Pakistan or by any Public-Sector organization in Pakistan.

## 17.4 General Criteria for Summary Rejection of Bid

The Bids not meeting the following mandatory criteria shall be summarily rejected without right of appeal:

- i. Bids not prepared in English Language.

- ii. Bids without name, title, phone, fax and email address of the key person of Bidders for correspondence
- iii. Bids submitted without a Bid Bond.
- iv. Bids submitting later than Bid Closing Date and Time as per Tender Notice Published in newspaper.
- v. Bids not submitted in original.
- vi. Bids without Company's original letter head/pad.
- vii. Bids submitted in form of fax or email.

**Note:** OGDCL reserves the right to disqualify a Bidder / Packager/Vendor if it finds, at any time, that the information submitted by him concerning, his qualification as Bidder / Packager/Vendor was false and materially inaccurate or incomplete. Providing false information or violating the bidding requirements shall result in black-listing of Bidder / Packager/Vendor for three (03) years.

## **17.5 Joint Ventures/Sub-Contracting**

- JV arrangement is not acceptable. Only OEMs or OEMs approved packagers shall submit the bids for the supply of whole package. OEM's approved packagers must submit authorization letter from manufacturer.
- Sub-contracting arrangement for submission of bid is not allowed for any portion of work including design, Manufacturing, installation, commissioning supply, etc.

## **17.6 Assurance**

The successful Bidder shall be required to give satisfactory assurance of its ability and intention to complete the Design, Manufacturing, Supply, installation and Commissioning of SCADA and Telemetry System, pursuant to the contract within the time set-forth therein.

## **17.7 Amendments to Tender Document**

- At any time prior to the deadline for submission of Bids, OGDCL may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective Bidder, modify the Tender Document by amendment.
- The amendment shall form part of the Tender Document, and shall be notified in writing by fax or email to all prospective Bidders who have received the Tender Document, and will be binding on them.



- The Bidders are required to acknowledge receipt of any such amendment in the Tender Document.
- In order to provide prospective Bidders reasonable time in which to take the amendment into account in preparing their Bids, OGDCL may, at its discretion, extend the deadline for the submission of Bids.

## **17.8 Technical Bid/Proposal**

- Bidder / Packager/Vendor must share detailed project organogram showing dedicated experienced Project Manager and an experienced team. Resumes of entire team who will be involved in this project, shall be shared with OGDCL for evaluation.
- The prospective Bidder shall carefully study and examine the Tender Document and Instructions and comply with all requirements of preparation of the Bid. Failure to furnish all information required by the Tender Document or submission of a Bid not substantially responsive to the Tender Document in every aspect will be at the Bidder's risk and may result in the rejection of the Bid.
- Bidder / Packager/Vendor is bound to provide back-up services regarding repair & maintenance, trouble shooting and supply of all accessories and spares for next 10 years, declaration should be submitted with the bid.
- The SCADA and Telemetry offered by the Supplier must have local after sales service set-up for Pakistan.
- Drawings showing main equipment and general arrangement for SCADA and Telemetry System.
- Supplier/Manufacturer shall provide startup and commissioning spares required for SCADA/ telemetry and associated system.
- The Supplier/Manufacturer shall provide performance curve and data sheets for major equipment at operating points in technical specifications.
- List of spares for start-up and commissioning and minimum inventory spares. All spares for commissioning & start-up shall be covered. OGDCL shall not be responsible for any payment over and above the price indicated in financial bid.
- List of recommended personnel safety equipment to protect maintenance personnel and special tools.
- Detailed Bill of Material (BOM).

- The Bidder / Packager/Vendor shall submit a Level 1 Project Schedule in which all project related activities should be covered.
- List showing Scope of Supply & Services as per execution plan.
- The Bidder should confirm that during design period he will make plan to integrate the offered units with other units of plant and review of communication interface.
- Availability of spare parts of the equipment being supplied with country of origin along with lead time period and maintenance center(s) addresses, focus, e-mail to provide backup support.
- Additional required 2 years operational spares as mentioned at **para 14.3** are also required to be quoted separately with item wise price list which will not be included in financial evaluation but selection for order any of accessories/spares will be on OGDCL decision.
- Bidder / Packager/Vendor shall provide Warrantees / Guarantees of complete SCADA/Telemetry system as per **para 12** of Tender documents.
- Undertaking from the manufacturers for compliance of the warrantee liabilities (back-up guarantee), Interchangeability (free of cost including software may found corrupted) of parts and other after sale service obligations.
- Bidder/Manufacturer's confirmation that in case the equipment model becomes obsolete or OEM cease to manufacture the particular model, the supplier/bidder has to apprise well in advance and ensure to supply the spares sufficient for at least ten (10) years.
- Specific Quality Assurance and Quality Control procedures, which the Bidder intends to adopt/follow for equipment and manufacturing/ fabrication etc.
- Bidder/Manufacturer shall also be responsible for completeness of supplies of the material arrived at site before the installation of package, OGDCL nominated officials shall along with Supplier's representatives inspect and prepare report jointly that will be considered as final.

## **17.9 Commercial Bid/Proposal**

The following detailed information shall be necessarily submitted with the Financial Bid:

- Item-wise break-up and price of all major items of SCADA /Telemetry System as well as optional items.
- Supplier/Manufacturer shall provide Warrantees / Guarantees of complete SCADA system.

- Item-wise price list of spares for start-up and commissioning. All spares for commissioning & start-up shall be covered. OGDCL shall not be responsible for any payment over and above the price indicated.
- Item wise cost (as mentioned in BOQ vide **clause 15** must be provided by the bidder in its financial bid, otherwise its financial bid will be rejected. Bidder to submit written confirmation in technical bid that they have submitted item wise cost in financial bid..

## **17.10 Exception/Exclusion & Deviation**

- Bidders Proposals shall clearly state in a section clearly devoted for this purpose, all exceptions/exclusions to the requirements of these Instructions to Bidders including Form and Conditions of contract. For deviations or departure from technical specifications contained in the Tender document a list of such deviations should also be given. Any deviation/exception/exclusion found elsewhere (stated other than deviation list) shall not be considered and subject to automatic deletion/adherence with Tender Document if found, noncompliance in this regard may lead to rejection of bid.
- Bidder/Manufacturer must state any deviation from material or other standards specified. Separate list of proposed standards shall then be attached to the Bid indicating the appropriate standards proposed by the Bidder, stating in each case the comparable standards specified.

## **17.11 Bid Price**

The Contract shall quote on lump sum fixed price basis with full responsibility for Engineering, Design, Manufacturing, Supply, installation and Commissioning of SCADA/Telemetry System.

The prices shall be for complete scope and obligations detailed in this Tender Document. The quoted prices shall be firm and fixed for the Contract performance period and shall not be subject to escalation on any account.

The prices shall be quoted by the Bidder shall be at FOB and CFR basis.

The prices shall include all duties/taxes and levies payable on equipment, machinery and other items/services being supplied under the Contract in country of origin or exporting country and Supplier will assume full and exclusive liability on this account.

## 18. PREFERRED VENDOR LIST

Description	Vendor Name	Country
<b>1. Instrumentation &amp; Controls</b>		
<b>RTUs / MTUs/ PLC,</b> real-time database services communication infrastructure Work Stations, Printers, Cabinets	ABB	International
	Allen Bradley/ Rockwell	International
	Bristol Babcock	International
	CAC Baker	International
	Emerson Process Management	International
	Endress + Hauser	International
	GE Fanuc Automation	International
	Honeywell	International
	Modicon	International
	Schneider Electric	International
	Siemens	International
	Triconex	International
	Yokogawa	International
<b>HMI</b>	ABB	International
	Allen Bradley/ Rockwell	International
	GE Fanuc Automation	International
	Honeywell	International
	Iconics	International
	Wonder ware	International
	Siemens	International
	Yokogawa Electric Corporation	Japan
	Citect SCADA	International
<b>Radio &amp; Data Communication System</b>	ABB	International
	DATA-LINC	International
	MDS	International
	Motorola	International
	NEC Corporation	Japan
	NESIC	Japan
	Red-Line	International
	Rockwell Automation	USA
	Siemens	International
	TOA Corporation	Japan
	Trans Tel	Singapore
	3M	International
<b>IT/ LAN,</b> Personal Computers, Servers, Workstations	DELL / IBM / COMPAQ / HP/ Fujitsu/ Huawei	USA / UK

<b>Instrument Cables</b>	BATT	UK
	Belden	USA
	BICC Cables	UK
	DRAKA	Holland
	Erse Cablo	Turkey
	Kerpen	Germany
	Oman Cable	Oman
	Pirelli	Italy
<b>Fiber Optic Cables</b>	Clipsal	Australia
	Draka	Holland
	Fujikura	Japan
	Kerpenwerk	Germany
	Mesc	Saudi Arabia
	Pirelli	Italy
<b>Cabinet</b>	Rittal Hoffman	Germany USA
<b>Junction Boxes</b>	ATX	France
	CAEG Crouse-Hinds	Germany
	Chalmit	UK
	Emerson	USA
	Govan	Australia
	Hawke International	UK
	Killark	USA
	R. Stahl	Germany
	Technor - Italsmea	Italy
<b>Cable Glands</b>	ATX	France
	Clipsal	Australia
	CMP	UK
	Cooper Capri	Ireland
	Cortem	Italy
	Crouse Hinds / Cooper Industries	USA
	Hawke International	UK
	Peppers Cable Glands Ltd.	UK
	R.Stahl	Germany
<b>Terminal Blocks</b>	ABB Entrelec	Switzerland
	Phoenix	USA / UK / Singapore
	Weidmuller Klippon	UK / USA / Netherland

<b>2. Electrical</b>		
<b>Solar</b>	Apollo Solar	International
	BP Solar	International
	Deka	USA/ International
	GE-Energy	USA
	Kyocera Solar	Japan
	Samsung	International
	Solar craft	International
	SunWize	International
	Toshiba	Japan
<b>Power &amp; Control Cables</b>	A.G.E. Industries (Pvt.) Ltd.	Pakistan
	AEI	UK
	Ducab	UAE
	Newage Cables	Pakistan
	Oman Cables	Oman
	Pakistan Cables	Pakistan
	Pioneer Cables	Pakistan
	Pirelli	Italy / UK
	Saudi Cable	Saudi Arabia
<b>Protection Relays</b>	<b>ABB</b>	Germany
	<b>Allen Bradley</b>	Germany
	General Electric	USA
	Fast Cables	Pakistan
	Omron	International
	Schneider Electric	France
	Siemens	International
<b>I.S Barriers</b>	Elcon	Italy
	MTL	UK
	Papperl & Fuchs	Australia
	Stahl	Germany

**END**

List of Documents (Annexures and Flags)

**List of Annexures**

- |               |                                      |
|---------------|--------------------------------------|
| 1- Annexure A | Detail Specification of SCADA System |
| 2-            |                                      |