



OGDCL PAKISTAN:
OIL & GAS DEVELOPMENT
COMPANY LIMITED

NASHPA COMPRESSION PROJECT PHASE-II

ISSUED FOR TENDER

REV	DATE	DESCRIPTION	ORIG	CHKD	LE	QA	PM	LOCAL REPR.	PROJ. MAN
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ENAR Petrotech Services (Pvt.) Limited,
7-B, Sector 7-A, Korangi Industrial Area,
Karachi Pakistan

TITLE:

SPECIFICATION FOR GENERAL & PACKAGED INSTRUMENTATION

CONTRACT NO.
14-0193

DOCUMENT NO:

0193 - IMA – 6000 – 0



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1.0 INTRODUCTION

Oil & Gas Development Company (OGDCL) is the leading E&P Company of Pakistan and is “Operator” of the Nashpa Field. Nashpa Field is located in District Karak, KPK. Nashpa is a JV concession with working interest of OGDCL, PPL and GHPL.

OGDCL has decided to install compressor(s) facilities to cater the depleting pressure of reservoir/wells and optimize the production over the Nashpa Field life. The compression facilities shall be installed at Nashpa LPG Plant as a Front End Compression.

The conceptual study was carried out in Phase-I, which concluded that four compressors of same capacities of (each of 35 MMSCFD) with philosophy of 03 operating and 01 standby will be installed at Nashpa Plant as Front End Compressors. Compressors will operate in parallel configuration.

This document is intended to specify the basic requirements for instrument designing, engineering, instrument selection, sizing, procurement, testing, and installation, pre-commissioning and commissioning which deemed necessary for defining minimum requirement for General and Packaged Instrumentation and fire and gas detectors/devices at FEED stage and shall not be considered comprehensive and final for procurement.

The CONTRACTOR shall develop a detailed specification with actual model numbers, quantities and make during detailed engineering based on this document and submit to the client for approval.



1.1 Scope

This specification covers the basic Specifications for General and Packaged Instrumentation and fire and gas detectors/devices required for the safe and efficient functioning of NASHPA Compression Facility to be installed at NASHPA field.

This specification shall be read in conjunction with the “Specification for Package Control System” Doc No. 0193-IMA-6001, “Specification for Instrument Installation” Doc No. 0193-IMA-6002 and other relevant project documents.

The CONTRACTOR shall develop a detailed specification for Field and Package Instrumentation during detailed engineering based on this document and submits to the client for approval.

1.2 Order of Precedence

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

The order of precedence shall be as follows:

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

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

1.3 Contractor’s Responsibility

The CONTRACTOR responsibility shall include development of all design documentation for General and Packaged instruments, instrument selection, sizing, procurement, testing, installation, pre-commissioning and commissioning. Reference to this document and other project specifications does not absolve the CONTRACTOR from their responsibility for supplying suitable instrumentation. The CONTRACTOR shall develop detailed datasheets; specifications and installation details based on this specification and submit to COMPANY for approval during detailed engineering stage.



1.4 Instrument Selection

In order to standardize on the minimum number of instrument type, Contractor shall only provide instrumentation on the project from “Approved Vendor List”. Any instrument manufacturer not mentioned in the list will not be acceptable. The Contractor shall submit his vendor list with the bid.

1.5 Deviations

COMPANY strongly discourages any deviation to the requirements of any of the listed or attached documents, specifications, recommended vendors, country of origin, codes, standards, regulations, guidance notes, ITB scope of work etc. However, if it is inevitable to propose any deviation, same shall be referred to the COMPANY (advising reasons for deviation) during pre-bid stage for a response. CONTRACTOR has to submit statement of compliance to the ITB / Tender Document in its bid proposal. In the absence of such a statement, it shall be understood that all listed requirements are accepted, without any exception / deviation. Any cost for engineering and materials, subsequently identified shall be wholly borne by the CONTRACTOR and the changes incorporated without slippage to schedule or delivery and without further charge to the COMPANY.

Undue exceptions may also render a bid disqualified as theme of bidding is to have bids of same level for evaluation purposes. COMPANY will not accept any deviations which are buried within the body of the Technical or Financial Proposal and do not appear in the separate list, stated above.

1.6 Abbreviations

ESD	Emergency Shutdown System
UCP	Unit Control Panels
CCR	Central Control Room
PI	Pressure Indicator
TI	Temperature Indicator
LG	Level Gauge
FT	Flow Transmitter
PT	Pressure Transmitter
TT	Temperature Transmitter
LT	Level Transmitter



FAT	Factory Acceptance Test
C&E	Cause and Effect Matrix
COMPANY	OGDCL(Oil & Gas Development Company Limited)
CONTRACTOR	EPCC/SUPPLIER

1.7 Language and Units of Measurement

The governing language shall be English language.

The units of measurement to be used on this project shall be as listed below:

- Mass pounds (lb)
- Pressure pounds per square inch gauge (psig)
- Temperature degrees fahrenheit °F
- Mass flow pounds per hour (lb/h)
- Liquid flow barrels per day (bpd)
- or US gallons per minute (gpm)
- Vapour flow million std. cubic feet per day (MMSCFD)
- Density pounds per cubic foot (lb/cu ft.)
- Viscosity centipoise (cP)
- Length mile, feet, inches (m, ft, in)
- Pipe diameter inch (in)
- Time seconds (s)
- hours (h)
- day (d)



2.0 SERVICE CONDITION

2.1 Environmental Conditions

REFER project Design Basis Document No. # 0193-A-1000 for complete environmental data.

The CONTRACTOR shall take special note of environmental conditions associated with an installation being situated in Pakistan. It shall be considered that the Compressor Packages shall be installed in the extreme conditions of heat, humidity and dust.

- Climate : Desert sand storm
- Temperature : Maximum 55 °C (115 °F)
Minimum -1.1 °C (35 °F)
- Relative Humidity : 10%-17%
- Wind Velocity : 100 mph max
- Daily Rain Fall : 0-50 mm



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3.0 CODES AND STANDARDS

The instrumentation shall confirm with the latest version of standards, codes and statutory regulations listed below:

British Standards Institute:

BS EN 60079	Code of Practice for the Detection, Installation and Maintenance of Electrical Apparatus for use in Potentially Explosive Atmospheres.
BS 5908	Fire Precautions in Chemical Plant.
BS EN 61000-4-1	Method of Evaluating Susceptibility to Radiated Magnetic Energy.
BS EN 50288-7	Instrumentation Cable – Specifications for PVC Insulated Cables
BS ISO 9000-2	Quality Systems
BS 6121	Mechanical Cable Glands
BS EN 60228	Specifications for conductors in insulated cables and cords

American Petroleum Institute Standards:

API RP 551	Process Measurement Instrumentation.
API RP 554	Process Control Systems

Instrument Society of American Standards:

ISA	Practices and Standards for Instrumentation.
ISA 5.1	Instrumentation Symbols and Identification

National Fire Protection Association Codes:

NFPA 70	National Electric Code
NFPA 72	National Fire Alarm and Signalling Code

Institution of Electrical and Electronics Engineers:

IEEE	Regulations for Electrical Installations.
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International Electro-technical Commission:

IEC 60332	Fire Resisting Characteristics and Tests of Electric Cables
IEC 60529	Degrees of Protection for Electrical and Electronic Equipment Enclosures



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Institute of Petroleum:

NACE 0175 / Materials for use in H₂S-containing environments in oil and
ISO 15156 gas production

Institute of Petroleum:

Model Codes Safety Codes Parts 1 and 15

International Standards Organization:

ISO 9000 Quality Systems



4.0 GENERAL REQUIREMENTS

4.1 General

Only instruments of proven design shall be utilized with particular attention being paid to reliability and materials of construction.

Process fluids, steam or water shall not be piped into local or main plant control rooms for direct measurement. Measured variables shall be transmitted only by electronic signals to the main plant control room.

All equipments shall preferably have the same type and quality of instruments and documentation as the rest of the facility. Frequent quality control inspections will be required by COMPANY functional acceptance test will be witnessed by COMPANY before approval to ship is granted.

All process control loops shall be electronic and complete indication shall be provided on the PLC/HMIs and Workstations.

All non in-line instruments shall be provided with suitable stands. Instruments may be supported on Steelwork where location and access is suitable. Instruments shall not be supported off Process Pipework.

Self-operated instruments such as regulators may be used only for non-critical services.

Instrument tubing fittings and cables for all instruments shall be supplied pre-installed on skid. All loose supplied equipment shall be clearly specified and complete installation procedures shall be provided prior to shipment.

All cables within the skid shall be installed on cable trays/ladders or conduits. Cable Glands shall be used for connection of cables at enclosures.

Proper consideration shall be given to selection of instruments and instrument components, such that they shall be suitable for the internal fluid conditions and for the environment.

Instruments or their connections must not protrude outside the limits of the skid on which they are mounted.



All instruments (shutdown or process control) shall be provided with complete isolation. Even if the instruments are shown directly mounted on P&ID the Contractor shall provide the instruments installed with isolation. Specifically all level instruments shall be external cage mounted with complete isolation, drain and vent valves.

Instrument parts shall be resistant to the corrosive properties of the process fluid to which they are exposed. Seals, purges, and protection shall be used, as necessary, to ensure reliable instrument performance.

Housings and exposed parts of instruments shall be flameproof and weather proof where required.

All proposed plastic components shall be defined in CONTRACTOR'S quotation together with toxic and fire hazard detail.

Where instrument air is required on the Package/Skid, a galvanized carbon steel air header shall be provided. Air header shall be 1" NB minimum and shall be mounted adjacent to all instrument air users. Each user shall be provided with a block valve adjacent to header. All take-offs shall be from the top of header, which shall be terminated at skid edge with a single flanged connection.

The project piping specification shall establish process connection sizes, types and rating, etc. for direct connected and in-line instruments such as valves, thermowells, flow elements and level instrumentation.

In case of the highly corrosive fluids, special attention will be paid towards the selection of materials for in-line instruments, control valves, and relief valves in sour service.

All pressure / differential pressure transmitters shall have an accuracy of 0.075 % of span or better. Temperature Transmitters shall have an accuracy of 0.1 % of span or better. Level Transmitters shall have an accuracy of 0.1 % of span or better.

Pressure and temperature gauges shall have an accuracy of 1% of span.

Measuring ranges for all instruments shall selected such that the maximum process variable shall be at 75 % of the overall range e.g. for a pressure instrument having the



maximum process pressure of 75 psig the measuring range of the instrument shall be 100 psig minimum.

All Control Valves and ESD / BDV valves shall be tested and calibrated prior to and after installation.

All instruments shall be factory calibrated. Calibration certificate from manufacturer shall be furnished for project records. Complete list of instrument having manufacturer serial number and year of manufacturing shall be provided for future correspondence with manufacturer and to ensure brand-new status of instrument.

Preferably Switches shall be considered for Shutdown purpose. More than One instrument (switch or transmitter) shall be considered as 2oo2 (2 out of 2) voting system and configuration for all Instruments (Switches or transmitters) serving process shutdown in compressor package. Voting logic shall be applied to minimize the occurrence of complete loss of production caused by single transmitter fault or spurious trip shutdown. Also Maintenance Override Switch (MOS) Shutdown as bypass system shall also be configured for each of the variables that causes a shutdown sequence to start or for maintenance, calibration, etc. under password protection.

All field process switches e.g. temperature, pressure, level etc. and solenoids shall be provided with snap-acting hermetically sealed micro-switches with single pole change-over contacts rated for 5A at 24VDC minimum. Switches shall be specified to have fixed narrow switching differential.

4.2 Hazardous Area Instrumentation

Equipment installed in a hazardous area shall be certified for Class-1, Div.-II, Group C&D or or Zone-2 Gas Group II B T 3, unless otherwise detailed on specifications or other project documents.

Instruments in hazardous areas shall be certified for use in the zone concerned. The preferred methods of protection for this project is Ex "d" Flameproof.

All junction boxes or panels mounted on skid shall also be certified as explosion proof from the above mentioned certifying bodies.



Other methods, such as Ex "e", Ex "i", Ex "s", Ex "m" or Ex "q", may be used if Ex "d" is not applicable after acceptance from Client.

Wherever possible, CONTRACTOR to avoid the use of IS circuits, If unavoidable Galvanic isolators are to be used within suitable enclosures.

4.3 Instrument Air Supply

The CONTRACTOR shall provide suitable filter regulator gauge with all instruments requiring instrument air supply. The filter regulator and other required accessories shall be assembled and connected to an instrument air header which shall be available and provided by the CONTRACTOR at skid edge for connection. The Contractor shall submit calculation of instrument air loading requirement for the complete skid Package/Skid.

Pressurization by instrument air involves a continuous utility requirement and hence shall not be allowed.

4.4 Signal Transmission

The following signal transmissions shall be used for general and Packaged instruments:

- Analogue (Pressure/DP/ : 2-wire, 4-20 mA d.c., generally from a Level/Flow transmitter supporting HART protocol
- Analogue (Temperature) :3-wire RTD to BS 1904 with a "Smart" 4-20 mA Transmitter
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- Analogue (Position) : 3-wire variable resistance with a 4-20 mA Transmitter.
- Analogue (Vibration) : 3-wire vibration sensor
- On/Off Valve Position : 2-wire magnetic proximity hermetically sealed adjustable switches (Ex "d")
- On/Off control : 2-wire, 24V d.c.
- On/Off from a volt free contact : 2-wire, rated for 24V 5A d.c.

4.5 Instrument Power Supplies

The supplied instrumentation shall be 24VDC operable. The available power supply will be 220V AC. CONTRACTOR shall provide redundant power supply for



conversion of 220V AC to 24 VDC with the control system. The capacity of the offered power supply may exceed the actual requirement of packaged devices and PLC based packaged control system. CONTRACTOR shall provide power supply or power conversion means, where necessary for instruments requiring different voltage levels. All power supplies within the system (Package PLC) shall be dual redundant.

4.6 Calculations

The Contractor shall be responsible for the sizing of all control valves and flow measuring elements. Control valve sizing shall be based on the equations and methods contained in the ANSI/ISA standard S75.01. The calculation sheets shall be issued as a part of documentation. Ranging calculation shall be made for all instruments as necessary to match process data to the relevant instruments standard ranges. These ranging figures shall be tabulated and issued as part of his documentation in addition to instrument data sheets.

4.7 Tags And Nameplates

All instruments shall be provided with tags. Tags shall be 316SS attached to the instrument with stainless steel wire.

The CONTRACTOR shall permanently affix proper nameplates to the instrument supports.

4.8 Skid Mounting and Access to Instruments

All general and packaged instruments shall be readily accessible from grade, ladders, platforms, or walkways.

The mounting height of local instrument shall generally be 4ft 6in to the centre line of the instrument from the floor or walkway.

All instruments located in areas subject to vibration shall be suitably protected. Instruments shall not be mounted on handrails.

Impulse lines shall be made as short and simple as possible.



4.9 Instruments

4.9.1 Level Instruments

• General

- Level instrument connections shall be made directly to vessels or bridles not to process flow lines. Block valves shall be installed between the instruments and the vessel connections. Drains valves shall be installed at the low point.
- All Level instruments and bridals shall be insulated and electrically heat traced.
- Level instruments shall be supplied preferably from the Approved Vendor List.

• Liquid Level Gauges

- Glass gauges shall be steel armoured with threaded ¾" top, bottom or side connections.
- Gauges shall not exceed 5ft long for any one assembly. If the range to be covered exceeds 5ft, two or more overlapping gauges shall be installed.
- All gauges shall have offset angle pattern safety ball check valves with union gauge connections, plugged vent/drain connections and flanged vessel connections.
- The visible coverage provided by gauges on operating vessels shall normally cover the full range of liquid level transmitting or controlling instruments and associated alarm and shutdown switches.
- Gauges shall normally be positioned to provide equal visible coverage above and below the maximum and minimum anticipated operating liquid levels.
- Lucite frost shields shall be installed when frost formation may occur. MICA shields shall be used on hazardous applications, e.g. acid, caustic, etc.
- The minimum size connection on a pressure vessel is 2" flanged. Gauges that are connected directly to the vessel shall therefore be provided with gauge cocks having 2" flanged vessel connections.
- Gauges on bridles shall have 3/4" flanged vessel connections.

• Reflex Type Level Gauges

- Reflex gauges shall be used on all clean services not listed under Transparent Gauges below.
- Integral fluorescent illuminators shall be provided for the straight through gauge glasses.
- The illuminators shall be designed for use in hazardous areas as specified.



Transparent Type Level Gauges

- Transparent gauges shall be used on installations involving acid, caustic, dark colored materials and for liquid-liquid interface service.
- Integral fluorescent illuminators shall be provided for the straight through gauge glasses.
- The illuminators shall be designed for use in hazardous areas as specified.

• Tubular Type Level Gauges

- Tubular gauge glasses shall not be used.

• Magnetic Type Level Gauges

- Magnetic type level gauges with external flip indicators may be used as an alternative to the above.
- Magnetic type level gauges may be favored in situations of difficult access or where interfaces may be difficult to see.

• Level Transmitters/Controllers

- Level transmitter shall be Integral with level measurement system.
- Displacer or differential pressure measuring type level transmitters shall be preferred.
- A displacer shall be installed in a fabricated external cage with rotatable head and in parallel with a gauge glass.
- Local level controllers shall be external displacer type.
- Level transmitter shall have LCD display for indication.
- If level indication and local control both are required, a dual pilot controller/transmitter shall be used.

4.9.2 Pressure Instruments

• General

- All locally mounted pressure instruments shall be readily accessible from grad, platform, walkway or fixed ladder.
- Pressure instrument shall be provided with diaphragm seal or protector when there is a possibility of plugging.
- Ranging of all sensing elements shall be with normal operating pressure at approximately 60% of maximum range or such that the normal operating range is within the middle third of the selected range.



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- Over range protectors shall be fitted to pressure elements where abnormal maximum pressures exceed the normal maximum operating range.
 - Pressure instrument for measuring pulsating pressure should be equipped with pulsation dampner.
 - The use of partially closed isolation valves is not permitted as a means of pulsation damping.
 - 316 SS Two Way Manifolds shall be provided with all pressure instruments.
 - Isolation and vent valves other than manifolds shall be provided in accordance with the COMPANY's piping specifications.
 - 316SS is the preferred material for elements of pressure instruments, unless otherwise stated, a diaphragm seal of suitable material may be provided when corrosive materials are encountered.
 - Pressure instruments will be mounted on separate standard posts (post will not be created after welding on process pipeline)
 - Pressure instruments will be supplied with calibration certificate traceable to accredited agency / NIST.
 - Pressure instruments shall be supplied preferably from the Approved Vendor List.
- **Pressure Gauges**
 - Pressure gauge dials shall be circular, white, laminated plastic with black numerals and markings to prevent parallax error.
 - Local pressure gauges shall have a 150mm (minimum) diameter dial size ½" NPT (male) bottom connection.
 - Pressure gauge element shall be bourdon tube 316SS.
 - Pressure gauge ranges shall be chosen such that the normal operating range is within the middle third of the gauge range
 - Pressure gauges intended to be used in high pressure service shall be provided with safety glass or plastic windows.
 - Pressure gauges shall be coupled to the process as close as possible without compromising for the visibility/accessibility.
- **Pressure Transmitters**
 - Pressure transmitters shall be of force balance, strain gauge or capacitance type with diaphragms
 - The fill fluid shall be selected in accordance with the process conditions.



- Pressure transmitters shall be able to withstand safely an over range to the piping or vessel design pressure without loss of calibration.
- All pressure transmitters shall have local LCD indication of output, with a 0-100% scaled meter.
- All transmitters shall have fully adjustable zero and span.
- All pressure transmitters shall be of the “Smart” electronic type using HART protocol.
- Impulse piping used shall be as short as practicable.

4.9.4 Temperature

- General

- All temperature elements, except for surface temperature measurement, shall be installed in a Thermowell, unless otherwise stated or agreed by the COMPANY.
- Temperature instruments shall be supplied preferably from the Approved Vendor List.

- Thermowells

- Thermowell shall be fully forged or solid bar stock flanged type, sized 1½ “NB on pipework and 2” NB on vessels. Thermowells shall have flanged connections. The rating and facing of the flanges shall be according to the relevant piping specification. Screwed thermowells shall not be allowed to be used.
- The standard material for thermo wells shall, as a minimum, be 316 stainless steel. Other materials shall be used as dictated by the process conditions. Consideration shall be made of the galvanic effects if the thermo well material is different to that of the pipe material.
- The fluid vortex shedding frequency of the thermowell shall not exceed 0.8 times the natural frequency of the thermowell. All thermowells will be provided with calculations in accordance with ASME PTC 19.3 and shall be submitted for approval by COMPANY.
- The insertion length ("U") of a thermowell is the sum of the immersion length and the nozzle length. As far as possible, this shall be standardized, and the nozzle length adjusted to optimize the insertion length. The immersion length shall be at least 50% of the pipe ID.
- The entire heat-sensitive length of the bulb (resistance thermometer element) shall be immersed in the middle third of the fluid stream. The minimum



immersion length shall be in accordance with the data sheet unless the vortex shedding frequency necessitates the use of shorter wells.

- Test thermowell shall be fitted with 316 Stainless Steel weatherproofing plugs and securing chains.
- All thermowell shall be stamped with Tag Number, 'U' length, material of construction, connection size and type.

• **Temperature Gauges**

- Rigid stem dial thermometers with multi-position (2-plane any angle) head of 150mm diameter shall be used for local temperature indication.
- Bimetal type thermometers with hermetically sealed stainless steel case with heavy duty glass are preferred.
- For high vibration prone applications, remote gauges with gas filled flexible capillary should be considered.
- Thermometer ranges shall be chosen such that the normal operating range is within the middle third of the gauge range.
- The dial shall be circular, white, laminated plastic, with black numerals and markings to prevent parallax error.
- Thermometer connection shall be a compression gland union for fitting to thermowell.



- **Temperature Transmitter**

- Resistance bulb (RTD) thermometers shall be used for centralized control, indication and recording of temperature.
- The length of the temperature element shall be such that the bottom of the sensor is in contact with the thermowell bottom.
- Resistance thermometer elements shall have a resistance of 100 ohms at 0°C. Elements shall be manufactured in platinum. RTS shall be in accordance with IEC 60751.
- Transmitters shall be installed for all temperature measurements. Direct connection of sensor to temperature measuring I/O cards shall not be acceptable.
- Temperature elements shall be spring loaded to ensure adequate thermal contact.
- Thermocouples shall only be used, with COMPANY approval, and where RTD's are unsuitable.
- Transmission of temperature signals shall generally be achieved by means of a "Smart" electronic 4-20mA HART transmitter located as close to the element as possible.
- All temperature transmitters shall have local LCD indication
- Head mounted types are preferred.
- All temperature transmitters shall be of the "Smart" electronic type using HART protocol

4.9.5 Flow Instruments

- Flow instruments shall be supplied preferably from the Approved Vendor List.
- **Orifice Plates**
 - Orifice plates in liquid or vapour services shall normally be the square edge, concentric orifice type. They shall be fabricated and installed according to ISO 5167.
 - The plate material shall be 316SS unless where the process requires other materials.
 - The d/D ratio should be within the range of 0.25 to 0.75, the metering rangeability shall not exceed 3 to 1, and the design flow shall be within approximately 0.65 to 0.75 of full range.
 - Orifice shall be sized for 100 inches Water Column differential if practicable.



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- Flow Orifice shall be supplied preferably from manufacturer like ISA Controls, Fluidic Techniques and Flow Engineering.
 - The following information shall be stamped on the upstream, inlet side of the handle orifice bore, nominal line size and schedule, plate material, flange rating and instrument tag number.
 - Orifice flanges shall be in accordance with the applicable piping specification, and shall be equipped with ½" NPT female taps. Flanges shall be weld-neck type.
 - Orifice plate & bore size calculations will be furnished during detailed engineering.

 - **Differential Pressure Transmitters**
 - All transmitters shall have fully adjustable zero and span.
 - Differential pressure transmitters shall be capable of withstanding full line pressure on either side without affecting calibration.
 - All differential pressure transmitters shall be of the "Smart" electronic type supporting HART protocol.
 - All differential pressure transmitters shall have local LCD indication of output, with a 0-100% scaled meter.

 - **Coriolis Flow Meters:**
 - The transmitter shall be HART-Compatible to allow programming to be done using the HART-Communicator.
 - The transmitter should be available with local display with meter register where user can view flow rate, density, temperature, mass and volume totals and inventory levels and status messages.
 - The sensor and all other wetted parts are compatible with the process fluid conditions. The sensor (metal tubing) shall be made of SS 316Ti, unless the process conditions dictate the use of higher corrosion resistant materials.
 - The wetted flow tube pressure ratings must be in accordance to ASME B31.3.
 - The analog output can be designated to represent mass or volumetric flow rate, density, temperature or events, while frequency output can be designated to represent flow rate.

 - **Vortex Flow Meters:**
 - The Meter shall be SMART type with HART protocol with 24 VDC power supply and of 4 – 20 mA output.



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- The Vortex Flow Meters shall be based on the principle of Karman Street for flow measurement.
 - The Vortex Flow Meter shall be provided with a local integral LCD display.
 - The sensor and all other wetted parts are compatible with the process fluid conditions. All wetted parts including sensors shall be made of SS 316Ti, unless the process conditions dictate the use of higher corrosion resistant materials.
 - **Positive Displacement Flowmeter:**
 - P.D. Flow Meter shall consists of an integral mounted transmitter, meter register and strainer with vapor eliminator etc
 - The meter shall be of positive displacement single case rotary type in which 3 (Three) rotors shall turn in synchronized relationship with 3 (Three) Cylindrical bores with no metal-to-metal contact within the meter element.
 - The Meter shall be SMART type with HART protocol with 24 VDC power supply and of 4 – 20 mA output.
 - **Turbine Flowmeter:**
 - The Turbine Flow Meter shall be provided with a local integral LCD display.
 - The Turbine Flow Meter shall be SMART type with HART protocol with 24 VDC power supply and of 4 – 20 mA output.
 - The Turbine Flowmeter shall not be sensitive to density variation and shall not have a low sensitivity to viscosity.
 - The wetted parts are compatible with the process fluid conditions with Rotor material shall be of titanium or aluminum and Bearing material shall be of titanium or aluminum.
 - **Ultrasonic Flowmeter:**
 - The Ultrasonic Flow Meters shall be based on the principle of transit-time sound travel shift techniques.
 - The Ultrasonic Flow Meter shall be in-line mounted with measuring devices are permanently installed in the pipeline and the active sensor element is replaceable at process conditions.
 - The Ultrasonic Flow Meter shall be provided with a local integral LCD display.
 - The Ultrasonic Flow Meter shall be SMART type with HART protocol with 24 VDC power supply and of 4 – 20 mA output.



- The Ultrasonic Flow Meter shall be self-monitoring and diagnostic.

4.9.6 Shutdown Valves

- General

- Shutdown valves shall of Tight Shut-Off Class VI type (no leakage)
- Shutdown valves, complete with actuators, shall be approved by the COMPANY and shall conform to or be superior to the relevant COMPANY's Piping Specifications.
- The following requirements define the type of actuator to be used and the ancillary equipment to be valve mounted.
- All shutdown/sequence valves shall be ball valve type. Those installed as hydrocarbon system isolation valves shall be the certified fire safe and anti-static type.
- Shutdown valves shall operate fail-safe, both on air supply and electrical failure.
- After resetting the ESD the shutdown valve shall be opened from package/skid, i.e. by providing a manual reset at the solenoid valve etc.
- Accumulators may be considered where necessary to achieve fail-safe action.

- Actuator

- Ball Valves

- Actuators shall be sized to operate the valve atleast twice the full line differential pressure with 75psig air pressure and be capable of normal operation at upto 150 psig.
 - Actuators shall normally be spring return single acting piston operated scotch yolk type.
 - Actuators, which are not of this type may only be used with prior approval of the COMPANY.

- Dampers

- Damper actuators shall have sufficient torque to overcome dynamic forces and friction forces within the dampers or louvers under worst case conditions.
- The actuators shall be designed to cope with fouling and distortion, so that full force of the actuator does not damage damper blades and linkages.
- The dampers shall be air cylinder operated and opposed by a spring to return to the fail position.



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- Dampers shall be fitted with solenoid valves and limit switches, to provide open and close status.
 - The actuators shall be designed to cope with fouling and distortion, so that full force of the actuator does not damage damper blades and linkages.
 - **Valve Failure Action**
 - The valve actuator shall be designed so that the valve fails open, fails closed, or fails in the last position, as determined by safety considerations, on both supply pressure and electrical failure.
 - Fail closed Spring to close
 - Fail open Spring to open
 - Fail locked No spring double acting piston with air relay to lock air pressure in actuator.
 - **Hand Wheel**
 - A hand wheel and gearing where necessary shall be provided to allow manual operation of the valve, if specified by the COMPANY.
 - **Electrical Limit Switches**
 - Limit switches shall be fitted to all actuated ball gate and plug valves at both end of travel. Contact action shall be to open when position is reached.
 - The closed limit switch should be wired to the open indicating lamp and vice versa. Consequently both lamps will be on when the valve is in travel.
 - The switches shall be snap acting hermetically sealed micro type operated by cams/rollers attached to the valve stem, not to the actuator.
 - Electrical Limit Switches shall be supplied from the Approved Vendor List.
 - Contact rating shall be 2-Amp minimum at 24V D.C.
 - Switches shall be set to operate at the fully open and fully closed extremes of travel.
 - **Solenoid Valves**
 - Solenoid valves shall normally have stainless steel 3-port bodies and be fitted with continuously rated coils suitable for 24V D.C. operation.
 - They shall be de-energized for the failure position of the valve and be supplied with a manual reset lever when on emergency shutdown duty.
 - Terminal chamber with 20mm ISO screwed entry shall be integral with solenoid valve.
 - Solenoid valves shall be supplied from the Approved Vendor List.



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- Coil shall be rated for continuous operation at maximum ambient temperature and be provided with surge suppression diodes or resistors across the coil to prevent reverse EMF effects.

4.9.7 Control Valves

- General

- Materials specified shall comply with the latest edition of ASTM, AISI, API, MSS and ANSI codes for control valve materials. All control valves shall have a leakage class of Class IV minimum.
- Control valve shall be supplied from the Approved Vendor List.
- Control valve shall be sized by Manufacturer's standard.

- Required Valve Capacity

- Required valve capacities will be referred to in terms of CV coefficients. Cv for these purposes will be defined as the GPM of water that the valve will pass with 1.0-PSI pressure drop at rated stroke.
- The Control Valve size shall not be less than 50% of the line size.
- The Control Valves shall be sized in accordance with ISA 75 and IEC 60534.
- Generally, valves shall be selected to have a minimum opening of 20% and maximum valve opening of 80%.
- Valve sizing to be checked by the CONTRACTOR submitting quotations, with any alternate sizing recommendations submitted to COMPANY for approval.

- Valve Body & END Connections

- The preferred valve type for control valves shall be Globe. The CONTRACTOR shall take permission of Client if any other type is selected by the CONTRACTOR
- Castings shall be free from injurious blowholes, porosity shrinkage faults, cracks or other defects. Castings with defects that were plugged, welded, burned or impregnated are unacceptable. Wall thickness shall meet or exceed minimum requirements of applicable codes.
- Internal passage ways shall offer minimum restriction to flow. Pockets and shoulders tending to create turbulence or solids accumulation shall be minimized.



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- Bonnets and blind heads shall be of the same material as the valve body and of integral or bolted type construction with fully retained gasketing. Threaded bonnets are not acceptable.
 - Cooling fins and extension bonnets shall be of the same material as the body. Extension bonnets shall be supplied when operating temperature is below 0°F. Cooling fins or extension bonnets are to be supplied when operating temperature is above 450°F.
 - Angle valves shall have full venturi throat.
 - All control valves shall have flanged connections. The flanges shall be in accordance with ASME B16.5.
 - End connections for flanged valves shall be in accordance with the Piping Design and Materials Specification.
 - The face to face dimensions of flanged globe-bodied valves shall comply with IEC 60534-3.
 - Normally all control valves shall have flanged connections. The rating shall be in accordance with the relevant piping specifications. Flanges shall conform to ANSI B16.5 with rating and facing as specified in the applicable piping specification.
 - The direction of flow shall be clearly marked on the valve body. The CONTRACTOR shall determine the direction of flow which is more desirable for the operating conditions and comply with the noise requirements.
 - All valves in hydrogen or hydrogen-effluent service shall have bonnet flange and lower blind flange fitted with retained metallic gaskets suitable for these services.
 - When split body valves are specified, they are to be of through bolted construction. Body flanges shall be either ring types joint or have fully retained gaskets. Body gaskets shall be Teflon filled monel “Flexitallic” (preferred) or non-corrugated solid monel. Two extra sets of body gaskets shall be furnished for each valve.
 - Bypass valves, drain and isolation valves shall be provided for all control valves.
 - The use of line-size bodies with reduced trims shall be compared economically with the cost of an installation involving a smaller body size and piping reducers. In all cases, the use of body sizes less than half the line size shall be avoided wherever possible.



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- **Plug, Stem and Guide**
 - The plug form shall be solid contoured, tapered, splined, or solid V-ported and shall have the specified characteristic. Where low lift V-port plugs are specified, they may be of hollow construction. Acorn type plugs are not acceptable for angle valves regardless of valve size.
 - Three-way valve plugs specified for diverting service shall seat from outside the inlet chamber. Plugs specified for combining services shall seat from inside the outlet chamber.
 - Valve flow characteristics shall be as follows:
 - Linear – Capacity (C_v) directly proportional to valve stem travel.
 - Percentage – A plot of valve stem travel versus capacity (C_v) shall be a straight line function on semi-log graph paper.
 - Quick opening – CONTRACTOR's standard design.
 - Variations from the specified characteristic shall be so noted on the CONTRACTOR's quotation and submitted to the COMPANY for approval.
 - Plug stems shall be super finished in micro inches per the Manufacturer's Standard Tolerance. Plug stems shall have adequate strength to withstand maximum developed thrust of actuator. Separable plugs and stems shall be pinned.
 - Globe pattern valves (three-way, single and double seated) shall have top and bottom guided construction preferably, However, heavy duty type plug guiding is acceptable for single seated valves.
 - A splined valve plug or guide shall be provided or an equalizing connection shall be provided to permit relief of pressure from behind the guide post.
 - When a flushing connection is to be provided on angle valves, a splined valve plug or guide must be provided. An equalizing connection is optional.
 - The practice of skirt guiding (i.e. cage trim) is generally undesirable and unacceptable, and valves constructed in this fashion will be considered only on their individual merit when the application is submitted to the COMPANY for approval.
 - Rotary stem valves (ball, eccentric plug, etc.) shall have suitable guiding to prevent excessive shaft deflection due to maximum differential pressure or actuator thrust.
 - For 6" and larger valves, the post and guide bushing shall be designed to prevent rotation of the valve plug and stem.



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- When split body valves are specified, the valve plug shall seat from the top regardless of actuator action. Seat ring shall be of clamped-in design.
 - When tight shutoff is specified, with metal contact, for single seated valves, the leakage shall not exceed 0.0005 cubic centimeters of water per minute per inch of seat diameter per PSI differential pressure.
 - **Required Actuator Thrust**
 - The actuator shall be sized such that the rate of change of spring force is greater than twice the rate of change of stem force from zero lift to maximum lift.
 - To estimate stem forces the information on the Project Specification shall be used as follows.
 - When the valve is closed, upstream pressure is as indicated and the downstream pressure is assumed to be zero.
 - When the valves is throttling, the upstream and downstream pressure are assumed to be the same as indicated on the Project Specification.
 - **Yoke and Stem**
 - Yokes shall be of suitable rigid material for open type construction and heavy duty.
 - Actuator stems shall have adequate strength to withstand maximum developed thrust of actuator.
 - All valves shall be equipped with a valve stem travel indicator where so feasible. The indicator on valves having non-linear flow characteristics shall show percent of maximum capacity for the corresponding percent of travel.
 - **Diaphragm Type Actuators**
 - Diaphragm cases shall be of steel construction with suitable corrosion protection for a refinery atmosphere.
 - Diaphragm shall be of molded age resistant material suitable for withstanding the pressure and chemical characteristics of the operating medium over a wide range of ambient temperatures.
 - Diaphragm effective area shall remain essentially constant throughout the full stroke. The required thrust to stroke the valve as defined in paragraph IV-C-1 shall be accomplished by applying a 3-15 PSI air signal to this effective area. When the CONTRACTOR's largest diaphragm area available does not produce sufficient thrust with a 3-15 PSI air signal, a multiple thereof may be



used. (See paragraph VI-E.) Other “bench sets” are not to be used in order to undersize actuator.

- When double diaphragm pressure balanced type valves are specified, the area of the air diaphragm shall be twice the area of the gas diaphragm unless otherwise noted on Project Specification.
- **Pneumatic Piston Type Actuators**
 - Pneumatic piston type actuators shall have integral mounted force balance positioner and shall fail safe as noted on Project Specification on air failure.
 - Pistons and cylinders shall be of material suitable for withstanding the pressure and chemical characteristics of the operating medium over a wide range of ambient temperatures.
 - The CONTRACTOR shall provide all necessary pneumatic equipment for operation of these actuators.
- **Hand Operated Actuators**
 - Hand wheels where required shall be of the non-rising type with fine pitch threads for precise valve plug positioning. All threaded parts shall be precision fitted for minimum backlash.
- **Noise Requirement**
 - If the globe type control valve, which would normally be supplied for the operating conditions indicated on the Project Specification, will generate a noise level in excess of 90 db (decibels based on 2×10^{-4} Micro bar) measured 3 feet from the valve, then the CONTRACTOR shall submit an alternate proposal to the COMPANY for approval.
- **Trim**
 - Materials of construction for valve trim parts shall be selected to meet the requirements as shall be described in the respective valve data sheet. CONTRACTOR shall confirm the suitability of trim material.
 - The trim material for the control valves shall be minimum 316 SS and shall be suitable with the process conditions. For services where there is cavitation/ flashing stellited trim material shall be selected.
 - The trim characteristics for the control valve shall be selected in accordance with the process requirements.
 - Trim type letter designation on Detail Engineering Project Specification shall indicate trim material and any special notes associated with the trim type designation.



**SPECIFICATION FOR GENERAL
& PACKAGED INSTRUMENTATION**

- **Accessories**

- **Air Filter Regulator Set**

- Whenever an independent air consuming device such as a positioner, transducer, multiplying relay, pressure control unit, etc. is supplied, the Supplier shall include an air filter regulator set designed for 50 to 100 PSIG inlet pressure.

- **Gauges**

- Gauges of suitable range shall be furnished for air supply, input signal and output signals of all accessory pneumatic equipment. Where no accessories are required, a 0-30 PSI gauge shall be mounted on the valve diaphragm or tagged and shipped separately for mounting on valve diaphragm. Unless noted otherwise, gages are to be calibrated in English Units (PSI).

- **Positioners**

- Positioner shall be provided for all control valves. They shall be either yoke mounted balance or integral force balance type and they shall not be affected mechanically or functionally by any vibration encountered when so mounted.
- All positioners shall be Smart HART type .
- Positioners shall be suitable for operation on 2 wire 24vdc power supply.
- Positioners shall be easily converted from direct to reverse acting.
- Positioner shall be supplied from the Approved Vendor List.
- For high vibration prone area, contactless type magnetic positioners should be selected.

- **Limit Switches**

- Where limits switches are specified they shall be supplied and fitted by the control valve CONTRACTOR and shall be wired to a junction box suitable for the environment and hazardous area classification in which the valve will be installed. This junction box shall be mounted on the valve assembly.
- Electrical Limit shall be supplied from the Approved Vendor List.
- Contact rating shall be 2-Amp minimum at 24V D.C.

- **Identification**

- Valve shall have the following identifying information:]
 - Equipment identification number (tag number).
 - Pressure rating, material and size of valve and flow direction on the valve body.



- Manufacturer's name, model, serial number, valve action, characteristic, stem travel, CV value, material of construction, size (body and trim) type of plug and spring range, maximum working pressure of the actuator etc. on the nameplate.

4.9.8 Safety and Relief Valves

- **General**
 - Pressure relieving valves shall be designed, sized, constructed, tested and installed in accordance with ASME VIII. For items not covered by ASME VIII then API RP 520 Parts 1 and 2 and API RP 521 shall be applied.
 - Pressure relieving valves shall be so constructed that, in the event of a fire, the operation of the valve shall not be prevented due to the partial or complete destruction of the internal components.
 - Safety valves for pressure relief shall normally be sized in accordance with API RP-520A vessel may have a full area stop valve between it and its pressure relieving device for inspection and repair purposes only. The stop valve must be so arranged that it can be locked or sealed open. When such stop valves are installed, a secondary method of automatically relieving vessel over pressure shall be provided. An interlock shall be provided to ensure that both relief routes are not closed simultaneously.
 - If the pressure relieving device discharges to a common relief header, a full-area stop valve shall be placed on the discharge side of the pressure relieving device such a stop valve shall be so arranged that it can be locked or sealed in either the open or closed position. Under no condition should these valves be closed while the vessel is in operation unless the vessel is fully protected by an alternative pressure relief device.
 - Where there is no secondary method of pressure relief, the devices will not have any means of isolation.
 - If the design of the pressure relieving device is such that liquid can collect on the discharge of the pressure relieving device the device shall be fitted with a drain at the lowest point where liquid can collect and be self draining.
 - Where no possibility of hydrocarbon pollution is present such as in water and air service safety relief valves may be vented to the local atmosphere.
 - Pressure relief valves of the pilot operated type shall be considered when the normal process operating pressure is within 10% of the relief valve set pressure. Pressure relief valves shall be spring loaded with balanced bellows if varying back pressure exceeds 10% of set pressure.



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- The pilot valve shall be constructed from 316 grade stainless steel and have resilient seat seals appropriate for the service, and provide on/off (non-modulating) control of the non-flowing design. A field test connection port shall be provided
 - Valves shall preferably have metal to metal seats. Resilient seat seals shall be provided on services where maximum tightness is essential, and to limit leakage which may be caused by the effects of corrosion or vibration. Where resilient seat seals are selected, the selected materials shall be based on maximum and minimum service pressure and temperature. Leakage shall comply with API Standard 527. Pressure and vacuum relief valves for storage tanks shall normally be of the weight loaded type and sized in compliance with API-2000.
 - All valves size 1” NB and larger shall have end connections flanged to ANSI B16.5. Flanges shall be integral or of the weld neck type. Where alternative end connections are required these shall be subject to approval by the COMPANY
 - Sizes up to 1½” NB may have ends screwed, to ANSI B1.20.1 (N.P.T.F.) for category D fluids as defined by ANSI B31.3.
 - Minimum rating of inlet and outlet flanges shall be ANSI Classes 300 and 150 RF respectively. Higher ratings shall be equal to or greater than the rating of the system.
 - Relief valves shall have dimensions in accordance with API Standard 526.
 - All pressure relieving valves shall be of manufacturer's standard type.
 - **Overpressure**
 - Notwithstanding ASME VIII, overpressure for gases or vapors shall be limited to 10% of set pressure for single valve applications and 16% for multiple valve applications. Overpressure for fire exposure duty shall be limited to 21% of set pressure.
 - Overpressure for liquids shall be limited to 10% of set pressure on pressure vessels, and from 10 to 25% of set pressure on piping.
 - Valves on liquid service operating at low pressure tend to chatter; therefore overpressures of less than 10% on liquid service should be avoided.
 - **Capacity**
 - Pressure relieving valves for use on gas or vapor service shall be designed to achieve rated discharge capacity at a pressure not exceeding 110% of the set pressure for general duty and 121% for fire exposure duty.
 - Valves on liquid service shall achieve rated discharge capacity at specified overpressure up to a maximum of 125% of the set pressure.



- **Inlet/Outlet Piping**
 - Relief valves shall be installed with spindle in a vertically upward position, either directly on a pressure vessel/header nozzle, or on a connection fitting that provides direct and unobstructed flow between the vessel/header and the valve.
 - Where a pressure vessel is fitted with safety valves to prevent the vessel from being operated at a pressure greater than the permissible working pressure a suitable stop valve on the supply line and a pressure gauge with the maximum allowable working pressure marked in a distinctive color shall be provided.
 - The total pressure drop between the protected equipment and the inlet of the valve shall not exceed 3% of the set pressure of the valve when passing the valves full rated capacity for the chosen effective area in accordance with API 520.
 - The pressure relief piping shall be designed and supported to withstand discharge reaction forces, wind, thermal and dead loads. The reactive forces caused by the pressure discharge including forces due to back pressure shall be calculated in accordance with API RP 520.

4.9.9 **Analyzers**

- **General**
 - Installations shall generally be in accordance with API RP 551.
 - Analyzer equipment and installation must comply with the area classification.
 - Gas Chromatographs wherever used shall be of Thermal Conductivity Detector type
 - Moisture analyzer wherever used shall be of Quartz Crystal Microbalance type.
 - All other analyzers shall be selected after consultation with the COMPANY.
 - Analyzers shall be installed in weather resistant enclosures where required meeting the minimum ingress protection of IP 66.
 - Analyzer equipment and installation must comply with the area classification.
 - H2S analyzers shall be used to detect H2S traces where required.

4.9.10 **Tubing Installations (Pneumatic, Hydraulic, Process)**

- **General**
 - The standard signal tube shall be 6,10 and 12mm OD ASTM, A269 TP-316 stainless steel with a minimum Molybdenum Content of 2.5%.



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- Design and installation shall be in accordance with good engineering practice as outlined in API RP 550 Part I, Section 7.
 - The wall thickness for each tubing size should be common throughout the plant in order to avoid an error at the warehouse and during installation. The wall thickness selected should be for safety at the highest pressure anticipated for the tubing size.
 - All tube fittings shall be Swagelok or equal, double ferrule type.
 - The number of fittings used in a particular installation shall be kept to a minimum and the use of elbows shall be avoided as far as possible.
 - Bulkheads shall be provided for all local panel and inter-skid pneumatic connections. Bulkheads shall have no more than two rows of connections and enough separation to make spanner access comfortable.
 - Supports for field connected pipe shall be provided adjacent to bulkheads, so that the pipes or multitubes cannot transfer stress to their connecting fittings.
 - 15% spare is required at bulkheads, in addition all unused instrument spaces shall be allocated bulkhead connections.
 - Valve-off branches or sub-headers (block manifolds), including 15% spare, shall be teed off from the top of the air supply header.
 - Only one manufacturer of stainless steel compression fittings will be used throughout the plant facilities.
 - **Location, Support and Routing**
 - Tubing shall be routed to minimize accidental mechanical abuse and possible damage to tubes from fire or overheating.
 - Stainless steel tubes shall be supported every 5ft using plastic tube clamps with galvanized top plates, nuts and bolts. These to be bolted to channel or tray work or to structural steel bracing when necessary.
 - Channel or tray supporting tubing shall be sized for a minimum capacity of 50 percent greater than that required.
 - Tubing bundles and single tubes shall be fastened to the tubing supports at intervals of 5ft and near the entering and departing tangents of a vertical change in direction.



4.9.11 Fire & Gas Instruments/Devices

General Requirements

- All fire and gas detectors/ devices shall be suitable for operation from a nominal 24VDC source of supply derived from the System cabinets.
- Calibration gas cylinders shall be provided for each type of detector used. The quantity of the cylinders shall be adequate for testing and calibration of all detectors supplied.
- Test Lamp, Alignment kits, calibration kits and any other special equipment shall be provided for testing of Fire & gas detectors.
- Factory Calibration Certificates shall be provided with each detector.
- For increased reliability, all fire alarm sensors shall be provided with self diagnostic circuitry to verify actual alarm condition to prevent false alarms. Only a verified alarm shall initiate the alarm sequence.
- The emergency hooter of variable & straight tones shall be provided.
- All fire sensors, to be mounted in hazardous area, shall be certified to be used in mentioned hazardous area, certificates shall be provided by the CONTRACTOR.
- Gas detector for toxic gases shall be of electrochemical type.
- All field devices shall remain stable under the worst environmental conditions. Sensitivity of detectors shall not change significantly as a result of supply voltage variations within the following range -15% to +10% of nominal voltage.
- All field devices shall provide sufficient terminals to accommodate end of line and in line resistors where applicable. This shall provide the required resistors.
- All field devices where applicable shall be suitable for "one man" calibration.
- The Manual Alarm Call Point (MAC) installed in hazardous area shall be suitable to be used in mentioned hazardous area classification.
- Weather protection (minimum IP66 or equivalent) and Mechanical protection shall be provided for all field mounted electronic devices/instruments.
- Field devices shall operate over a humidity range of 0 to 95% relative humidity and be able to withstand 100% condensing humidity for short periods of time.
- Detector alarms shall be self-latching with remote reset from the Safety system.
- Field devices shall be capable of retaining a guard for impact protection where appropriate and shall incorporate means of preventing small insects from entering any part of the device.



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- The choice of fire detectors for an area shall reflect the anticipated prime indication of a fire. Heat, Smoke and Flame detectors shall be considered depending on the risk and the location.
 - Fire detectors shall be of a field self resetting type such that after removal of the hazard normal surveillance shall be restored without the renewal of any components.
 - The detectors shall be mounted stable.
 - Fire detectors must be by passable for short times to allow welding, photography etc.
 - All digital system I/O is implemented as dry contacts.
 - Contractor shall design compression facility area and packaged fire and gas detector location to cover all possible points of gas leakage or where arcing / sparking may occur.
 - Fire and Gas detectors and devices shall be supplied from the Approved Vendor List.

Flame Detectors

- Flame detectors shall be of the infra red (IR) type incorporating a 90 degree minimum field of view, tolerant to thick smoke, dirty environments and resistant to solar radiation, whether direct, reflected or modulating.
- Flame detectors shall be integrated devices that contain all sensing, signal processing and visual indicators.
- The detector shall be capable of a 0.5 second response time to an intense fire signal.
- The device shall be capable of responding to a fire when hot surfaces are present and shall not be inadvertently activated by them.
- The detector shall have modular design that allows the sensor module to be easily replaced in the field without the use of special tools.
- The detector shall have a swivel mounting bracket to allow easy adjustment.
- The use of flame detectors shall be restricted. Flame detectors are the choice in open process areas where process materials are handled above their auto-ignition temperature and where "flange - fires" could initiate major accidents.
- In open areas, Flame detectors shall be directed downwards in order to avoid incorrect readings produced by sky or any other sources above the horizon. When spacing Flame detectors, the vendor should be consulted.



Gas Detectors (Infra Red Type)

- Both Open Path & Point Type Gas detectors shall primarily be installed to monitor areas of the plant where flammable gas may escape and/or cumulate.
- Each detector will respond to a level of accumulation and be designed to alarm at two pre-set alarms.
- Output from individual detectors shall occur at settable levels of concentration % LEL (Lower Explosive Level).
- Due to the reliability of infra-red type gas detectors, activation of a single detector shall initiate a confirmed gas alarm.

Smoke Detectors (Photoelectric)

- The detector shall sense visible smoke likely to occur during overheating in electrical risks.
- The detectors shall be based on the light-scatter principle utilizing a labyrinth chamber.
- The light trap labyrinth chamber shall be easily removed for periodic cleaning.
- Bases shall be available for surface mounting; these shall be supplied separately from the detector units and shall have a facility for a remote indicator.
- The detector shall be of robust construction and manufactured specifically for an exposed dirty environment. The detectors shall be installed in Plant Control building, where required.

Heat Detectors (Rate-of-Rise, with fixed temperature)

- The detector shall operate from a rapid rise in temperature or at a fixed maximum temperature for the appropriate classification given in NFPA-NFC 72E.
- The detector shall be based on the twin thermistor principle using solid state components with no moving parts.
- Bases shall be provided for surface mounting, these shall be supplied separately from the detector units.
- Detectors shall be self-latching and have no moving parts.
- Detectors shall be capable of retaining a guard for impact protection where appropriate and shall incorporate a means of preventing small insects from entering any part of the detector.
- The detector shall operate at a pre-set temperature. It shall comply with NFPA-NFC-72E.



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- The detector shall be of robust construction and manufactured specifically for an exposed dirty environment.
 - The detector shall indicate the temperature setting.
 - Detectors shall be capable of retaining a guard for impact protection where appropriate and shall incorporate a means of preventing small insects from entering any part of the detector.

Toxic Gas Detector (H2S)

- Both open path H2S Gas detectors of Near IR Laser Scanning and point type detector of catalytic type shall be installed to monitor areas where toxic gas (hydrogen sulfide) may present.
- Laser Open Path Gas Detector shall be supplied with both receiver and transmitter.

Manual Alarm Call Points (MAC)

- Manual Alarm Call Points (MAC) shall be used to supplement the automatic fire detectors and be of push button type, with key reset and protected from accidental operation by a lift up flap or glass cover.
- The call point shall include encapsulated changeover contacts rated for 24VDC 5A. The switch contacts shall have sufficient clearance to earth and the switch construction shall withstand 500 VAC insulation test to any earthed metal.
- Manual Alarm Call Points (MAC) shall be supplied equipped with current limiting resistors permanently fitted in-side the unit.
- Manual Reset keys shall be provided with each MAC if required.
- Operation of the call point shall cause a change in loop current to be detected at a control module, in the Safety.
- Terminations shall be screw and clamp type suitable for 2.5mm² conductors and incorporate capacity for all permissible field wiring configurations. Separate earth terminals shall be provided.
- Externally mounted Manual Alarm Call Points (MAC) shall be of robust metal construction with integral surface mounting lugs. All screws shall be of 316 stainless steel socket heads in recesses.
- Internally mounted call points shall also be of metal construction but may be of lighter construction suitable for surface mounting.
- All Manual Alarm Call Points (MAC) shall be of epoxy painted and be labeled in accordance with the local authority requirements. MAC shall be painted in



RED, should have ingress protection minimum IP65 or equivalent and in accordance with area classification mentioned in datasheets.

- All Manual Alarm Call Points (MAC) shall have a minimum of 2 entries at the bottom of the enclosure and shall be plugged by the vendor.

Beacons & Sounders

- Beacons shall be used in areas of high ambient noise or where additional means of warning are required.
- Red Color Beacons shall be used for fire and yellow /orange color shall be used for gas leakage.
- The beacons shall be of the Xenon Flashing type, color Amber suitable for the area classification in which they are to be installed. They shall be of a rugged construction, include a means of mounting and facility for lens protection. The beacons shall be powered by 24VDC through the Safety System and shall give a light output of 5 Joules minimum. Vendor shall state maximum distance at which the above output can be achieved.
- It shall be possible to manually activate from the control building all beacons for plant evacuation.
- Alarm annunciations shall be sent in different light colors and different audio tones; alarm enunciators shall be arranged in such a way that they can alert every personnel at every possible position.
- Audible Alarms can be silenced by means of a reset switch, but can activate again if new fault alarm activate. Audible level alarm, 110dB.
- As a minimum, alarm system Instruments installed outdoors shall be suitable shall be suitable to be used in mentioned hazardous area classification.
- Hooters shall have feature for selection of straight and variable pitch.
- One manual hand operated siren shall be provided within the plant for annunciation of any emergency conditions manually.

4.9.12 Instrument Cable

- **General**
 - In general, all the electronic instrumentation and associated cabling, junction boxes, glands, etc. installed in area classified as hazardous shall be certified (by an internationally recognized certifying authority) as suitable for the designation of the area in which it is installed.
 - Single pair and multi-core cable shall be PVC insulated 7-stranded copper conductor, PVC bedded, steel wire armored, overall screen with drain wire (for digital signal cable), individually and overall screen with drain wire (for analog signal cable), PVC outer sheathed, flame retardant cable supplied in



accordance with the specified standards but special requirements shall be treated on merit..

- Signal wiring for special instruments shall be according to the manufacturer's recommendations, but not less than the minimum established in this Section. All cabling shall be of the type specified for use in hazardous areas, unless agreed otherwise with the COMPANY.
- All instrument cables, control cables and its cable gland with shroud shall be supplied by the Contractor.
- The cables used for ESD and F&G shall be Fire Resistant in accordance with IEC 60331. All other instrument cables shall be flame retardant to IEC 60332.
- Cables glands EEx'd' type suitable to area classification shall be used on all instrument and junction boxes for cable connections. Gland body material should be Brass with ingress protection of IP66.
- CONTRACTOR shall submit technical specifications of instrument cables in the bid document.

- **Identification**

- Sheath color of special cables shall be as per supplier standard. All special cables shall be clearly labeled for ease of identification.
- Each single core and multi-core shall be identified by sleeves at both ends.
- Each junction box, or terminal rack terminal shall be identified by the connected instrument tag number. Cores bearing different tag number but requiring to be commoned shall be connected to individual identified terminals and the terminals commoned by inter-connection. Not more than one core shall be connected to each terminal.

- **Cable Separation**

- Wiring for thermocouples, electronic signals and analyzers shall be in separate trays or trays with metal separation. Signal wiring shall not be run in the same tray as power wiring.
- Cable runs shall be carried out in a neat and professional manner and separation of cables from power cable shall be 2ft minimum.

- **Data Cables**

- Data cables shall be fire retardant to IEC 332.3, with armour protection.
Cable type Suitable for Modbus TCP/IP data communications

- **Fiber Optic Cables**

- FO cables shall be in accordance with G652
- FO Cable shall be of armored type.



- All connectors, splicing equipment and connectors for FO cables shall be included in CONTRACTOR scope.
- OFDM Testing and Link loss testing shall be carried out on the FO all FO cables at site prior to laying. The cables shall be subject to testing at the factory as per the client requirement.
- FO cables shall be used for connectivity of the Compressor PLCs with Engineering and Operator Workstation HMIs in Control Room.

4.9.13 Junction Boxes

- Junction boxes shall be supplied at skid edge and shall be drilled and tapped to suit metric glands for all incoming cables.
- There shall be dedicated junction boxes for electrical supply cables. Signal cables shall be taken to separate boxes.
- There shall be separate junction boxes for each of the following groups of cables:-
 - Cable carrying digital signals
 - Cables carrying analogue signals
 - F&G detectors/Devices
 - Power Cables

4.9.14 Glanding

- All electrical instruments shall be supplied with cable entries to suit metric cable glands. Junction boxes and instruments shall have explosion proof sealed cable glands to prevent the ingress of gas to the safe area through the cable. All spare entries shall be sealed by a method that ensures integrity of the junction box. Standard cable entry size on instruments shall be screwed M20 x 1.5.

4.9.15 Earthing

- The cable armor shall be earthed at each end to an electrical earth boss welded to the structural steelwork. Screening shall be continuous throughout the loop but earthed at the control panel end only, to an instrument copper earth bar insulated from the steel structure.
- Instrument body shall properly be earthed.
- Clean instrument earth shall be used for earthing signals and cable screens.

4.9.16 Protection

- Each instrument shall be line fused.



4.9.17 Isolation

- Each instrument shall be capable of being isolated without removing cable cores from terminals.

4.9.18 Cable and Junction Box Designations for Instrumentation

- Cable and junction boxes shall be identified with unique number labeling.
- Junction boxes shall number and tagged with engraved SS nameplates.

4.9.19 Protection and Tracing/Lagging

- **Housing**

- Normally, Package/Skid instruments shall be supplied with protection to IP65 minimum and to suit the maximum/minimum ambient temperatures given in the project specification.
- Instruments shall be housed under the following conditions as a minimum:-
 - Where the instrument case is not weatherproof.
 - Corrosive substance from an external source.
- Housings or enclosures for indicating or recording instruments shall be fitted with a viewing window.

- **Lagging**

- Instruments and their process connection lines shall be lagged, if required for:
 - Heat retention
 - Personnel protection

- **Seals and Purges**

- The application of seals and purges shall be considered, where viscous or corrosive fluids are present, to assure reliable instrument performance.



5.0 JUNCTION BOXES AND WIRING

5.1 General

Sufficient junction boxes shall be provided to segregate differing voltage levels and signal types (analogues from digitals, control from safety, IS from non-IS).

Ingress protection for local junction boxes shall be to IP65 minimum.

All spare cores in cables entering junction boxes shall be fully terminated and earthed, with 20% spare terminals unwired.

All junction boxes shall be supplied wired to skid mounted instruments. The junction boxes shall be ready for glanding and termination of multicore cables to be laid from skid to control room where required.

All junction boxes shall be front panel access. The front panel shall be hinged and pad-lockable.

Panels shall be made from stainless steel, to AISI-316 for all parts except for internal parts forming secondary structures, which may be to AISI-304. Plastics (subject to COMPANY approval) may be used for minor support and electric cable trunking.

Wire brushed stainless steel surfaces are required to reduce reflection from shiny surface.

The junction box shall be supplied with single or multiple rows of DIN rail mounted terminal blocks (Weidmuller or equivalent). The terminal blocks shall be Ex'e' certified, and shall have spring loaded screw terminal connections suitable for wire sizes up to 2.5sqmm. Terminal rows and terminal numbers shall be clearly marked for identification.

Junction boxes shall be selected from manufacturers' standard sizes according to design requirements. The standard sizes for junction boxes shall contain the following numbers of terminals suitable to meet the 'Exe' certification:

- 11 Terminals
- 30 Terminals
- 60 Terminals
- 120 Terminals



All junction boxes shall have at least 20% spare capacity in terms of gland connection entries, terminals and duct space. The spare entries shall be plugged with explosion proof plugs.

The Contractor shall draw the COMPANY's attention to parts to be fabricated from stainless steel of grades or finish other than specified and shall obtain COMPANY's approval.

All junction boxes shall have stamped 316SS tag plates fixed to the front panel with stainless steel screws.

The Supplier shall submit As-built termination drawings of the junction boxes.

5.2 **Wiring on Skid**

Wiring shall be on cable trays, in trunking or on vertical wire racks designed so as to produce a neat and accessible layout, properly supported and wherever necessary, loomed up. The cable trays and other raceways shall have 50% spare space.

Separate wire-ways shall be provided for signal cables and power wiring runs with adequate separation.

Identification sleeves shall be fitted to each end of wiring runs, and shall be inscribed with instrument tag number and terminal number.

No splices or connectors shall be permitted in a cable or wire run. All terminations shall be crimped pin type. Any other type must be approved by the COMPANY.

All instrumentation and junction boxes shall be connected to the skid grounding bar by direct wiring from the instrument or junction box ground lug.



6.0 TEST AND INSPECTION

It is COMPANY's intent to have all Package/Skid instruments tested at the Vendors facility before shipment. CONTRACTOR shall submit Vendor testing procedure for COMPANY/Engineering Consultant's approval CONTRACTOR shall submit test records for COMPANY/Engineering Consultant's approval and records. COMPANY reserves the right to witness all tests.

7.0 PAINING AND PREPARATION FOR SHIPMENT

Requirements for Painting and Preparation for Shipment as per Supplier standard and if any difference were found is to be approved from COMPANY. For loose supplied instruments the manufacturer's protective seals that cover openings or components of instruments such as gauges, valves, indicators, and controllers shall be provided and shall not be removed until the components are ready to be connected into the system.

8.0 WARRANTY

CONTRACTOR shall provide warranty of each instrument in name of the COMPANY. Manufacturer shall warrants that the equipment manufactured and sold by it will, upon shipment, will be free of defects in workmanship or material. Should any failure to conform to this warranty become apparent during a period of one year after the date of shipment, Manufacturer shall, upon prompt written notice from the COMPANY, correct such nonconformity by repair or replacement, F.O.B. factory of the defective part or parts. Correction in the manner provided above shall constitute a fulfillment of all liabilities of Manufacturer with respect to the quality of the equipment.



9.0 DOCUMENTATION

9.1 General

The CONTRACTOR shall prepare drawings, instrument schedules and other data to allow for the efficient procurement and for installation, operation and maintenance of the control and instrument facilities.

- Control System Architecture Drawing
- PLC Control System Architecture Drawing
- Overall System Architecture Drawing
- Reference documents, codes and standards
- Quality Plan
- Operator Interface Proposals including Screen Animation principles and color standards, display sketches, alarm philosophy
- System hardware configuration
- Power supply details including distribution line diagrams
- I/O List
- Availability and reliability calculations
- Cause & Effects
- Logic Diagrams
- Loop Drawings
- Typical Engineering Drawings
- Technical Data Sheets of components used
- Instrument & JB Location Layout
- Instrument Cable Layout
- Cable Schedule
- Instrument Master Index
- Wiring, termination and interfacing details drawings
- Equipment manufacturer model numbers and retails
- M.T.O. List

In addition to the hard copies, 03 sets of soft copies of the documents & drawings shall be provided on CD or better storage media.