طرح نگهداشت و افزایش تولید 27 مخزن

INSTRUMENT & CONTROL SYSTEM DESIGN CRITERIA

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1.0 INTRODUCTION

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

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

GENERAL DEFINITION

The following terms shall be used in this document.

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

2.0 SCOPE

This document covers minimum necessary requirements for the design and selection of instrumentation and control/safety system of New Gas Compressor Station for the “Preservation and Production Increase of Binak oilfield”.

It shall be used in conjunction with data/requisition sheets for present document subject.

3.0 NORMATIVE REFERENCES

The Latest Edition of following codes & standard are applicable in this project:

3.1 LOCAL CODES AND STANDARDS

- IPS-E-IN-100 Engineering standards for general instrumentation
- IPS-E-IN-105 Instrument Workshop, Layouts, Test and Calibration Tools
- IPS-E-IN-110 Engineering standard for pressure instruments
- IPS-E-IN-120 Engineering standard for temperature instruments
- IPS-E-IN-130 Engineering standard for flow instruments
- IPS-E-IN-140 Engineering standard for level instruments
- IPS-E-IN-160 Engineering Standard for Control Valves
- IPS-E-IN-190 Engineering standard for Transmission systems
- IPS-C-IN-100 Construction and inspection standard for general instrument field inspection, calibration and testing of instrument and instrument system
- IPS-C-IN-110 Construction standards for pressure instruments
- IPS-C-IN-120 Construction and installation standard for temperature instruments
- IPS-C-IN-130 Construction and installation standard for flow instruments
- IPS-C-IN-140 Construction and installation standard for level instruments
- IPS-C-IN-160 Construction Standard for Control Valve
- IPS-C-IN-190 Construction Standard for Transmission Systems
- IPS-G-IN-200 General Standard for Instruments Air System
- IPS-I-IN-100 Inspection Standard for General Instrument Systems
- IPS-M-IN-110 Material and equipment standard for pressure instruments
- IPS-M-IN-120 Material and equipment standard for temperature instruments
- IPS-M-IN-130 Material and equipment standard for flow instruments
- IPS-M-IN-140 Material and quality control standard for level instruments

- IPS-M-IN-160 Material and Equipment Standard for Control Valve
- IPS-M-IN-190 Material and equipment standard for transmission systems
- IPS-G-IN-210 General standard for instrument protection
- IPS-G-IN-230 General standard for Analyzers

3.2 INTERNATIONAL CODES AND STANDARDS

- AGA American Gas Association
- IEC-60584 Thermocouples
- IEC-60529 Classification of Degree of Protection Provided by Enclosures
- IEC-60751, BS1904 Industrial Platinum Resistance Thermometer Sensors
- ANSI-MC 96.1 Temperature Measurement Thermocouples
- BS EN 837 Specification for Bourdon Tube Pressure Vacuum Products
- IEC 60079 Electrical Apparatus for Explosive Gas Atmospheres
- IEC 60144 Ingress Protection for Dust and Water Jets
- IEC 60079 (Relevant Sections) Code of Practice for the Selection, Installation and Maintenance of Electrical Apparatus for use in Potentially Explosive Atmospheres
- ASME VIII Unfired Pressure Vessels
- ANSI B1.20.1 Pipe Threads, General Purpose
- BS 1042 Measurement of fluid flow in closed conduits
- ISO 5167 Measurement of fluid flow by means of orifice plates, nozzles, and Venturi tubes inserted in circular cross- section, conduits running full
- NACE MR-0175 Sulphide stress cracking resistant metallic materials for oilfield equipment
- NACE RP-0775 Preparation, Installation, Analysis and Interpretation of Corrosion Coupons in oil field operation.
- ANSI B16.5 Pipe flanges and flanged fittings. inserted in circular cross section conduits running full
- API RP-521 Guide for Pressure-Relieving and Depressuring Systems
- API RP-526 Flange Steel Pressure Relief Valves

- API 527 — Seat Tightness of Pressure Relief Valve
- API-607 — Fire Test for Soft-Seated Quarter-Turn Valves
- API RP 550 Part I — Installation of Refinery Instruments and Control Systems
- ANSI/FCI 70-2 — Control Valve Seat leakage
- ANSI/ASME B16.36 — Orifice Flanges
- ASTM D3230 — Standard Test Method for Salts in Crude Oil
- ISA S.5.1 — Instrumentation symbols and identification
- ISA S.5.4 — Instrument Loop Diagrams
- ISA RP7.3 — Quality Standard for Instrument Air
- ISA S18.1 — Annunciators - sequences and specification
- ISA S.20 — Specifications forms for process measurement and control instruments, primary elements and control valves.
- ISA S75.01 — Flow equations for sizing Control Valves.
- ISA S75.02 — Control Valve capacity test procedure.
- ISA S75.03 — Uniform face to face dimensions for flanged globe type Control Valves.

IEEE (Inst. of Electrical and Electronic Engineers)

- IEEE-C62 — Guides and standards for surge protection.
- IEEE 802 — Local area networks
- IEEE-830 — Guide to software requirements specification.
- IEEE-1012 — Standard for software verification and validation plans.
- IEEE-1016 — Recommended practice for software design descriptions.

European Codes

- CENELEC — For electrical equipment in hazardous areas (for European Manufacturers only):
- EN 50.014 — General Rules
- EN 50.018 — Explosion-proof Equipment
- EN 50.020 — Intrinsic Safety Equipment
- EN 50019, 50039 — Electrical apparatus for potentially explosive atmospheres,

The latest published version or amendment shall apply unless otherwise stated.

3.3 THE PROJECT DOCUMENTS

- BK-GNRAL-PEDCO-000-PM-RT-0001 Endorsement Report For Basic Design
- BK-GNRAL-PEDCO-000-PR-DB-0001 Process Basis of Design
- BK-GNRAL-PEDCO-000-IN-SP-0001 Spec. For Instrumentation
- BK-GNRAL-PEDCO-000-IN-SP-0002 Spec. For Control System
- BK-GNRAL-PEDCO-000-IN-SP-0003 Spec. For ESD system
- BK-GNRAL-PEDCO-000-IN-SP-0012 Spec. For Fire and Gas System
- BK-GNRAL-PEDCO-000-IN-SP-0004 Spec. For Instr. & Control of Pack. Unit Syst.
- BK-GNRAL-PEDCO-000-IN-SP-0010 Spec. For Instrument& F&G Cables
- BK-GNRAL-PEDCO-000-SA-SP-0002 Spec. For Hazardous Area Classification
- BK-GNRAL-PEDCO-000-IN-SP-0009 Spec. For Fire & Gas Sensor and Devices
- BK-GCS-PEDCO-120-PR-PH-0001 Control philosophy
- BK-GCS-PEDCO-120-IN-DG-0002 Instrument Hook-up Diagram
- BK-GCS-PEDCO-120-IN-BD-0001 Control/ESD/F&G sys. Block Diagram Config.

3.4 ENVIRONMENTAL DATA

Refer to " Process Basis of Design; Doc. No.: BK-GNRAL-PEDCO-000-PR-DB-0001", for environment data and site conditions.

3.5 ORDER OF PRECEDENSE

In case of any conflict between requirements specified herein & the requirements of any other referenced document, this subject shall be reflected to CLIENT and the final decision will be made by CLIENT.

4.0 ABBREVIATION

Industry standard abbreviations shall take their usual meaning. Outlined herein are the most common, which may be used in this and other project documents:

CCR	Central Control Room
C&E	Cause &Effect
DCS	Distributed Control System
ESD	Emergency Shutdown System
EWS	Engineering Workstation
F&G	Fire and Gas
FAT	Factory Acceptance Test
FGS	Fire and Gas System
HD	Heat Detector

HVAC	Heat Ventilation and Air Condition
ITR	Instrument Technical Room
I/O	Input / Output
IS	Intrinsic Safety
LAN	Local Area Network
LCP	Local Control Panel
LEL	Lower Explosion Limit
MAC	Manually Alarm Call point
MCC	Motor Control Center
MMI	Man Machine Interface (Operator Interface)
MOS	Maintenance Over-ride Switches
OWS	Operator Workstation
PA	Public Address
PA/GA	Public Address/General Alarm
PC	Personal Computer
PCS	Process Control System
PLC	Programmable Logic Controller
QA	Quality Assurance
QC	Quality Control
SAT	Site Acceptance Test
SIL	Safety Integrity Level
UCP	Unit Control Panel
UPS	Uninterruptible Power Supply

5.0 CONTROL SYSTEM BASIS OF DESIGN

In this section, the basis will be expanded regarding the design of Process Control System, and separated Emergency Shutdown System and Fire and Gas Control System

The principle aims and objectives of the control and safety systems are:

- The protection of personnel
- Respect for the environment
- Safeguarding of the assets
- To ensure the plant is controllable
- To allow the safe start-up and shutdown of all plant and equipment
- To provide automatic protective action where deviation of plant variables could result in a hazard to personnel, environment or equipment
- To provide the operations personnel with sufficient information to allow the plant to be controlled safely and effectively.

The DCS system will implement all graphics in order to cover all aspects of normal plant operation, maintenance and engineering requirements of the facilities.

The objective in using such a configuration is to standardise the operator interface, configuration and hardware components. These systems shall integrate all instrumented systems to serve plant monitoring, control, safety and operations of the facilities.

The following control and safety systems which are completely independent from each other shall be provided:

- DCS based Process Control System
- F&G system
- ESD system

All Safety system inputs, outputs, secondary events and operator actions will be time stamped at I/O modules.

From control/Safety point of view there is no interface between new and existing facilities of Binak Compressor station. Only ESD status will be transmitted between new and existing ESD systems as an alarm.

5.1 GENERAL REQUIREMENTS OF CONTROL AND SAFETY SYSTEM

There will be a central control/protection/monitoring point for new trains of the '' Binak Compressor Station'' which will be located in a CCR/ITR in the new plant building. From this point of control it will be possible to monitor, control and take safety related actions covering the entire plant.

The Control Room will be continuously manned. It is from here that the overall operations for the whole facilities will be conducted.

DCS system shall be capable to provide AUTO\MANUAL function for all control loops. The AUTO\MANUAL soft-switch to be provided in DCS following to P&ID notes.

Some of the control actions will be carried out by local operators but all actions will be under the supervision of the CR operators. Adjacent to the Control Room will be a Technical Room that will house control system panels of entire Binak gas compressor station equipment and packages.

All equipment, laptop and other accessories shall be selected as industrial.

5.2 DISTRIBUTED CONTROL SYSTEM (DCS)

The principle aims and objectives of the DCS are:

- To ensure the plant is controllable
- To allow the safe start-up of all plant and equipment

- To provide the operations personnel with sufficient information to allow the plant to be controlled effectively.

A DCS (Distributed Control System) based Process control system should be considered for This Project. The DCS will implement all graphics in order to cover all aspects of normal plant operation, maintenance and engineering requirements of the facilities. The objective in using such a configuration is to standardise the operator interface, configuration and hardware components. The system shall have a seamless integration of all instrument systems to serve plant monitoring, control, safety and operations of the facilities.

5.2.1. DCS Network

The DCS shall have several levels of communication, typically as follows:

- I/O bus to connect DCS I/O modules to a central processor
- Industrial Ethernet LAN to connect DCS system to operator/engineering workstation and etc.
- Communication network to connect DCS to the other systems (serial link).In case of Type C Packages serial link shall be Modbus RTU

Communication system shall be composed of dual redundant high-speed LAN and dual redundant controller bus.

Operator stations and Engineering workstation shall communicate with each other and the other devices (e.g. Basic controllers, Multifunction controllers, Data acquisition Devices and interfaces) via redundant coaxial/ fiber optic cables.

Package operator work station (if any) shall be connected to dedicate UCPs via individual LAN communication network. Monitoring for packages which have no OWS will be done by DCS work station and all required data will be transmitted to DCS by serial link.

Switching capability from one to another one shall be both automatic and manual (selectable).The proposed LAN shall be a real time process control network with a bus type structure using the one of international industrial standard methods for line access. The data transmission speed of the LAN shall be at least 100 Mb/s.

The LAN shall have a minimum spare capacity (shall be approved by CLIENT) for data exchange rate.

5.2.2. System Performance

Targets for the DCS are as follows:

- **System network speed:** As fast as possible, generally of the order 100 Mb/sec. for

operator control networks, 100 Mb/sec for plant level control.

- **Display call up time:** In the shortest possible time, for display backgrounds and a further shortest possible time, for insertion of dynamic values.
- **Alarm presentation:** Visible at operator workstation within shortest possible time of detection at field interface.
- **Operator initiated action:** 2 seconds from key stroke to feed back of the response change of state of the controlled device on the screen.
- **Closed loop control response:** Max 2 seconds from key stroke to feed back of action the change of state of the controlled device on the screen.

5.2.3. Operator workstation (OWS)

The industrial PC based OWS shall be located at the Control Room. OWS assembly shall typically comprise:

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- Two dual 32'' industrial monitor workstations to be used for DCS systems with industrial keyboards and industrial Mouse which is configured for operation of DCS system by DCS vendor (all monitoring data for ESD and F&G is also present in DCS system and could be shown in DCS work station).
- Two 32'' industrial Single monitors workstations to be used for Gas Compressor package (provided by package vendor) with industrial keyboards and industrial Mouse which is configured for operation of all train of gas compressor package by package vendor.

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Note: EWS and OWS of ESD are common. (One system for both OWS and EWS) Also EWS and OWS of F&G system are common (One system for both OWS and EWS) and are located in engineering room. (Refer to part 5.2.4)

The system shall support at least four different levels of access control either via the use of a removable key and/or by entering a pre-configured password. It shall also be possible to configure user-specified functions to each level.

View only Level: This level shall facilitate 'View only' functions and will not require a key or password.

Operator Level: This level shall include typical operator functions and will require a key or password.

Supervisor Level: This level shall include all the operator functions as well as the pre-configured supervisory functions and will require a key or password.

Engineering Level: This level shall include all functions and will require a key or password.

Different type of keys shall be used for the operator, supervisory and engineering levels. Once removed, access shall revert to the 'View only' level.

Workstations for the OWS shall be of robust industrial design. DCS workstations shall be desktop PC-based from well-known manufacture's furnished with the latest modern technology and shall include:

- Central processing unit
- Operator keyboard & roller ball for operator workstation
- QWERTY industrial keyboard for Engineer level functions
- Industrial wide 32" LED monitor

Redundant network interface and memory storage device shall be considered for OWS Industrial PC.

Workstation shall be provided with readily accessible CD/DVD R/W and diskette drives. The operating system shall be last revision of Windows, unless otherwise agreed. The system shall have direct data exchange (DDE) and Object linking and embedding for Process Control (OPC) capability. At any workstation access to DCS/ESD functions at Engineer or Supervisor level shall be restricted by key or password security.

5.2.4. Engineering Workstation (EWS)

1 Individual industrial PC based engineering workstation for DCS shall be provided as a part of the vendor's scope of supply. EWS and OWS of ESD and F&G system are common and are located in Engineering Room of control building, and shall be used for development and configuration of the DCS network and associated devices. Workstations shall be provided with all necessary software and hardware locks.

The EWS shall retain the complete system database and all system configurations. Suitable configuration tools, including configuration software, manuals and guides required shall be supplied as a part of the Engineering station. Tools shall include standard PC software such as MS Office etc. The configuration tools shall be self-contained and shall not require any other software or tools to carry out configuration and display graphics development. Enough facilities, including software database and hardware provisions in I/O cards, shall be provided for remote calibration of transmitters through engineering station.

EWS shall be of robust industrial desktop PC-based from well-known manufacture's furnished with the latest modern technology and shall include:

- Central processing unit
- Operator industrial keyboard & industrial mouse for operator workstation
- QWERTY industrial keyboard for Engineer level functions
- Industrial wide 32" LED monitor

Redundant network interface and memory storage device shall be considered for EWS Industrial PC.

Also, Asset Management Service shall be considered in this EWS to apply calibration and HART management purpose.

The systems shall be supplied with one hand held HART communicators.

5.2.5. PRINTERS

As a general principle historical data shall be retained within the DCS, with printout on demand only. The printers shall be compatible with latest technology. The number of printers has been specified in Control/ESD/F&G sys. Block Diagram Config. Doc.No.BK-GCS-PEDCO-120-IN-BD-0001 and shall be connected to individual network and shall be in communication with DCS LAN.

5.3 ESD SYSTEM

ESD system shall be supplied as a safety system of the project. ESD system shall be high available and complete in all respects, including all required ancillary equipment necessary for the satisfactory operation of the systems.

Full redundancy, SIL 3 requirements shall be respected to design ESD system and it shall be suitable for safety applications and certified as such by TUV or equivalent recognized international authority. (IEC 61508 or DIN V 19250)

OWS and EWS assembly shall typically comprise:

- EWS and OWS of ESD are common and are located in engineering room.
- All monitoring data shall be also monitored by DCS work station.

Vendor's scope of work shall include all hardware, software, fabrication, assembly, wiring, testing and Documentation as per this specification and its attachments including, but not limited to, the following:

- Implementation Specifications, System Engineering and Hardware Design Engineering associated with the ESD system.
- I/O modules, processors (CPU), power supply modules, logic, interface modules, internal system batteries, relay cards, communications modules, etc. for the complete operation of the ESD system.

- Supply of terminals, fuse terminals with fuses, switches, MCB, IS barriers, relays, ELCO (typically) boards, mounting rails, cable ducts, internal wiring, nameplates, etc. for the system and marshaling cabinets.
- Supply of System/Marshaling cabinet's c/w all required hardware, all inter panel cables / printer, cables, connectors etc., and spare parts as per SPIR form, special tools for operation and maintenance of the both ESD system.
- Interface the ESD system to the DCS via interface serial link and hard wire.
- System cables between the system components and marshalling boards within the cabinet and between the associated systems.
- Engineering, hook-up, system assembly, configuration and testing.
- Any additional programming equipment other than the engineering workstation, if any required for re-programming purpose with necessary cable.
- 110V AC non-UPS power supply units, protection devices for the power supply units and distribution to internal system devices and accessories.
- 24VDC power supply (supplied from redundant UPS 110VAC or DC Charger and Batteries 24 VDC), convert and distributed by ESD panels to the field transmitters (two-wire system operating at 24 VDC) and solenoid valves.
- Complete software (both standard and customized), configuration, programming, software design engineering of the ESD system to perform the functions depicted in the plant Cause & Effect Charts attached to the MR.
- Factory Acceptance and integrated testing of the complete the ESD system as specified in this document.
- Preparations for shipment, inclusive of packing of all system components
- Project management of complete the ESD system
- All other items and engineering services required for the ESD system to be fully functional as intended
- Start-up and Pre-commissioning spares as specified.
- Proposal for Warranty-period operations and maintenance spares as specified
- Evergreen licenses for all software and firmware required, in CLIENT name.
- Proposal for training as specified
- Special tools, test equipment and consumables essential for the normal maintenance of the system.
- Proposal for VENDOR's qualified personnel and equipment for technical support, testing and commissioning of the ESD system.
- Data and Documentation per Vendor Document Requirement List (VDRL)
- QA/QC and Inspection

The units shall be able to manual initiation of fire-fighting systems, to be actioned at all locations and to provide overview information on the OWS in the control building.

For ESD system shall provide the high integrity shutdown functions according to cause and effect

and ESD logic. It shall be connected to matrix panel be enabled to perform common functions, such as overall plant shutdowns, to be actioned at specific locations Also, it shall provide overview information of shutdown functions on the OWS in the control building. The system shall meet the safety integrity level (SIL) SIL-3 according to IEC 61508 certified by TUV, or others approved. The SIL of ESD loops shall be determined by risk analyze study. This shall define the requirements for each instrumented protective function in terms of a Safety Integrity Level.

It is anticipated that up to three levels of SIL (SIL 1, 2 and 3) may be identified for different protective functions.

Safety related actions that employ multiple sensors (voting) for a sensor application on a protective system shall be designed to employ a "2 out of 3" voting concept.

Instruments for protective functions shall be independent from those used for process control.

If a programmable system with dual redundant or triple modular redundant architectures is to be used for SIL 3 then a quantitative analysis (including the impact of common-cause faults) shall be required to demonstrate that SIL3 will be achievable. In addition a third party (e.g. TUV class AK6) evaluation of the system, certifying the system as SIL3 and the manufacturer’s extensive operating experience with SIL3 applications will be required. The logic solver should have diagnostic features that conform to those specified in IEC 61508.

The facility to inhibit inputs and override outputs for maintenance purposes shall also be provided for all safety functions. For SIL 1 and SIL 2 functions, inhibits and overrides shall be implemented in the node software.

The ESD system shall have a minimum availability of 99.99% where availability is defined as “no loss of personnel safety”.

The units shall also be connected to DCS to provide the operator at the Control Room with alarm & status information of ESD system.

The central point of control for all fire zones will be the panel in the Control Room, Supported by matrix panel in the Control Room which will provide alarm and shutdown annunciation for all facilities and will enable the operator to take executive action under emergency conditions.

5.4 F&G SYSTEM

F&G system shall be supplied as a Fire and Gas Detection System of the project. F&G system shall be high available and complete in all respects, including all required ancillary equipment necessary for the satisfactory operation of the systems. The F&G system shall detect at an early stage the presence of fire, flammable gases and toxic gases in all areas of the plant, buildings, shelters and etc., and shall initiate appropriate audible and visual alarms to warn of the detected hazards.

Full redundancy, SIL 3 requirements shall be respected to design F&G system and it shall be suitable for safety applications and certified as such by TUV or equivalent recognized international authority. (IEC 61508 or DIN V 19250)

OWS and EWS assembly shall typically comprise:

- EWS and OWS of F&G are common and are located in engineering room.
- All monitoring data shall be also monitored by DCS work station.

Vendor's scope of work shall include all hardware, software, fabrication, assembly, wiring, testing and Documentation as per this specification and its attachments including, but not limited to the following:

- Implementation Specifications, System Engineering and Hardware Design Engineering associated with the F&G system.
- I/O modules, processors (CPU), power supply modules, logic, interface modules, internal system batteries, relay cards, communications modules, etc. for the complete operation of the F&G system.
- Supply of terminals, fuse terminals with fuses, switches, MCB, IS barriers, relays, ELCO (typically) boards, mounting rails, cable ducts, internal wiring, nameplates, etc. for the system and marshaling cabinets.
- Supply of System/Marshaling cabinet's c/w all required hardware, all inter panel cables / printer, cables, connectors etc., and spare parts as per SPIR form, special tools for operation and maintenance of the both F&G system.
- Interface the F&G system to the DCS via interface serial link and hard wire.
- System cables between the system components and marshalling boards within the cabinet and between the associated systems.
- Engineering, hook-up, system assembly, configuration and testing.
- Any additional programming equipment other than the engineering workstation, if any required for re-programming purpose with necessary cable.
- 110V AC non-UPS power supply units, protection devices for the power supply units and distribution to internal system devices and accessories.
- 24VDC power supply (supplied from redundant DC Charger and Batteries 24 VDC), convert and distributed by F&G panels to the field transmitters (two-wire system operating at 24 VDC) and solenoid valves.
- Complete software (both standard and customized), configuration, programming, software design engineering of the F&G system to perform the functions depicted in the plant Cause & Effect Charts attached to the MR.
- Factory Acceptance and integrated testing of the complete the F&G system as specified in this document.
- Preparations for shipment, inclusive of packing of all system components

- Project management of complete the F&G system
- All other items and engineering services required for the F&G system to be fully functional as intended
- Start-up and Pre-commissioning spares as specified
- Proposal for Warranty-period operations and maintenance spares as specified
- Evergreen licenses for all software and firmware required, in CLIENT name.
- Proposal for training as specified
- Special tools, test equipment and consumables essential for the normal maintenance of the system.
- Proposal for VENDOR's qualified personnel and equipment for technical support, testing and commissioning of the F&G system.
- Data and Documentation per Vendor Document Requirement List (VDRL)
- QA/QC and Inspection

Vendor shall be fully responsible for the coordination with Sub-Vendors for materials and services provided. A list of all proposed sub-suppliers should be included in the proposal.

Vendor shall provide site assistance for the specified location and commissioning as outlined in this document.

The Vendor shall be responsible for the coordination between the DCS Vendors in providing obtaining all necessary information for engineering, integration and testing of the F&G system. This shall include provision of the F&G system hardware to allow integrated systems testing.

The omission from this specification of any items essential for the correct functioning of any part of the equipment shall be brought to the notice of the CLIENT. Failure to do so shall not absolve the Vendor from supplying the overall system equipment complete in every respect to the intent of this specification.

The fire detection and annunciation system inside buildings including heat detector, smoke detector, manual alarm call points, sounder, beacons and etc. addressable devices and protocol to be used. If main F&G system is not supporting the addressable protocol a dedicated fire & alarm control panel shall be supplied for building fire detection and annunciation purposes.

5.4.1. ADDRESSABLEL FIRE ALARM SYSTEM (FACP)

All addressable detectors inside buildings shall be connected to Addressable Local Fire Alarm Control Panel which will be located inside the control building . Smoke detectors, Heat detectors, indoor manual call points and Fire horns and etc. (except Gas detectors inside the buildings) shall be addressable type. Conventional detectors shall be connected directly to F&G system.

Fire Alarm System (FACP), which are located within the non-process buildings, shall interface directly to the F&G system for status display and monitoring only.

FACP shall be microprocessor-based fully addressable system. It shall be capable of controlling all alarm functions within building.

5.5 UNIT CONTROL PANEL (UCP)

The following basis will be expanded in the Specification for Instrument and Control of Package Units.

Large and complex machinery packages will be controlled by vendor standard Unit Control Panels (UCP) and related local control panel (LCP). For smaller packages that do not have standard UCP's the package vendor will supply package mounted instrumentation for connection to the DCS/ESD of the plant (refer to "Specification for Instrument and Control of Package Unit System (PU), BK-GNRAL-PEDCO-000-IN-SP-0004).

Machinery/package items and control system type for this project has been listed here below:

TAG NO.	PACKAGE	CONTROL PANEL TYPE
IG-2201	LP FLARE IGNITION PACKAGE	CONTROL SYS. TYPE A
PK-2207	CORROSION INHIBITOR	CONTROL SYS. TYPE A
PK-C-2101A/B/C	GAS COMPRESSOR PACKAGE	CONTROL SYS. TYPE C
PK-G-2204	NITROGEN GENERATOR PACKAGE	CONTROL SYS. TYPE C
PK-C-2203 A/B	AIR COMPRESSOR PACKAGE	CONTROL SYS. TYPE C
PK-DR-2203 A/B	AIR DRYER PACKAGE	CONTROL SYS. TYPE A
PK-2101	DEHYDRATION PACKAGE	CONTROL SYS. TYPE C

To meet maintenance consideration UCP packages are preferred to be mounted in the Instrument Technical Room.

Below panels might be installed in Instrument Technical Room (ITR Located next to the CCR)

- Control system cabinet
- Marshaling panel
- Common utilities Marshaling panel

UCPs for Packages shall contain the equipment for machinery (vibration) monitoring and data acquisition, a programmable electronic system for processing relevant signals, and a human machine interface in the form of a VDU and keyboard to display individual alarms and enable control, normal operation and shutdown from the UCP.

The LCP will have a local/remote switch to enable control from the LCP (ie, local) or from the UCP (i.e., remote)

UCPs shall interface directly with associated MCC's for control and shutdown of relevant electrical

machinery drives (via IRP).

Status information (digital and analogue) to the DCS from the UCP's shall be limited to that which is essential to enable successful normal operation of the package from the Control Room.

Commands (digital and analogue) from the DCS to the UCP's shall be considered for those which are essential to enable normal successful operation of the machines from the Control Room.

The DCS/UCP interface signals are to be shown on the package P&ID's.

All command\status from ESD system or F&G system to the UCP's will be hardwired and shown on the package P&ID's. All critical signals (commands and status used in logics) between DCS and UCP shall be hardwired. Only the statuses could be transferred via MODBUS RTU. The serial link shall be redundant.

For more details, refer to BK-GNRAL-PEDCO-000-IN-SP-0004 Specification for Instrument and Control of Package Unit System (PU).

5.6 MACHINE MONITORING

Machine monitoring shall be provided for all major rotating machines to provide machine protection.

Vibration monitoring system shall be provided together with non-contacting vibration probes at each bearing of the motor in accordance with API 670, if required.

In order to monitor the temperature of the stator winding, embedded resistance temperature detectors (RTD) shall be provided for all medium voltage and high voltage motors.

Oil lubricated bearings and/or bearings of motors, and also the thrust bearings of all MV and HV vertical motors shall be equipped with resistance temperature detectors, where required.

The machine monitoring equipment will be supplied as part of each package and could be merged by UCP (via suitable interface convertor/transducer for sensors).

The machine monitoring signals shall be transferred to DCS via UCP by serial link.

5.7 INSTRUMENT/ELECTRICAL INTERFACES

The type of instrument/electrical interface to the motor starters and feeders will be hardwired to interface compartments (IRP).

IRP shall be designed to make sure no signal level higher than 24VDC is to be connected to the DCS, ESD system, F&G system or UCPs.

The DCS/F&G system/ESD system interface with feeders and motor starters shall be limited to

following commands and status indications/alarms:

- Start command (2 sec high pulse)
- Stop command (2 sec high pulse)
- Trip command (low signal for trip)
- Run/Stop Status (high signal for run status)
- Local/Remote status (high signal for local status)
- Tripped on Fault (high signal for fault status)
- Available for remote control (high signal for available status)

The type of signal selected for each electrical device shall be shown on P&ID.

Safety related systems shall send hardwired command signals to the electrical switchgear via IRP. Hardwired command signals will energize the coils of dedicated 24VDC electromechanical relays located in the IRP.

5.8 PANELS AND WIRING

Field panels, including local control panels, shall be rated IP 65 minimum. It shall be noted that all panels with PLC shall be located in ventilated area. A front cover with through visibility can be provided to achieve this as long as the cover does not have to be opened for operator control purposes. (If this method is used the equipment exposed when the front cover is opened shall be IP 54).

Panels color shall be RAl7035 and shall be equipped with applicable fan, filter, heater and hydrostat

Panels located in rooms or enclosures shall be IP 54 minimum. Field Panels shall be certified suitable for the hazardous area specified. The panels shall be EMC compliant with the requirements of IEC 61000.

The VENDOR shall state where the standard panel differs from the custom panel requirements given below.

Custom build panels and cabinets shall meet the following criteria:-

- Panels shall generally be free standing, fully enclosed cubicle type complete with front access doors.
- Each panel/cabinet bay shall be approximately 800mm (w) x 800mm (d) x 2100mm (h) maximum including plinth. Bays may be bolted together, however they should be limited to a nominal 2400mm in length to facilitate handling and shipping. Each suite of bays shall be mounted on a single plinth.
- Panels shall be fitted with a plinth constructed from steel channel with a minimum of 4 bolts down points.
- Panel access shall be from the front and rear. Access doors shall be fully gasketted and

adequately stiffened to prevent distortion. Doors shall be mounted on lift-off hinges complete with lockable handles. Maximum hinged door width shall be 750mm.

- Where doors have components mounted on them, steps must be taken to prevent damage to wiring, equipment or adjacent apparatus.
- All joints shall be continuously welded with 100% penetration and all welds ground smooth.
- Holes and cut-outs shall be cleanly drilled or cut. No gas cutting process shall be employed.
- Weather shields shall cover front and rear field panels.
- Marshalling cabinets shall be considered as back of panel type
- Panels shall be constructed with multiple cable clamp facilities, complete with dust seal.
- Panel doors shall be lockable by means of a common key.
- Control room located panels and cabinets shall be suitable for the location and match the style and design of the room.

Final panel size and access requirement shall be agreed with the EPC CONTRACTOR.

The panel shall be supplied as one complete unit unless it is required to be sectioned for shipping and access. Removable lifting eye bolts (minimum 4) with local stiffening shall be provided to allow single point lifting and transportation of the fully assembled and wired panel, without any distortion. The Vendor shall supply spreader beams if required for a single point lift.

Instruments on the panel front which require adjustment or which have dials that require inspection shall be fitted within a height of 1-metre to 2-metre from grade or platform.

Air purging should not be used as a method of obtaining certification without prior approval. The use of air purge panels shall be avoided.

Wiring shall be sized to suit each application with a minimum CSA of 0.75mm² (except for ribbon type cabling), and shall be of high fire resistance, non-melting type, with minimal toxic fumes and smoke characteristics. Wire colours and sizes for internal cabinet wiring may be to VENDOR'S standard.

Internal signal and power wiring shall meet IPS-IN-C-190, IPS-IN-E-190 and IPS-IN-M-190 and be fire resistant to BS 4066 Part 1 (IEC 60332 Part 1) or equivalent.

Signal wiring shall be screened and/or segregated, within the cabinet, where interference may affect accuracy.

Wiring shall be routed in vented flame retardant plastic trunking with adequate separation and sized so that not more than 50% of the cross sectional area is filled with conductors. Trunking shall be located so as not to interfere with access to any equipment and shall not encroach on space allotted to any future equipment. Trunking and terminals shall not be fitted in the area up to 150mm from the gland plate.

Internal cabling shall be clearly identified and separated from incoming signal cables.

Where Intrinsic Safety circuits are installed, wiring terminals, interface units, grounding and power supply units shall be grouped together on separate terminal racks. Mechanical separation shall be provided between I.S. circuits and other electrical equipment.

Power and ESD terminals shall be guarded by labelled shielding.

Terminal strips shall be mounted with enough space for easy accessibility and maintenance. Spare terminals shall be provided for all unused (spare) pairs.

All powered output circuits (e.g. solenoid valves, indication lamps, sounders) shall include short circuit protection with failure indication. Self-recovering short circuit protection is preferred but it can be provided by fused output terminals.

Sufficient terminals shall be provided for the termination of all cores and screens of the EPC CONTRACTOR supplied cables.

All terminals shall be positioned to ensure adequate access for terminating cables.

Terminals for I.S. circuits shall be segregated from N.I.S. circuits and coloured light.

Only one cable core/wire shall be terminated into an individual terminal. When two or more cores require to be made common, a link bar shall be used.

Each terminal rail in panel shall be uniquely identified.

Each wire shall be identified, as shown on the VENDOR's wiring and schematic diagrams, using O type ferrules.

Gland sizes shall be selected to suit the cable outer sheath diameter tolerance.

For the glanding of interconnecting cables that will be provided by the EPC CONTRACTOR, the Panel VENDOR shall supply separate undrilled removable gland plate. The glands shall be EPC CONTRACTOR supplied and fitted.

5.9 EARTHING

For instrumentation, three (3) dedicated earthing network shall be used.

- Instrument Protective Earth (IPE) :

  Field instrument enclosures, cable armor, supporting arrangements, tray and junction boxes, cabinets shall be earthed to the IPE.

- Instrument Earth (IE) :

  It shall be used for earthing the screens of cables, except those carrying intrinsically safe signals.

- Intrinsically safe earth (ISE) :

  It shall be used for earthing the screens of cables carrying intrinsically safe signals through the galvanic isolated barriers bus bar.

Impedance of IE & ISE shall be less than 0.5Ω Ohm.

All earth bars shall be clearly labelled and shall have two M10 studs for connection of two earthing cables, one at each end. Cabling from cabinet earth points to plant earth points will be supplied by EPC CONTRACTOR.

All metal parts of the equipment not associated with the circuits shall be bonded to the main chassis. Serrated washers shall be used to ensure electrical contact between metal parts.

Doors and other removable parts shall be bonded using flexible braided earth straps, suitably sleeved for protection.

All outdoor equipment shall be connected to an external earth stud for EPC CONTRACTOR’s connection to the platform earthing.

Earthing cables shall be:

Outer Sheath:

- Colour green/yellow for general service.
- Colour green for I.S. service.
- Bonding for electrical continuity shall be 6mm2 minimum CSA.

All instrument signal cable screens shall be earthed once only and at a central point. This shall be at the panels. All screens shall have continuity through all junction boxes and be insulated from earth at the field end.

Cable armouring shall be earthed at both ends. Note that where non-metallic enclosures are used, a means shall be provided to preserve the electrical continuity of armouring and/or metallic cable sheaths.

Separate earth sumps shall be provided for instrument earth, I.S. Earth and safety earth.

6.0 GENERAL INSTRUMENT REQUIREMENTS

This basis will be expanded in ''Specification for instrumentation Doc.No.BK-GNRAL-PEDCO-000-IN-SP-0001'' for selected devices as per project P&IDs.

All instrumentation for installation in exposed locations shall be rated for the hazardous conditions that shall be experienced on the platform. Any instrumentation that cannot be supplied with weatherproofing (IP rating) suitable for the specified conditions shall be protectively housed accordingly. Instruments and equipment externally mounted shall be rated to a minimum of IP65 and also shall be applicable to work on temperature range of -2~55°C and humidity range of 0~100% RH. For items that can be subjected to direct deluge the rating shall be IP65. Internally mounted instruments shall be rated to a minimum of IP 54.

All instruments that may be exposed to direct sunlight shall be provided with sunshades to prevent the temperature of the instrument rising above ambient temperature.

The preferred material for instruments and fittings is 316/316L stainless steel.

The use of plastic shall be avoided due to the degradation of the material when exposed to high levels of UV radiation.

Stainless steel subjected to temperatures higher than 60degC and a saline atmosphere will suffer from stress corrosion cracking. Process conditions in general will not subject the instrument process connections to temperatures higher than 60°C. Instrument tubing and fittings in external locations that are subject to direct sunlight may rise above this temperature. Where this can take place the tubing and fittings shall be provided with suitable shading or insulation.

Frost protection for instruments on fresh water service is not required.

All instruments to be located in external locations hazardous shall be certified for a minimum protection of Zone 2, IIB T4.

General instrumentation, excluding solenoid valves which shall be EExd, shall by preference be made safe by intrinsic safety using galvanic isolation. If intrinsic safety is not available then explosion proof enclosures (EExd) shall be used.

Instruments used in safety applications may require fire proofing. This requirement is to be identified during HAZOPs.

All instruments shall be certified as EExia, the signals shall be 4-20mA and HART protocol shall be supported. The transmitter communication technology shall be fully matched with process control system.

All instruments shall be provided with a stainless steel tag plate attached to the instrument by

stainless steel wire.

All instruments as appropriate shall have a stainless steel data plate showing the serial number and model number as a minimum.

6.1 TEMPERATURE MEASUREMENT

Bi-metallic every angle dial thermometers shall be used for local indication. Dial size shall be 150 mm diameter unless otherwise specified in the data sheet.

Where Bi-metallic types are not suitable, gas or liquid filled capillary instruments may be used. Mercury filled systems shall not be used. Guaranteed gauge accuracy shall be 1% of full scale range.

RTD shall be used as means of temperature measurement. The choice between resistance thermometers and thermocouples shall take the following into consideration:

- Where accuracy of measurement is required greater than obtainable with a thermocouple, a resistance thermometer shall be used.
- Resistance thermometers shall not be used where high frequency vibration is present, e.g. in high velocity steam or gas streams.
- Where narrow range duty is required i.e. less than 100°C range a resistance thermometer shall be used.

RTD’s shall be platinum preferably 3-wire. Two-wire is not permitted. RTD PT100 shall comply with BS 1904 and have a resistance of 100 ohms at 0°C and a fundamental interval of 38 ohms. They shall be of the grade of accuracy appropriate to the application.

Thermocouples shall be two wire types. Thermocouple elements shall be in accordance with ISA/ANSI-MC 96.1 except where averaging or differential thermocouples are required.

Thermocouples and resistance thermometers pocket assemblies shall be provided with weatherproof terminal heads certified for the appropriate area classification. Heads shall be orientated to prevent ingress of water.

Thermowells shall be constructed in accordance with project standards from one-piece Stainless Steel 316/316L material as minimum.

On small lines where adequate immersion cannot be obtained by the thermowell inserted perpendicular to the line, the well shall be inserted at 90 degrees bend in the line.

- Transmitter shall be designed to allow the fitting of either an integral or remote located process variable indicator, where specified on the instrument Data Sheet. The design of transmitter and local indicator combination shall be such that failure of the indicator

electronics will not affect the operation of the transmitter.

- The input signal shall be galvanically isolated from the output and ground. Accuracy of the transmitter shall be ±0.1% percent of calibrated span, includes combined effects of linearity, hysteresis and repeatability. Electrical connection shall be ISO M20 x1.5.

Temperature switches shall be bracket mounted type, and should be selected as liquid / gas filled system or thermocouple actuated/differential expansion, depend on applicable working range of each type. The switches shall be fully compensated against variations in the ambient temperature. The accuracy of switches shall be better than ±1% of span. Microswitch shall be snap action type, hermetically sealed, with gold or silver plated contacts. Switch contact shall be DPDT and shall suit the electrical area classification. The contact rating shall be 10A at 110 VDC.

6.2 LEVEL MEASUREMENT

The following local level instrument types shall be used:

a) Gauge glasses for vessels and small tanks. Gauge glasses shall be applied where indicated on the P&ID's

b) Float type instruments for large tanks, where local indication only is necessary

c) Differential pressure instruments where float type instruments are not suitable (e.g. viscous fluids).

d) Magnetic level gauges to be used where only local indication of liquid level other than by means of level gauge glasses is required and instrument air supply or instrument electricity supply is not available.

e) Radar type measuring application shall be based on “Non-contacting Sensor (Antenna Type)” measuring approach or using of “Contacting Sensor (Guided Wave Radar Type)” based on project requirements.

Local indication of vessel or tank level shall be achieved by means of gauge glass type.

When gauge glasses are selected the reflex type shall be selected wherever possible. The transparent type (with illuminators) shall be selected for adhesive liquids, which could give unclear readings on reflex type gauges.

Gauge glasses shall be fitted with a maximum of four sections. When a greater visible range is required multiple gauge glass units shall be installed and staggered to ensure a continuous visible length.

Min SS 316L construction shall be used for all wetted parts where process requires it. Reflux gauge glasses shall be used on colorless services.

Reflex gauges shall be used for liquid and vapour interface detection except in the following circumstances, where transparent gauges shall be used:

- Viscous, caustic or acidic service.
- Glass corrosive duty (e.g. Acid, caustic, high pressure steam or condensate), when the glass shall be protected with a mica sheet between glass and gasket.
- Color or turbidity observation.
- Gauge glasses shall have a maximum of four (4) sections combined together to form a single gauge column. Each section shall have a visible length of approximately 300 mm. Where more than one column is required they shall overlap with a minimum of 25 mm visible length. Gauges on vaporising service shall be manufactured with larger chambers than gauges on other services.

For fire water tanks, float and cable level gauges to be used. Vendor to provide float guide wires which shall be installed plumbed, properly centered, free of kinks or twists to be provided and pulled out under proper spring tension.

For liquid/liquid interface, corrosive liquid service or where clear indication from a distance is required, local indication shall be provided by means of magnetic follower gauges. Displacers in externally mounted chambers shall be used for displacer type level transmitter, where applicable.

Internal displacers may be used on vessels where an external arrangement is not possible (eg. sumps).

Where the displacer is subjected to turbulence, the effect shall be minimized by shielding, guidance or other means.

Either 4-20mA-HART protocol shall be used for process value measurement. The transmitter communication technology shall be fully matched with process control system. For Emergency Shutdown System, analogue 4-20mA-write protected transmitter or digital switches to be used. Electrical connection shall be ISO M20 x1.5.

Float/Displacer type switches in externally mounted chambers shall be used. Chambers having a flanged closure for easy internal inspection shall be used. The float arm and float shall be able to pass through and clear the nozzle through which they are installed.

Connection between float and switch mechanisms shall be by use of a magnetic coupling. This coupling shall be shrouded against accumulation of magnetic particles. Contacts for switches shall be gold plated, double pole, and double throw contacts. They shall be hermetically sealed micro switches with a typical rating of 10A at 110 V DC.

Vent and drain connections shall be ¾” NPT female.

6.3 PRESSURE MEASUREMENT

Dials shall have diameter of 150 mm and shall be white with black figures, non-rusting metal. Blow out disc shall be located in the back of the casing.

Over-range stops shall be provided for the over-range limit.

Unless otherwise specified, Min SS 316L alloy shall be used for pressure elements, sockets, Movement and tips material.

All gauges shall be equipped with screw driver slot type adjustment for calibration purposes.

Min SS 316L, 2 valve block manifold shall be provided.

Transmitter shall be designed to allow the fitting of either an integral or remote located process variable indicator, where specified on the instrument Data Sheet. The design of transmitter and local indicator combination shall be such that failure of the indicator electronics will not affect the operation of the transmitter. The transmitter shall be 4-20mA supporting HART protocol.

Electrical connection: ISO M20 x1.5

Accuracy: better than ±0.4% of instrument scale for SMART type.

Tree-way (Two Valve) Stainless Steel manifold shall be supplied and integrated to pressure transmitters. The manifold process/instrument connection is 1/2" NPT female, the vent/drain connection is 1/4" NPT female.

For pressure switches, pressure element shall be of diaphragm, Min SS 316L capsule or piston type. Pressure element connection shall be ½” NPT male and have wrench flats.

Pressure element shall be designed to have an over-range protection rating as minimum 1.3 times of sensor range.

Pressure elements shall be designed to have an over range protection rating of at least the design pressure of the process line or vessels, and as a minimum 130% of full scale. The accuracy of the pressure switch assembly shall be at least ±1% of span and repeatability shall be also at least ±1% of full scale, the set point shall be field adjustable over the full range of the switch. The set point adjustment shall be internal.

Electrical connection shall be ISO M20 x1.5.

Switch element shall be micro switch snap action type hermetically sealed, with gold plated contact. Micro switch shall be DPDT type, Contact rating shall be 10A at 110 VDC nominal.

Diaphragm seals shall be utilized for the following services,

a) High viscous heavy oils,

b) Fluid with solid materials,

c) Vapor containing H2S,

d) Corrosive chemicals.

Where capillary extension is specified for transmitters, the capillary length shall be stated on the Instrument Data Sheet and be provided with spiral wound stainless steel armor.

Process connections for clean fluids shall be ½" NPT screwed bottom connections.

6.4 FLOW MEASURMENT

Orifice plates shall be used for liquid, vapor and gas services.

Manufacturing of orifice plates shall be generally in accordance with ISO 5167 standard or AGA Report No 3 for Natural Gas metering and BS 1042.

Concentric, sharp edged orifice plates with flange taps shall be used in most applications. The use of eccentric orifices shall be limited to gases containing liquid, liquids containing solid particles, or liquids containing gas.

Orifice plate material shall generally be Min SS 316L. Orifice tag number, material, direction of flow, nominal diameter and bore diameter shall be

The minimum orifice flange rating shall be ANSI 300 # RF.

The differential pressure transmitter shall be used for primary flow elements as stated in section 6.3.

Five-way Stainless Steel manifold shall be supplied and integrated to differential pressure transmitters. The manifold process/instrument connection is ½" NPT female, the vent/drain connection is 1/4" NPT female.

Differential pressure transmitter range shall be selected in accordance with the following:

a) For orifice meters, normal flow rate shall be between 70% and 80% of capacity, provided anticipated minimum and maximum flow rates will be between 30% and 95% of capacity;

b) If range ability larger than 30% to 95% is required, two differential pressure transmitters connected to the same orifice taps shall be used.

Minimum 10:1 turn down ratio is required to be considered for flow measurement equipment.

Variable area meters as simple local indicators with suitable mechanical protection may be used on non-hazardous, low flow service with temperatures up to 130 ºC. Their use shall be limited to meters up to 1 inch in size.

The calculation of restriction orifice plate shall be in accordance with ISO 5167.

Restriction orifice plates shall be constructed with a thickness specified at full rating.

Restriction orifice plate material shall generally be Min SS 316L. Other suitable materials shall be selected depending on the process fluid and as specified on individual data sheets.

Drain/weep holes shall not be provided on the restriction orifice plates. Orifice bore shall not be beveled for the restriction orifice plates.

Electromagnetic flow meters are based on the principle that an electromagnetic force (EMF) is generated when a conductive fluid moves in a magnetic field. If the field is perpendicular to a pipe which contains a moving fluid and if the conductivity of the fluid is above a certain minimum value, a voltage can be measured between the two electrodes in the pipe wall. As this voltage is proportional to the strength of the magnetic field, the average velocity of the moving fluid and the distance between the electrodes, the volumetric flow rate is derived. The electromagnetic flow meter shall have an accuracy of ±0.5% of full-scale detection. Uncertainty is the summation of all the errors in the measuring system including accuracy, linearity and repeatability.

The in-line type thermal flowmeters consists of a sensor typically installed on a bypass around a restriction in the main line. The in-line element shall be supplied with two temperature elements on both sides of a separate heating element. The thermal mass flowmeter are suitable for cases subjected to viscosity changes. The thermal mass switch shall be DPDT type, Contact rating shall be 10A at 110 VDC nominal.

The usual accuracy is about 0.25% usually applied for flow instruments.

6.5 CORROSION COUPON/PROBE

Corrosion coupons/probes shall be located at all points as indicated in the P&ID’s where significant corrosion or erosion is anticipated.

Coupons may be used to determine the average fluid corrosively by measurement of weight loss. The method facilitates an assessment of the corrosivity of an environment with respect to the specific material of construction of that part of the plant in which the corrosion monitoring is taking place.

Careful consideration shall be given to the proposed monitoring location and coupon position during the development of the corrosion monitoring strategy.

Coupons shall be installed through on-line retrievable access fittings, with a flanged line

connection. Coupon retrieval and positioning tools shall be included.

On-line corrosion monitoring should be installed at points where accessibility during scheduled maintenance is anticipated.

6.6 MAINTENANCE SYSTEM

The diagnostics provisions shall be provided at an engineer station in the Control Room. Additionally diagnostic interrogation shall be possible via a hand-held device at the field cable marshaling cabinets, without infringing any hazardous area certification requirements.

Refer to Specification for Control System Doc.No.BK-GNRAL-PEDCO-000-IN-SP-0002, Specification for ESD system, Doc.No.BK-GNRAL-PEDCO-000-IN-SP-0003 and Specification for Fire and Gas system, Doc.No.BK-GNRAL-PEDCO-000-IN-SP-0012 for diagnostic detail and other system specifications.

6.7 INSTRUMENT HOOKUP/INSTALLATION

Process impulse connections up to and including the primary isolation valve shall conform to the piping, vessel or equipment specification. The tubing and fittings up to the instrument shall conform to the General Instrumentation Specification. The primary isolation valve can be of the compact type to save weight and space. All pressure measuring devices shall have 2 valve manifolds and all differential pressure measuring devices shall have 5 valve manifolds. As general, Instrument Hookup/Installation to be performed in accordance with IPS standards No. IPS-D-IN-010, IPS-D-IN-100, IPS-D-IN-101…107, IPS-D-IN-112, IPS-D-IN-115, IPS-D-IN-116 and IPS-D-IN-119.

Where possible manifolds shall be of the type suitable for direct mounting to the instrument.

Instruments can be close coupled to the tapping point and supported by the process connection as long there is good maintenance access and the instrument is not subjected to detrimental vibration.

6.7.1 Connection on piping and equipment

Specifications for instrument connection on piping and block valves, minimum flange rating for instrument connection = 300 lbs

INSTRUMENT			TYPE AND SIZE OF INSTRUMENT CONNECTION*[4]
TO PIPING	Orifice flange and nozzles(Instrum. Tapping)		½ in.
	Annubar or pittot tube	Flanged	2in.
	Thermowells	Flanged	1 ½ in.
	Pressure Instrument and Bourdon tube pressure gauges		1/2 in. Thread*[2]
	Corrosion coupon /probe		2 in. flanged
	Variable area meter (rotameter)		As same as pipe size
To Equipment	Thermowells	Flanged	2in.
	Pressure instrument and Bourdon tube pressure gauges		1/2 in. Thread*[2]
	Displacer	External	2in. Flanged
		Internal	4in. Flanged
	level switch	External	2in. Flanged
		Internal	4in. Flanged
	Differential pressure		1/2 in. Thread*[2]
	Gauge Glasses		2in. Flanged
	Magnetic Level		2in. Flanged
	Corrosion coupon /probe		2 in. flanged
STAND PIPE*[3]	Displacer	External	2 in. Flanged
	level switch	External	2 in. Flanged
	Differential pressure		1/2 in. Thread*[2]
	Gauge Glasses		2in. Flanged
	Magnetic Level		2 in. Flanged

Notes:

1. Valve type as per piping specification
2. Diaphragm seals on pipe and vessels for pressure/flow indicators/transmitter should be

considered 2 in.

3. Standpipe dia. 3 in. With dia. 3 in. Vessels connection.
4. For more details and interface of piping/vessels and pneumatic connections refer to Instrument Hook-up Diagram, Doc. No. BK-GCS-PEDCO-120-IN-DG-0002.

7.0 ACTUATED VALVES

7.1 CONTROL VALVES

Control valves shall be in accordance with “Specification for Control and Regulation Valve” document.

Control valve body material and rating shall be in accordance with the appropriate Piping and Valve Material Specification, but shall be ANSI 300# minimum rating.

The noise level shall be attenuated to a maximum of 85 dBA at one meter downstream, and one meter measured vertically from the pipe.

The material of bonnet shall be suitable to withstand the ambient temperatures and operating temperatures indicated in the datasheets.

Cable entries shall have metric threads or be supplied with adaptors to 20 mm ISO (female). Electrical flying leads shall not be used.

Packing shall not contain any asbestos. External lubricators or grease nipples shall not be used.

Actuators shall be adequate to stroke the valve and sized based on the line rating and the maximum differential pressure to which the valve will be exposed.

For actuators, standard spring range shall be 0.2-1 barg.

Control Valves normally are fitted with pneumatic spring return diaphragm actuators. Spring and actuators shall be sized based on available supply pressure.

Electric actuators may be used (subject to CLIENT agreement) at site locations where instrument air is not available. Note that only “fail locked” operation will be available.

“Fail open”, “fail close” or “fail locked” modes will be determined by process or safety requirements.

A HART type positioner(with a 4~20mA signal), compatible with control system that can provide diagnostics on the operational status of the control valve trim, shall be considered for all valves, this signal shall be displayed on HMI panel. The diagnostic data would be accessed over the Fieldbus link, otherwise position transmitter to be considered for all control valves.

Pneumatic connections shall generally be ¼”NPTF unless a high air capacity requirement dictates

a larger size.

Local manual operation shall be provided by a side mounted hand wheel and declutching mechanism, only when specified.

Valve selection is generally based on application, size and cost. The globe type control valve shall be specified for the majority of applications; however butterfly, disc or ball type valves may be considered where adverse service conditions and size requirements are more cost effective.

For each application process control shall be achieved with the valve operating between 10% and 90% open.

The minimum globe control valve body size to be used shall be 1 inch and Body sizes smaller than 1 inch may be used for special applications, for valve sizes smaller than 1 inch, reduced trim in 1 inch size bodies normally will be preferable.

Special ball valves with integral attenuator or vee port have good control characteristic and give high turndown.

Full ball valves are not recommended for slurries due to the solids settling out in the body cavity.

Valves shall be sized in accordance with ISA Standard S75.01. Certified noise calculations shall be provided for each valve.

The stroking time of control valves shall be evaluated on the basis of the process control requirements. For critical analogue control systems such as surge control of compressors, the stroking time shall be less than 5 seconds. For other analogue control systems, longer stroking times may be acceptable.

The valve trim maximum allowable leakage rate shall be specified by reference to ANSI/FCI 70-2 standard, min leakage class shall be Class V.

The most common types of pneumatic control valve accessories which may be supplied with the control valve are, Solenoid Valves, Convertors, Positioners, Electro pneumatic Positioners, Booster Relays, Extension Bonnets, Hand wheels, Air Filter regulator, Limit Switch and etc.

The control valve shall be sized such that the CV value of the control valve for maximum process flow with the pressure drop across the control valve at maximum process flow is approximately 80% of the maximum CV value for that control valve. Furthermore, the control valve shall never have less than 25% lift for minimum process flow at the specified pressure drop.

7.2 SELF ACTUATED REGULATOR VALVES

Self-actuated regulators shall be in accordance with “Specification for Control and Regulation Valve” document.

Self-actuated regulators shall have the same general requirements as control valves. Pressure Regulator valves should be able to regulate a considerable range of the pressure as the input pressure.

A regulator is a very simple control device in which all of the energy to operate it is derived from the controlled system. Self-actuated regulators can be used in the following services:

- Pressure control
- Level control
- Flow control
- Temperature control

All regulators, whether they are being used for pressure, level of flow control, fit into one of the following two basic categories:

- Direct-operated: Direct-operated regulators are adequate for narrow-range control, and where the allowable change in outlet pressure can be 10 to 20 percent of the outlet pressure setting.

- Pilot-Operated: Pilot operated regulators are preferred for broad-range control, or where the allowable change in outlet pressure is required to be less than 10 percent of the outlet pressure setting. They are also commonly used when remote set point adjustment is required for a regulator application.

7.3 SAFETY RELIEF VALVES

Safety relief valves shall be in accordance with “Specification For Pressure & Safety Relief Valve” document.

Pressure relieving devices shall be provided to protect the plant against malfunction or fire in accordance with the recommended practices included in API RP520, API RP521 and applicable vessel codes.

For each relief valve the relief case, fire, process malfunction, equipment failure, must be evaluated and the relief valve sized for the worst case.

For cases were a constant back pressure is exerted the cold set pressure shall be the required relief pressure less the constant back pressure.

Spring loaded relief valves connected to a closed discharge system shall have a closed bonnet.

If the superimposed back pressure in a shared common relief header due to static conditions or due to the result of pressure coming from other connected sources result in the relief pressure increasing by more than 10% of the set pressure then a balanced bellows type relief valve shall be used.

For relief valves connected to a common header were the built up back pressure can exceed the allowable overpressure balanced bellows shall be used. However the back pressure shall not exceed 50% of the set pressure, taking into account the maximum allowable operating pressure of the bellows.

All direct activated spring loaded safety relief valves on hydrocarbon service shall be of the full nozzle, high lift type. A closed bonnet shall normally be provided on conventional safety relief valves, except as follows:

- An atmospheric vented bonnet shall be provided for all safety relief valves which vent steam, air or liquids to atmosphere.
- A piped vented bonnet shall be provided for safety relief valves having a bellows seal where the process fluid is toxic. The vents shall be piped to a safe area or relief header to cater for possible bellows failure.

Pilot operated relief valves may be considered for applications that cannot easily be met by conventional relief valves.

Relief valves shall have flanged connections in accordance with the requirements of the Piping Specification unless this conflicts with API RP 526 when this shall govern.

7.4 ESDV AND BDV VALVES

ESDV and BDV valves shall be in accordance with “Specification for On/Off and ESD Valve” document.

The process isolation valves ESDV and the blowdown valves BDV shall be of fire safe type complying with the piping specification.

The valves shall be tight shutoff (leakage class VI), fire-safe to BS 6755 or CLIENT standard.

Single acting, pneumatic actuators with spring return to the safe position shall be employed. The type of actuator used shall be based on cost, space and weight considerations.

The valve actuators shall be sized to have 150% of the torque required to open and close the valve with an assumed maximum upstream process pressure and zero downstream pressure and with the minimum air supply.

The actuator shall have fitted adjustable stops in the open and closed position.

The piston seal configuration shall be of a fire safe design, e.g.:

- A primary elastomeric seal

- A secondary metal seal to prevent excessive leakage across the piston in case the primary seal fails due to a fire

Actuators shall be equipped with a mechanical locking device to block valves in their safe position in case equipment maintenance, repair or testing is required. The locking arrangement shall be such that accidental actuation causing movement of a valve from its safe position is not possible. This locking device shall be clearly visible when installed. The locking device shall be designed to withstand the closing force of the actuator with the maximum specified supply pressure applied.

The actuator maximum possible torque under maximum supply pressure conditions shall not exceed 80% of the valve stem shear torque.

A manually operated three-way valve with a lock closed facility shall be provided for each actuator to enable the valve to be closed locally and be locked closed for operations / maintenance purposes. For blowdown valves the valve shall enable the valve to be locked open. The valve shall be provided with a stainless steel label that shall indicate the normal and the locked positions.

Solenoid valves shall be 24VDC certified EExd. The valves shall be made from 316 stainless steel as minimum.

Unless otherwise specified all electrical equipment including solenoid valves and limit switches shall have a degree of ingress protection IP 65.

Partial stroking facility to be considered for ESDs and BDVs.

Unless otherwise specified, the maximum valve stroking time to achieve the safety position shall be defined according to size of the body (5 seconds for body up to 4”, 1 second per inch for body greater than 4”).

ESDV and BDV valves’ accessories shall be considered in accordance with Doc. No.: Specification for On/Off and ESD Valve.

7.5 PROCESS ISOLATION VALVES (XV)

Process isolation valves shall be in accordance with “Specification for On/Off and ESD Valve” document.

These valves are used to isolate a section or a line and are controlled by process control logic. The result of process control logic is closure of valve in accordance with the P&ID and data sheets.

Isolation valves shall be designed to open and close remotely from the control room through the ESD system. Failure position shall be stated on the valve data sheets and P&ID’s. Actuators shall be sized to fully open and close the valves at the maximum differential pressures and within the time spans as specified in the individual data sheets.

Isolation valves shall be full bore or reduced bore ball or plug valves according to the piping specification requirements. Unless otherwise specified in the data sheets.

8.0 ACCESSORIES

8.1 JUNCTION BOXES

Junction boxes shall generally be used with multi-conductor cables to reduce the number of cables.

The minimum ingress protection of junction box and cable glands hall be IP65.

Junction boxes shall be fabricated in epoxy coated aluminum or flame retardant Glass Fiber Reinforced Plastic, GRP.

Protection class of junction box shall be Eexe. Each junction box shall be sized with 20% spare terminals for the termination of spare conductors of the multi-conductor cable.

All Junction Boxes shall have external fixing lugs provided for installation. All Junction boxes shall be supplied with an internal/external earth stud for safety earth.

All junction boxes shall be supplied with an approved certificate and certification label attached to the lid.

All labels shall be securely affixed so as not to degrade IP rating of enclosure. Junction boxes shall be supplied, complete with certified screw terminals and links, assembled on terminal rails and terminals shall be labeled on both sides.

A junction box shall contain only signals of the same class. I.S. signal lines and non-I.S. signal lines shall not be contained in the same junction box. This rule shall be also applied for ESD signals, PCS signals, PSS Signals and F&G signals.

All Junction boxes shall be supplied pre-drilled with cable entries, suitable blanked off with certified plugs which shall be installed on spare connection.

All junction boxes shall be manufactured from stainless steel, with a finish suitable for the environment.

Protection class of cable glands shall be Eexd. It is preferable all single and multipairs cables enter into the junction box from bottom side of it.

8.2 CABLING

Within the plant area, underground cabling shall be used generally, laid within dedicated cable trenches. However, cables shall be installed in duct banks for crossing of roads. Above-ground cabling, using cable trunking or cable trays shall be limited to connection of field instruments to

field mounted junction boxes.

Above ground cables shall be armoured in accordance with IPS-M-EL-271. Underground cables shall be lead sheathed in accordance with IPS-M-EL-271 where soil contamination by hydrocarbon liquids aggressive to the cable insulation is anticipated.

Instrument signal cables shall be adequately separated from power cables and electrical power equipment to minimize noise interference. A minimum cable separation distance, segregation of trenches, terminal boxes and wiring notes shall be as per IPS-C-IN-190 guide lines.

Flame retardant cables according to IEC 60332.3 shall be used for instrument cables as a minimum requirement.

Fire resistant cables according to IEC 60331 shall be used for safety system as:

- Cables for fire-fighting equipment as:
  - Command and monitoring cables for remote operated firefighting, deluge and CO_2 systems (IF ANY).
  - Fire and gas detection circuits.
- Cables related to ESD system and F&G system equipment as:
  - Connection Cables between transmitter and ESD system
  - Connection Cables between Detectors and F&G system
  - Power supply cables to solenoid valves of all ESDV, and BDV.
  - Cables related to emergency electrical shutdown.
- Any other areas related to safety aspects.

Unless otherwise specified, equipment and cabinets/panels shall be designed for the bottom cables or cord sets, and shall be equipped with gland plates.

All wires shall be identified at both ends using plastic tie-on markers. Above-ground cables shall be marked at their termination points (outside the terminal box where applicable) with a suitable label, of engraved or embossed plastic.

Underground cables shall be marked at approx. 50 cm intervals by means of embossed strips of corrosion resistant material (e.g. stainless steel or nylon).

In addition, cables shall be marked either side of cable transits, building entry/exit points, etc. All wiring shall be identified by sleeve-type markers, e.g. Grafoplast or equivalent

Specialist cable types (eg, co-axial, cat. 5, fiber optic, composite etc.) required for DCS, ESD system, F&G system, vibration monitoring etc. are to be defined in conjunction with selected

vendors.

Refer to ''Specification for Instrument/F&G Cables, Doc.No.BK-GNRAL-PEDCO-000-IN-SP-0010'' for more detail.

8.3 CABLE TRAYS & ACCESSORIES

Cable Trays and associated accessories including tray covers shall be pre-fabricated type galvanized steel sheets

The nominal width of cable trays selected is 50, 100, 150, 300, 450 and 600 mm. The cable trays shall be supplied in standard length of 3000 mm.

Types of trays used are perforated type, Ladder Type & Solid type.

The Flange height shall be considered for Ladder Type as 50 mm & for perforated & solid type trays as 100 mm.

The thickness for cable trays shall be considered 2 mm and the thickness for cable tray cover shall be considered 1.5 mm.

The maximum spacing between the rungs of the ladder type cable tray shall be considered as 250 mm.

Cable tray covers shall be provided for Perforated & solid type trays as indicated in the project drawings.

Accessories: The cable tray accessories are Vertical Elbows, Horizontal Bends, Adjustable Bends, Crosses, Tees and Reducers, etc,. All accessories shall have minimum bending radius of 600 mm.

Galvanizing: All cable trays, tray accessories, tray covers & tray supports including washers, etc. shall be hot dip galvanized. Should the galvanizing of the samples be found defective the entire batch of steel shall be regalvanized at BIDDER's cost.

Grounding conductors for Cable Trays 25 x 6 GS flat conductor shall run along the trays & interconnecting the trays at every 2.5 m intervals. 95 Sq.mm stranded copper conductor shall be used to grounding trays at minimum two points and in addition at 25 meters interval for longer length of trays

Manufacturer shall perform metrological / chemical composition and mechanical test on random samples of cable trays such as:

1. Visual inspection, dimensional checks and verification of bill of material as per approved drawings.
2. Test for galvanizing to ensure that materials and workmanship to the relevant standards.

3. Zinc coating thickness test
4. Copper sulphate test (uniformity test).

9.0 SERVICES

9.1 INSTRUMENT AIR

In general, pneumatic systems (if any) shall be designed for instrument air supply with design pressure of 11 barg and the specification at instrument air header according to below table:

Operating Conditions at Producer's Battery limit (Instrument Air Header)

System	Temperature (°C)			Pressure (bar g)		
	Min	Norm.	Max	Min	Norm.	Max
Instrument Air	-	65	-	-	8	-
Plant Air	-	65	-	-	9	-

Operating Conditions at User's Battery limit

System	Temperature (°C)			Pressure (bar g)		
	Min	Norm.	Max	Min	Norm.	Max
Instrument Air	-	65	-	4	7.5	8.5
Plant Air	-	65	-	4.5	8.5	9

All devices shall be designed to operate at minimum instrument air pressure of 3 barg.

9.2 POWER SUPPLIES

A battery backed 110V AC UPS will be provided for Binak gas compressor station.

The UPS's will provide the DCS, ESD system and UCP with un-interrupted and stable power and will maintain power to the panels for a pre-determined time after failure of power generation. This period will be set by timers provided in the UPS distribution board.

The time period will be initially based on a minimum of 2 hours.

The UPS will provide the supply through two independent distribution boards. The DCS and ESD system will accept two 110VAC supplies, one from each distribution board. The panels supplied from the UPS shall derive the required voltage levels (e.g. 24VDC etc) from the incoming 110VAC

using redundant rugged industrial type power supply units.

The F&G system UPS shall be 24VDC with capacity of 24 hour for normal load and 5 minute full load.

10.0 ELECTRO-MAGNETIC COMPATABILITY

The design of the instrumentation systems shall be such as to: -

- Avoid susceptibility to electromagnetic interference from other systems
- Avoid causing electromagnetic interference to other systems (Including telecoms).

11.0 SPARE CAPACITY

All systems shall be sized to have a minimum of 20% full wired spare and 20% installed spare I/O. CPU loading shall not exceed 50% of the maximum capacity. At least 20%, spare space shall be considered for cabinets for future extensions.

Multicore cables shall incorporate a minimum of 20% spare pairs. All unused cores in I.S. cables shall be connected to I.S. earth.

Instruments (including spares parts) shall be supplied with additional 20% of total quantity of each category (at least one item).

12.0 SPARE PARTS AND SPECIAL TOOLS

12.1 SPARE PARTS

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

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

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

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

SPIR form shall be approved by CLIENT prior to procurement.

12.1 SPECIAL TOOLS

The VENDOR shall provide any special tools required for the satisfactory operation and maintenance of his equipment. A complete list of special tools shall be provided by the VENDOR at enquiry stage.

13.0 TRANING

Training shall be prepared to provide suitable personnel as required for the following:

- Design configuration assistance to CONTRACTOR
- Operator training courses
- Maintenance training courses
- Site installation and commissioning support.

VENDOR shall provide detailed information of factory and onsite training courses in his proposal.

VENDOR shall furnish UNIT RATES for providing training in English for three groups of employees:

- Engineering
- Operators
- Maintenance

Training shall be for Control System, especially on Ethernet TCP/IP data highway communication protocol.

As an additional option, VENDOR shall provide an instructor to conduct operator training before the start-up of plant operations. The training will be specific to the specific facility systems, graphics, control, etc. The instructor shall be required to provide a training manual based on compilation of all configuration work done on the facility systems.