

	<b>CONCEPTUAL, BASIC and DETAIL DESIGN ENGINEERING OF STYRENE PARK OFFSITE</b>			
	Document Title : Specification for Package Instrumentation			

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## 1 INTRODUCTION

Feed and utility lines and network construction, Styrene Monomer tank construction, Peroxide and its sidelong equipment warehouse are among this company's missions.

Some of the ongoing Projects of this company are:

ABS-Rubber project


ESBR project

EPS project

Poly Styrene

## 2 DEFINITIONS AND ABBREVIATIONS

AK	Anforderungs Klasse (Safety Requirement Class by TÜV)
ANSI	American National Standard Institute
API	American Petroleum Institute
ASME	American Society for Mechanical Engineers
CCR	Central Control Room
CHP	Central Hendijan Platform (Existing)
DHSV	Down Hole Safety Valve
DIN	Deutsches Institut für Normung e.V.
ESD	Emergency Shutdown
EWS	Engineering and Maintenance Work Station
HMI	Human Machine Interface
ICSS	Integrated Control and Safety System
IEC	International Electrotechnical Commission
LTR	Local Technical Room
MOV	Motor Operated Valve
NACE	National Association of Corrosion Engineers
OWS	Operator Work Station
PC	Personal Computer

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PCS	Process Control System
PLC	Programmable Logic Controller
PSD	Process Shutdown
SDS	Shutdown System
SDV	Shutdown Valve
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SOE	Sequence of Event
SSV	Surface Safety Valve
TÜV	Technischer Überwachungs Verein (German Technical Inspectorate)
USD	Unit Shutdown
VDE	Association of German Electrical Engineers
VDU	Video Display Unit

### 3 APPLICABLE CODES, STANDARDS, SPECIFICATIONS AND SITE ENVIRONMENTAL CONDITIONS & UTILITIES

#### 3.1 International Codes and Standards

To achieve operational safety, sound engineering practices must be followed. All guidelines described within this philosophy complement applicable sections of the following codes and standards (and their current amendments)

##### **American Society of Mechanical Engineers**

ASME B16.104	American National Standard for Control Valve Seat Leakage
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME PTC 19.3	Performance Test Code Temperature Measurement
ASME 7.0.01	Quality Standard of Instrument Air
ASME 75.01.01	Flow Equations for Sizing Control Valves
ASME 75.02.01	Control Valves Capacity Test Procedure


##### **American Petroleum Institute**

API RP 500	Recommended Practice for Classification of locations for Electrical Installation at Petroleum facilities Classification as Class 1, Zone 0, Zone 1 and Zone 2.
API RP 520	Recommended Practices for the Design and Installation of Pressure Relieving Systems

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API RP 521	Guide for Pressure Relief and Depressuring Systems
API RP 526	Flanged Steel Safety Relief Valves (sections 1 to 4)
API RP 527	Commercial Seat Tightness of Safety Relief Valves with Metal to Metal Seat
API RP 551	Process Measurement Instrumentation
API RP 552	Transmission Systems
API RP 554	Process Instrumentation and Control
API RP 555	Process Analysers
API 670	Machinery Protection Systems
<b>British Standard</b>	
BS 381C	Specification for Colours for Identification Coding And Special Purpose Process Analysers
BS EN 837-1	Pressure Gauges Bourdon Tube Pressure Gauges, Dimensioning, Metrology, Requirement and Testing.
BS EN 837-2	Pressure Gauges Selection and Installation Recommendations for Pressure Gauges.
BS 6379	Code of Practice for Instrumentation in Process Control Systems: Installation design and Practice.
BS EN 60529	Specification for Degree of Protection Provided by Enclosure (IP Code)
<b>Energy Institute</b>	
EI IP Model Code	Area Classification Code for Petroleum Installations (1990) being Part 15, of the IP Model Code of Safe Practice in the Petroleum Industry
<b>International Electro technical Commission</b>	
IEC 600 79	Electrical apparatus for explosive gas atmosphere
IEC 600 68-2-3 Ca	Environmental testing – Part 2 – Tests – Test Ca : Damp heat, steady state.
IEC 600 92-375	Electrical Installation in Ships. Shipboard telecommunication cables and radio frequency. Cable General Instrumentation, Control and Communications Cable. Transmission Systems
IEC 60 801 Part 1	EMI and RFI Immunity. Electromagnetic compatibility for industrial process measurement and control equipment.
IEC 60 331	Fire Resisting Characteristics of Electric Cables
IEC 60 332.3	Test on electric cables under fire conditions. Part 3 Test on bunched wires or cables.
IEC 60228	Conductors of Insulated Cables
IEC 60331	Fire-resisting characteristics of electric cables
IEC 60332	Test on Electrical Cable under Fire Conditions
IEC 60 529	Degrees of Protection Provided by Enclosures (IP Code)
IEC 61158-2	Foundation Fieldbus Standard for use in Industrial Control Systems- Physical Layer Specification and Service Definition
IEC 60754	Test on Gases Evolved during Combustion of Materials from Cables

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IEC 61131-2	Programmable Controllers; Equipment Requirements
IEC 61131-3	Programmable Controllers: Programming Languages
IEC 61508	Functional Safety of Electrical / Electronic / Programmable Electronic Safety Related Systems
IEC 61511	Functional safety-Safety Instrumented Systems for the process industry sector Instrument Association of America
ISA S5.1	Instrumentation Symbols and Identification
ISA S5.2	Binary Logic Diagrams for Process Operations
ISA S18.1	Annunciator Sequences and Specification
ISA S 20	Specification Forms for Process Measurement and Control Instruments Primary Elements and Control Valves
ISA S 75-01	Flow Equation for Sizing Control Valves

#### **International Organization for Standardization**

ISO 5167	Measurement of Fluid Flow by Means of Pressure Differential Devices.
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#### **National Association for Corrosion Control (where applicable)**

NACE MR0175	Sulphide Stress Cracking Resistant Metallic Materials for Oil Field Equipment
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#### **Others**

NACE MR01-75-90	Sulphide stress cracking resistance metallic materials for oil field instruments NFPA
	National Fire Protection Association SOLAS Safety of Live At Sea
DIN V 19250	Control Technology Fundamental Safety Aspects to be considered for Measurement and Control Equipment

### **3.2 Associated Project Documentation**


EI027-000-ED-IN-DIG-0003	Overall Control Block Diagram
EI027-000-ED-IN-DCR-0001	Instrument & Control Design Criteria
EI027-000-ED-IN-SPC-0005	Technical Specification for Control Valves
EI027-000-ED-IN-SPC-0010	Technical Specification for On/Off Valve
EI027-000-ED-IN-SPC-0006	Technical Specification for Pressure Safety/Relief Valves
EI027-000-ED-IN-SPC-0001	Technical Specification for Field Instruments
EI027-000-ED-IN-SPC-0012	Technical Specification for Instrumentation Cables

### **3.3 Site Environmental Conditions & Utilities**

The Equipment shall be suitable for outdoor installation on offshore saline atmosphere at the following operation conditions:

Outdoor Conditions:

Max. Ambient Design Temperature	48 °C
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Min. Ambient Temperature	5 °C
Max. Relative Humidity	80%
Min. Relative Humidity	65%
Indoor Conditions:	
Design Temperature.	45 °C
Relative Humidity	50%


#### 4 SYSTEM OF UNITS

ISO system will be used. (SI units with some possible exceptions for production flow units)

e.g. Liquid: Actual Barrels Per Days (BPD)

Gas: Standard Cubic Feet Per Day (SCFD)

Pressure	General in Bar gauge (Barg) Vacuum in Bar absolute (Bara)
Differential Pressure	bar or mbar in flow measurement
Temperature	Degree Celsius (° C)
Level	meter / millimetre (Or % of range)
Flow	MMSCFD / m3/hr (Gas Flow) M3/hr (Liquid Flow)
Viscosity	Centipoise (cP)

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## 5 DESIGN REQUIREMENTS

### 5.1 General

The package unit Instrumentation shall be provided to enable safe and convenient package start-up, uninterrupted operation and controlled shutdown as well as provide automatic protective action.

All the instruments and instrument system which are necessary to build the package unit shall be selected in accordance to the codes, standards and recommended practices indicated in the section 3.1 and also from those with proven track record in the similar offshore hydrocarbon processing application. The use of different make and manufacture of the components shall be minimized.

Electrical instrumentation for operation in the hazardous areas shall be suitable for the area classification. Certification requirements shall be as per Section 14.3.2 of this specification.

Where applications use intrinsically safe certified instruments, the whole loop shall be installed & wired up in compliance to the I.S techniques described in IEC 60079.

The Package Vendor is required to utilize equipment with IP ratings such that the detrimental effects of ingress are obviated.

The materials of construction for instruments shall be suitable for the service, pressure and temperature conditions to which they are exposed. Wetted parts shall generally be 316 SS material as minimum, unless process conditions require the use of other more stringent material. When more stringent materials are required the materials shall be as a minimum as per Project Specification No. EI027-000-EB-PI-SPC-0002, "Piping Specification and Material Classes".

### 5.2 Mechanical Vibration

The Package Vendor shall confirm that the equipment supplied can withstand the vibration levels of 4.0 Hz normally.

Anti-vibration mounting to isolate cabinets from the floor shall be supplied if required.

All plug connections and circuit cards/ modules must be equipped with locking/ latching mechanisms.

### 5.3 Material Requirements

#### 5.3.1 Wetted Materials

All wetted part materials shall as a minimum be:


316 Stainless Steel with minimum of 2.5% molybdenum content on all process and utility services.

Monel, for seawater service.

#### 5.3.2 Stainless Steel Grades

The minimum grade of Stainless Steel shall be 316.



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All Stainless Steel material shall be cleaned on completion of the WORK and sprayed with a clear Polyurethane lacquer protective coating.

### **5.3.3 Material of External Moving Parts**

All external moving parts shall be 316 Stainless Steel as a minimum.

All moving parts in hazardous areas shall not create sparks of sufficient energy to ignite a gas/ condensate cloud.

### **5.3.4 Chloride Related Corrosion**

Particular attention shall be paid to the salt content of the fluid streams and the atmosphere and the related operating temperature to assure that chloride stress cracking, crevice crack corrosion, pitting, and the like does not occur.

### **5.3.5 Galvanic Corrosion**

Material selection shall ensure dissimilar galvanic corrosion does not cause a decrease in the life of the facilities.

### **5.3.6 Corrosion Resistant Material**

All materials shall be externally corrosion resistant by choice of inherent materials or by the application of an offshore paint finish.

The use of cast iron shall require PURCHASER's approval.

All aluminum used outside of the air conditioned areas shall be virtually copper free and shall be free of metals such as Magnesium which may cause a spark.

### **5.3.7 Elastomers**

Selection of suitable elastomers shall depend on process/ service conditions, service application, chemical composition of fluid, etc.

Elastomers for valve seats shall be as per Project Piping Classes, Materials and Valve specification.


### **5.3.8 Nuts, Bolts, Washers and Screws**

These shall be 316 Stainless Steel up to ½" diameter. Higher sizes shall follow relevant Project Piping Classes.

### **5.3.9 Painting**

Painting requirements shall be as specified in the package unit specification.

Manufacturer's standard painting system for a tropical marine environment which is compatible and with equal quality is also generally acceptable and shall be detailed with bid for approval. The manufacturer's supply shall include a paint "repair kit".

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## 6 PACKAGE VENDOR SCOPE OF DELIVERY

### 6.1 General

**6.1.1** The Package Vendor shall assume full responsibility for Engineering, Equipment Selection, Interface Definition, Purchase, Installation, Testing, Calibration, Function Testing and Documentation of the instrument equipment and control system for the entire package.

The Package Vendor is also responsible for providing Purchaser with information necessary for integration with equipment outside the delivery, but essential for the intended performance of the package.

**6.1.2** The Package Vendor shall submit for review/ approval by Purchaser all documents defining the control system and associated vendor supplied field instruments for the package in accordance with the Vendor Data Requirement List (VDRL) included in Documentation Requirements.

**6.1.3** The Package Vendor shall as a minimum, perform inspection, calibration and function testing according to Section 14.0 of this specification.

**6.1.4** It is the Package Vendor's responsibility to assist Purchaser in defining all relevant functions and parameters for control and monitoring via the ICSS.

Package Vendor's scope of work shall include as a minimum:

All inline, online, and offline instrumentation shall be fully installed complete with all impulse line tubing, pneumatic signal tubing, instrument valves, instrument manifolds, instrument supports, instruments tags, instrument labels.

The skid edge junction boxes shall be fully hooked up to the skid instruments and local/ unit control panel and fully function tested. Where package UCP is interfaced by serial link with Purchaser's ICSS, the package vendor shall provide necessary hardware like general purpose PC loaded with representative sample of package I/O data base to the ICSS vendor for effective testing of the communication interface with the ICSS during ICSS FAT.



Also the recommended graphic pages (interface of operating station).

## 6.2 Field Instrument / Equipment

**6.2.1** The package vendor shall supply all instrument equipment, junction boxes, cabling, tubing, fittings and other items necessary for the satisfactory operation of the instrumentation and any associated control panels.

**6.2.2** All process connection shall be flanged to ASME B16.5, utility and hydraulic connections shall be NPT and shall be standardized per service as far as practical.

**6.2.3** The minimum electrical / instrument cable entry shall be 20mm ISO metric thread and shall be standardized as far as practical.

**6.2.4** All parts subject to moisture, fungus growth or insect attack shall be treated with polyurethane or equivalent coating to ensure suitability for tropical conditions.

**6.2.5** All lens and windows on instrument shall be heavy duty, impact resistant, shatterproof and wherever possible UV immune.

**6.2.6** Pressure relief valves shall comply with ASME Sec VIII Div.1, API RP 520, API RP 521 and other relevant codes. Pressure relief valves shall be conventional type direct spring loaded, full nozzle with a closed bonnet unless special consideration requires other type. Other types require Purchaser's approval.

**6.2.7** Displacer level transmitters shall be of the torque tube type.

**6.2.8** Control valves with equal percentage characteristics shall be sized to operate at approximately 75% of travel for normal flow conditions (70% for linear characteristics), less than 95% of travel for maximum design flow conditions (90% for linear characteristics) and no less than 20% of travel for minimum design flow conditions.

**6.2.9** Transmitters which require to directly interface with Purchaser's Process Control system (PCS of the ICSS) (i.e. not connected to package panel) shall be 4-20mA HART. Control valve positioners driven directly by Purchaser's PCS (i.e. not from package panel) shall be 4-20mA HART.

**6.2.10** Transmitters which require to directly interface with Purchaser's Shutdown system (ESD of the ICSS) (i.e. not connected to package panel) shall be of the 4-20mA, two wire type and intrinsically safe where available. The transmitters shall be Smart (HART) type where available.

**6.2.11** Shutdown/Blowdown valve (SDV/BDV) actuator shall be of fail-safe, hydraulic spring return, piston type. The Vendor shall ensure that the actuator make shall be of the same make of the actuators of the rest of the platform. The vendor shall confirm with the PURCHASER with respect to actuator make.

**6.2.12** On rotating machinery applications, all temperature elements which cannot be replaced on-line shall be duplex or redundant with both sensors pre-wired to terminals in the junction box.

**6.2.13** All electrical heaters shall be provided with thermocouples at the heater element and heater flange and wired to the heater control panel for over temperature protection.


**6.2.14** The minimum requirement for selection, standardization and procurement of instruments and equipment is given in Section 13.0 of this specification.

**6.2.15** Package Vendor shall submit list of instrument manufacturers with his bid for Company / Purchaser's review / approval.

## 6.3 Documentation

**6.3.1** The package Vendor shall prepare instrument data sheets for all instruments in his supply in accordance with ISA S20 standard instrument data sheets which are subject to Purchaser / Company's approval. Tag numbers for package instruments shall be allocated by Package Vendor in accordance with Purchaser's Tagging Philosophy. Sequence numbers shall be allocated by Purchaser.

Symbols and legend used on drawings shall be same as that used on the process and instrument diagrams (P&ID's).

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Logic diagrams shall comply with ISA S5.2 “Binary Logic Diagrams for Process Operations”.

The Package Vendor shall provide an operation and maintenance manual for all equipment with references to tag numbers to enable COMPANY’s technicians to operate and maintain the equipment in a safe and efficient manner.

**6.3.2** A comprehensive package of design drawings and manuals shall be provided for each instrument and its associated control equipment. Such documentation shall include the technical information necessary to ensure that the design concept of the equipment package is consistent and compatible with the rest of the platform instrumentation and control systems. These drawings / documents shall be submitted to the company for the review / approval / information.

Technical information shall include but not be limited to the following:

- A list of all instruments (Instrument Index), giving the make and type, detailed operating data (especially for flow meters, control valves and pressure relief valves), length of thermowells, etc.
- Instrument data sheets
- Control system software and application software; in CDs and in Hard Copies.
- I/O List and mapping to enable transfer of data between UCPs and ICSS
- Interface cablings / cards etc., to enable general purpose laptop PC to interface with the control system.
- Complete documentation of all application software and copies of program listing.
- Process and Fire & Gas Cause & Effect / Logic Diagrams / Relay Schematics
- Narratives for the control strategies
- Equipment layout drawings, showing the location of the instruments, junction boxes, (local) instrument panels, the cable routing between the individual instruments, junction boxes and panels, etc.
- Junction box documentation shall include terminal arrangement, signal wire allocation, the make type and size of the cable glands.
- Local panels’ documentation shall include drawings showing the construction panel layout and terminal arrangements with signal allocation.
- Instrument impulse line drawings
- Instrument Loop and Block diagrams
- Calculations sheets for control valves, pressure relief valves, flow measuring devices, etc.
- Utilities requirements
- Inspection/ testing procedures and the final inspection plan.
- A list of the trip/ alarm settings
- A list of the equipment Certificates.
- Programmable system software listing including I/O data mapping / addressing information for interfacing to the ICSS.
- Detailed write-up of control / sequential Operation / shutdown requirement to facilitate Purchaser’s ICSS configuration (in case of packages specified as directly controlled by ICSS).
- All operations and maintenance manuals for equipment packages.

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- Commissioning /start up procedure

The ICSS system will perform remote monitoring functions necessary for operation of the platform packages except where stated otherwise in the package specification.

## 7 CONTROL EQUIPMENT AND SYSTEM SELECTION GUIDELINES

The general platform requirements place emphasis on particular aspects of the instrument systems.

- The operator interface must be easy to use with respect to multi skilled operators and low manning level.
- The system should be easily configurable/ programmable (where applicable) to reduce the need for specialist staff.
- The system maintenance requirement must be low.

Due to operational requirements, Vendor supplied systems shall be based on the following principles:

- The operator shall via the ICSS system, normally be able to remotely monitor overall correct operation of all control systems and instrumentation.
- The operators shall, via the ICSS systems, have access to the system necessary to shutdown the package equipment.

The package Vendor shall recommend a control strategy, which in his opinion best meets the Company's objectives for standardization, ease of operation, availability, easy maintenance, etc. as given in section 5.2 above and the package specification and also meets his design and package responsibility. The PLC based controller shall meet purchaser's standardization requirement.

## 8 CONTROL SYSTEM (AND PANELS)

### 8.1 General


The operation of each packaged equipment should be monitored and controlled from dedicated local control system, Local Control Panel (LCP). The LCP to be locally installed within the skid limit unless specifically stated otherwise. The LCP installed outdoor shall be suitable for continuous operation in salt-laden corrosive marine offshore environment and shall suitable for installation hazardous area. Only EEx(i), EEx(n) or EEX(d) certified outdoor panels are acceptable in the order of preference for protection class. The Panel colour shall be per project standard. The panels shall be fabricated from minimum 3.0 mm thick corrosion resistant 316 stainless steel. The panels shall be designed to minimum IP 65 of IEC 60529 protected from exposure to direct sunlight and rain. For more details on the panel requirements refer to technical requisition packages for the individual equipment packages.

### 8.2 Interface with ICSS

The controls for the packaged equipment, including operational sequencing and safeguarding logics etc, should be self-contained within the UCP. Provision for all signal interfaces to the ICSS should be included within the UCP such that signal cabling is only required between UCP and ICSS marshalling cabinet.

Types of signal interface to the various Control Room systems above are:

- Shutdown

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Provision for shutdown of packaged unit equipment through only hardwired type connection from ICSS (ESD). Shutdown signal shall be normally open (shelf state), volt-free clean contact type and contact break/open to trip (fail safe). Contact will be rated 24V DC 0.5A and shall be sensed by 24 V DC from package panel.

- Equipment status On-Off / Start-Stop

For remote monitoring and control purpose from the Control Room of the unit packaged equipment operation. All monitoring and control circuitry shall be designed to fail-safe concept, with limit switches, contacts etc. ‘closed’ contacts when actuated and in operational mode. Contacts provided by UCP shall be volt-free rated at 0.5 A, 24VDC inductive. Contacts provided by ICSS (PCS) shall be volt-free, 24VDC 0.5 A inductive and shall be sensed by 24VDC from Package UCP.

Connection can be either via hardwiring or serial link. In the case of serial link communication, the communication protocol shall be MODBUS RTU to suit ICSS requirements (via RS 422 or RS 485 serial link to be finalised after order). (Communication via a serial link is acceptable only if specifically stated in Equipment Specification).

### 8.3 Interface with MCC

UCP’s interface to Purchaser’s MCC, where required, for start, stop of motors shall be via 24V DC interposing relays (vendor to supply one each for start, stop) located in UCP. UCP shall power the relays momentarily.

### 8.4 Alarm Annunciation

Package panel alarm annunciations that do not require first-up facility (e.g. pre-alarms) should have “Automatic Reset” in accordance with sequence A as detailed in ISA-S18.1. Package panel alarm annunciation groups that require first-up facility should have “Automatic Reset First Out with First Out Flashing and Reset Pushbutton with Silence Pushbutton” in accordance with sequence F3A-1 as detailed in ISA S18.1. (both audio and visual alarms shall be provided).

Process trip alarms shall have pre-trip alarms of sufficient delay to warn of potential trip situation.

The Time stamping of trips shall be done by the package UCP.

### 8.5 Fire and Gas Detection and Protection

The Fire and Gas Detection and Protection requirements as part of package, if any, will be specifically stated in the Package Specifications.


For enclosures, if any, in the package unit, provision of F&G devices and fire suppression system shall be by Package Vendor. Fire suppression shall be a self contained stand alone system. F&G devices shall be same make and model as Purchaser’s general area coverage F&G devices and they shall be wired to Purchaser’s ICSS (FGS), unless otherwise stated in Package specification.

### 8.6 Earthing

All instrumentation equipment & panels shall be earthed. LCP / UCP shall be provided with 25mm x 6mm copper earthing bars - insulated Instrument Earth, insulated I.S. Earth and Electrical Protective earth. Each bar shall have two 10mm bolts for Purchaser’s earthing cables.

### 8.7 Panel Cable Entry

Package panel installed in Purchaser’s Local Technical Room shall have cable entries from bottom.

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Package panel installed locally at skid shall have cable entries from bottom to prevent water ingress.

The skid mounted LCPs (Local Control Panels) shall meet the following:

- Specified hazardous area classification
- Ingress protection requirement
- Environmental protection
- Exposure to Sun, platform vibrations etc.,

## **9 INSTRUMENT, ELECTRICAL AND HYDRAULIC SUPPLIES**

### **9.1 General**

The Package Vendor shall, at bid stage, indicate his anticipated load for electrical and hydraulic supplies, peak, average and intermittent consumption values are to be given along with any requirement for power back up (time and consumption). This information shall be updated during detail engineering stage for purchaser's review / approval and final incorporation to the design of the top sides' facilities.

### **9.2 Electrical Supplies for Instrumentation**

**9.2.1** The power supply for the control room mounted UCP/package control panel and field mounted LCP shall be 110 VAC,  $\pm 10$ , 50 Hz (UPS) and the field instrumentation shall be powered by 24 VDC either from package control panel or from ICSS incase of instruments directly wired to ICSS.

**9.2.2** The Package Vendor shall provide all necessary terminals and fuses to distribute power logically within all cabinets in his supply. Attention shall be paid particularly to ease of circuit isolation for maintenance.

The Vendor shall ensure proper discrimination for fuses in the supplied equipment and shall state the size of fuse required in Purchaser's distribution board to supply and protect his equipment adequately. Purchaser shall check and verify the discrimination between the Package Vendor fuses and Purchaser's distribution board fuses.

All power supply and distribution units within the package shall be sized for 30% above the highest possible occurring load (including spares).


The terminals shall be of sufficient size to cater for incoming power supply cables.

**9.2.3** Requirements listed below relate to distribution within the package Vendor's Control System.

Each circuit, sub-circuit and control loop shall be individually protected (fused). If a control loop contains a number of items which can be operated independently, and whose function should be retained independently of other functions in the same loop, they shall be protected individually.

For other duties, cartridge type fuses of non-deteriorating type with appropriate characteristics to ensure discrimination shall be used. Rewire able type fuses shall not be used.



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## 10 CABLE REQUIREMENTS

### 10.1 General

**10.1.1** Cable for the package supply (internal on the package) shall be selected and purchased in accordance with the following minimum requirements:

- i) All outdoor cabling shall be flame retardant per IEC 60 332, with at least a galvanised steel wire armour or braid and inner and outer UV immune and sheathing non-reactive to chlorides.
- ii) All outdoor cabling on emergency related/ vital services shall be fire resistant per IEC 60 331 including all fire and gas, emergency visual & audible alarm systems and ESD, with at least a galvanised steel wire armour or braid and inner and outer UV immune and chlorides non-reactive sheathing.
- iii) The minimum conductor size shall be plain annealed copper wire of 1 mm sq. cross sectional area.
- iv) The capacitance, inductance and L/R ratio must not exceed certain values for intrinsically safe circuits depending on the hazardous area classification and equipment parameters. Reference should be made to equipment hazardous area classification.
- v) All instrument signals shall be run in twisted pair or twisted triple cabling, stranded copper conductors with overall screen and drain wire. Individual screen multi-pair cable shall be provided for analog signals.
- vi) Type A, Shielded, twisted pair, 0.8 mm<sup>2</sup> (#18 AWG) shall be used for FOUNDATION<sup>TM</sup> Fieldbus trunk and spur cables. The cables shall be armoured and suitable for IS application.
- vii) The outer sheath of cables shall be colour coded as follows:

Instrument intrinsically safe	=	blue
Instrument non intrinsically safe	=	grey
Fire and gas signals	=	Red



**10.1.2** All interface control and instrument cables shall be brought to junction boxes at the skid edge. The interface signal cable installation and hook-up between the skid edge and the ICSS or remote Unit Control Panel (where specified) shall be performed by others (except of fiber optic) unless otherwise specified. These signals shall be terminated and clearly identified on the terminal blocks in the junction boxes and the Unit Control Panel. Engineering of these cables shall be considered in package vendor scope of supply

### 10.1.3 Signal Segregation


Signal segregation shall be implemented by using dedicated junction boxes for different circuit types. From these field junction boxes separate multi-core cables shall be used for process control and safety systems. Consistent with certification requirements, non-IS and IS signals shall not be mixed within cables or junction boxes. However, running within the same cable tray is allowed. (Refer to section 10.5).

Instrument cables shall not be run in tray containing power cables.

## 10.2 System Cabling

System cabling refers to cabling complete with plug/ sockets connections at each end in ready made lengths. System cabling, if any, between the Package Vendor's panels at pressurised rooms shall be by the package Vendor.



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System cables will be used within pressurised rooms and will be non-armoured and Flame Retardant in accordance with IEC 60 332-3.

### 10.3 Gland Selection

Cables glands shall be standardised on a single manufacturer (per Approved Vendor list) by type. SS 316 glands shall be used for outdoors and areas requiring hazardous area certification.

Glands shall be weatherproof to IP65, SS 316 for outside of the air-conditioned areas and on all services requiring hazardous area classification, with PCP cable shroud.

SS 316 earth tags or star washer shall be used on all unthreaded entries to ensure proper earthing.

Certification of glands for hazardous area protection shall be as a minimum same as Junction Box or Equipment it is connected to.

Glands shall be in metric sizes with ISO thread connections.

Gland adapter material shall either be the same material as the gland or as the instrument.

### 10.4 Gland Installation

Plastic ring, or integral O-ring, shall be fitted between the gland and instrument/ Junction Box to maintain the unit's IP rating.

Gland shrouds shall be used for all glands in outdoor service, and heat-shrink sleeving over the glands is not permitted.

### 10.5 Cable Trays

Cable trays shall be heavy duty 316L Stainless Steel. Physical/mechanical dividers on instrument cable trays/ladder shall be provided to segregate non-IS and IS cables. The cable trays shall be supported on structural members and not process lines.

Cable trays in exposed area shall be protected by metallic cover.


## 11 TUBING AND TUBE FITTINGS REQUIREMENTS

Tubing shall be imperial size, minimum 316L stainless steel unless superior material is required for the process medium. (for seawater service monel tube to ASTM B 165 and monel fittings shall be used.) Tubing shall conform to ASTM A 269, seamless, bright annealed, with minimum molybdenum content of 2.5% and maximum hardness of RB-90. Tubing shall meet ASTM A269 supplementary requirement S4 and supplied with certified test report per ASTM A 450 / A 450M section 26.

Tube fittings shall be Swagelok, 316SS, (unless superior material is required for the application), imperial size, double compression type.

Tubing minimum wall thickness shall be as follows:

1/4" OD	:	0.035"
3/8" OD	:	0.049"
1/2" OD	:	0.065"

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Only 1/2" OD tubing shall be used for process connections. Process tubing shall have block and drain valves.

Tubing shall be continuously supported with 316L stainless steel edgewise up tray or ladder. Up to 3 runs of tubing can be supported on flat section or angle iron. Tubing shall be attached to supports using 316SS accessories.

## 12 JUNCTION BOXES

The junction boxes shall be made of heavy duty construction stainless steel with a minimum weather protection of IP65 to IEC 60 529 and shall be certified Ex'd/Ex'e', as applicable. They shall be constructed such that all necessary glands, earthing termination arrangements and cable stripping can be carried out easily. Terminal strips shall be sufficient for incoming cabling considering spare cores.

The cover shall be adequately stiffened to prevent distortion and provided with captive stainless steels screws for fastening.

Fixing lugs shall be incorporated in the design and preferably external to the box and with open "downward facing" bolt slots, in the top or bottom lugs.

Sufficient spare terminals and spare entries (c/w certified plugs) shall be provided on the junction boxes.

Cable entries shall be side and bottom only.

Terminals shall be suitable for min. 2.5 mm sq. conductors. Terminal blocks shall be non-hygroscopic, vibration proof and shall use captive screw for terminals. Terminals connecting signal wiring shall be Klippon Type SAK2.5. Klippon Type SAKR, shall be used for field terminals of UCP.

All Ex'i' terminals shall use light blue coloured terminals.

All junction boxes shall have a name tag and service traffolyte label fitted. These labels should be permanently attached to the front cover of the box.

All junction boxes for I.S. circuits shall carry an additional label stating that the equipment contains intrinsically safe circuits. The label shall be in English.

Intermediate junction boxes are not permitted on power cables. Cables splices are not permitted.

I.S, non I.S, analog, digital, power and shutdown signal cables should be terminated in separate junction boxes and positioning of these junction boxes on the same side within the skid limit is preferred.


Mounting of Junction Boxes shall allow sufficient bending radius for incoming cables.

Earthing lugs shall be provided on gland rings and bonded chassis.

## 13 INTERFACING REQUIREMENTS

The Package Vendor systems which are PLC based may, when specified, serially interface with Purchaser's ICSS to provide individual indication of all relevant status, and system alarm and any analogue parameter critical to the package system operation.

The serial data transmission rate shall be generally 9600 bps on RS485 link (to be finalised by Purchaser after order) using MODBUS RTU protocol.

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Where the number of signals is small or safety shutdown or fire & gas related, hardwired interface should be used. The hardwired signals shall be of the following types:

Analog (4-20 mA at 24VDC), 2 wire, isolated and powered at the package, UCP.

Volt-free contact (rated for 24V DC 0.5 Amps) for status and alarms from the package to Purchaser's systems and be powered by Purchaser's systems.

Volt-free contact (rated for 24V DC 0.5 Amps), fail-safe and be powered by 24VDC from Package panel for output control signals from Purchaser's systems.

All signals generated from equipment UCP shall be available for transmission to platform ICSS within one (1) second. Vendor shall indicate the refresh rate of analog signals in his system.

Vendor shall specify the amount and type of data that can be transmitted to ICSS; together with the required face plates, graphics, trends etc., which shall be made available on the ICSS.

Vendor shall configure his system for transmitting 'purchaser agreed' specified amount and type of data and work out with ICSS vendor how the data will be received together with the PURCHASER required presentation format on the ICSS.

## 14 INSTRUMENT EQUIPMENT SELECTION

### 14.1 Standardization

To facilitate operation and maintenance, standardization of all instrument equipment of the package shall be adopted. This applies to tagged field instruments and control valves, bulk material such as air filter regulators, tube, fittings, junction boxes, cables, terminals, switches, relay etc. Package Vendor shall furnish with his Bid a list of instrument equipment manufacturers for Company / Purchaser's review / approval.

### 14.2 Environmental Protection

The ingress protection according to IEC-60529 for instrumentation equipment shall be as minimum:

IP55: Equipment installed indoors (in enclosed buildings) and equipment located inside enclosure hoods


IP65: All Field Instrumentation.

### 14.3 Ex Equipment

#### 14.3.1 General

Signals to and from the local technical room shall be electronic. The communication between field devices (transmitters, and positioners of control valves) and PCS of ICSS central unit in Local Technical Room (LTR) shall be based on field barrier concept with digital, two-way, multi-drop communication which conforms to Fieldbus Foundation standard.

The electronic transmitters for shutdown loops shall be hard wired standard analogue output signal. The standard analogue signal shall be 4~20mA using a two-wire intrinsically safe (I.S) EEx 'ia' transmitter. The electronic transmitters shall generally be of 'Smart' transmitter type, 2-wire output signal of 4~20mA with digital communication (HART FSK protocol superimposed).

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Explosion proof EEx'd" shall be applied on all the Fire and Gas detectors, solenoid valves and all other discrete field instruments.

All instrument voltage shall be a maximum 24 volts D.C. and intrinsically safe instrument equipment shall be isolated by I.S. barriers on all appropriate input/output signals to/from the central unit, which is located at the safe area technical room.

#### 14.3.2 Certification Standardization

All electrical instruments / panels of packages located in hazardous area shall be certified to suit the hazardous classification of the area. Classification shall comply with the hazardous areas classification requirements defined by IP Code Part 15.

All electrical instruments / panels of packages located in hazardous open area shall be certified suitable for minimum Zone I, Gas group IIA & IIB, Temperature class T3 hazardous area.

All electrical instruments / panels of packages located in closed and pressurised non-hazardous areas shall be non-certified , general purpose type unless required to be live on confirmed high level gas, in which case, the item shall be certified suitable for Zone I, Gas group IIA & IIB, Temperature Class T3 , as a minimum.

#### 14.3.3 Certification and Labeling of Ex Equipment

All electrical and electronic equipment, which are located in hazardous areas, shall be certified to ATEX Directive 94/9/EC or other internationally recognized certifying authority. The equipment shall have labels both outside and inside the equipment stating the Ex certification of the equipment with authority name and certificate number. The Ex certification shall comply with the regulations and project selection criteria stated.

Devices connected to an Ex'i' certified circuit, and "non energy storing" to BS 5345 do not require individual certification. Such equipment (Simple Devices) can be thermocouples, switches etc. used as part of an Intrinsically Safe Circuit Ex'i'.

However, the manufacturer shall certify that the equipment is a "Simple Device", not requiring Ex'i' certification. Intrinsically Safe Circuits shall use galvanic isolator type safety barriers where practical.


### 15 INSPECTION, CALIBRATION AND FUNCTION TEST

Company / Purchaser shall reserve the right to perform inspection of the equipment during manufacture at any time. Company / Purchaser shall be notified ten (10) working days prior to testing.

Material certifications and record dispatching shall be made available to the Company / Purchaser during or at completion of fabrication. It is expected that assistance will be available for inspection of parts, during or after completion of fabrication, during a shop inspection.

#### 15.1 Scope of Work

The Package Vendor shall, before shipment visually inspect, calibrate, and functionally test all instruments which are included in the package instrumentation system. This shall apply whether instruments are mounted on the package, mounted but disconnected for shipment, or shipped loose for installation at the construction yard or offshore.

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The Package Vendor shall perform the following: control function testing before installation, installation checking and testing, leak testing, resistance and continuity testing and system function test where applicable.

Complete package functional test shall be performed at the Package Vendor workshop, which means Vendor's/ Sub-Vendor's Panel (s) and Skid(s) shall be hooked up and tested together.

Spool pieces shall be provided for all inline instruments which will have to be removed in case of line flushing (control valves, turbine meters, positive displacement meter etc.).

## 15.2 Documentation and Test Equipment

All tests shall be recorded and verified by the Package Vendor on suitable documents, and according to agreed procedures for inclusion in the final documentation for the package.

All test equipment shall have a valid calibration certificate.

## 15.3 Purchaser's Inspection Representative

Company / Purchaser's Inspection Representative shall be granted access to the Package Vendor's premises for inspection and verification of materials and work at any time. All material and test certificates shall be presented to the Inspector for verification or witnessing in accordance with the Package Vendor's approved Inspection Plan.

## 15.4 Calibration Procedures

The Package Vendor shall perform a check / inspections on equipment purchased or received from sub-Contractor and ensure that all instruments which are part of his supply, either have a valid calibration certificate supplied with the equipment, or are calibrated by the Package Vendor in his works. Calibration/ test certificate shall be issued for all instruments.

## 15.5 Functional, Performance and Interface Test

The Package Vendor must include the function testing procedure for the instrumentation system for testing of the package. This test procedure shall be prepared by the Package Vendor, and submitted to the Company for approval, 4 weeks before testing is performed.

Vendor shall prepare FAT procedure and schedule to demonstrate total system functional test, that the operation of the control, monitoring, logic systems, fire & gas systems, safety shutdown functions will perform as per specifications.


Vendor shall provide necessary hardware / software to the ICSS vendor to carryout communication link testing with ICSS.

## 15.6 Radio Interface Test

The following tests shall be carried out to demonstrate the immunity of the equipment to radio frequency interference.

All doors on the equipment cabinets or consoles shall be left fully open for the duration of this test.

During the test, the system shall be fully operational and shall be monitored for abnormal indications or spurious data.

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## 15.7 Flushing and Testing Requirements

**15.7.1** Shipping stops shall be removed prior to testing and replaced on completion of the testing work. Any labels indicating shipping stops have been replaced shall also be refitted.

**15.7.2** In case of flushing / cleaning of process and utility pipework all inline instruments including control valves and orifice plates shall be disconnected, removed and replaced by spool-pieces. Thermowells may be left in place.

**15.7.3** In the case of pipe work pressure-testing all instruments connected on small bore off takes which are protected by a block and bleed arrangement shall be isolated and vented. Where no block and bleed is provided the instrument will be removed unless there is no danger of damage due to leakage of the isolating valve. Orifice plates and thermowells may remain in place during pressure testing.

In general, instruments which form part of the process pipework may be left in place during pressure testing but if there is a danger of damage they are to be removed. Control valves with axial stem movement shall be removed or protected by spades or spectacle blinds. Control and shut off valves with rotary stem movement may be left in place provided the valve is rated to withstand the test pressure. All instruments forming part of the process piping shall be replaced for the reinstatement test.

After the reinstallation the Package Vendor shall recheck for correct installation including checks to ensure that valves, flowmeter etc. are installed in the correct flow direction.

**15.7.4** Instrument impulse lines shall be flushed and tested according to the Package Vendor's test procedure, which shall be subject to Company / Purchaser approval. A pressure test to 1.5 times maximum process design shall be performed. All the lines shall be drained with clean air or nitrogen after the test, the lines should be considered dry after blowing for 30 minutes.

**15.7.5** Hydraulic piping and equipment shall be flushed, pressure tested and leak tested according to the Package Vendor's procedures.

The Package Vendor shall certify that the system cleanliness level is in accordance with ISO 4406 class or better. The pressure test shall be performed to 1.5 times the maximum working pressure.


The flushing shall be carried out by a dedicated flushing unit with capacity of a flow rate of at least 1.5 times the service pump flow rate.

The system hydraulic pump shall not be used for flushing.

**15.7.6** Temporary connectors shall be installed to bypass hydraulic components which already have a Company / Purchaser approved flushing certificate. The jumpers shall be sized to the same diameter as the piping to avoid restriction of the flow.

**15.7.7** Instrument, Piping and equipment which have been protected with a rust inhibitor (preservation liquid) shall be ascertained for compatibility with the operating fluid. If not, the piping/ equipment shall be flushed to remove the rust inhibitor.

**15.7.8** Pneumatic signal and supply lines shall be flushed and pressure tested according to the Package Vendor's test procedure, which shall be subjected to Company / Purchaser approval. A pressure test to 1.1 times maximum design pressure shall be performed in accordance with the requirements of ANSI B 31.3.

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**15.7.9** Pneumatic signal and supply lines shall be leak tested according to the Package Vendor's test procedure, which shall be subject to Company / Purchaser approval. Instrument air or nitrogen should be used for the leak testing at the maximum operating pressure.

Bubbler method is preferred for leak testing. The bubble rate after pressurizing shall be less than one bubble in ten seconds.

**15.7.10** All instruments shall be calibrated, and the calibration results recorded on agreed record sheets.

**15.7.11** All cables shall be 'megger' tested for insulation, between core to core, core to screen, screen to armour, screen to ground, armour to ground.

Polarity and continuity of cores, screens and armour shall also be tested. All tests shall be documented on agreed record sheets.

Note: Instrument cables, once installed, shall NOT be 'meggered' under any circumstances.

**15.7.12** The completed skid instrumentation shall be subjected to, as full functional test as possible. This includes the operation of control valves, block valves and solenoid valves. Where a panel is provided as part of the package a full functional test of the panel together with the skid shall be carried out.

**15.7.13** The Package Vendor shall be responsible for the supply and cost of all replacement material and labour necessary to rectify faults which show up during instrument installation and testing, where such faults are due to design errors, faulty workmanship or faulty materials in the Package Vendor's supply.


**15.7.14** The absence of stress on instrument flanges shall be demonstrated by unbolting flanges and checking that pipe work does not spring apart.

## 16 SPARE PARTS AND SPECIAL TOOLS

### 16.1 Spare Parts

**16.1.1** The Package Vendor shall supply as a minimum the following (where applicable) commissioning spares for instrumentation as part of his scope of delivery:

- One (1) off each electronic card or circuit board type/ model number or one (1) off per – twenty five (25) units supplied, whichever is the greater.
- One (1) off packet of each fuse size or fifteen (15)% of the installed whichever is the greater.
- One (1) off packet of each light bulb size, or twenty (20)% of the installed whichever is the greater. In case of LEDs the % requirement may be eliminated.
- One (1) off hermetically sealed relay of each type/ model or one (1) per twenty (20) installed whichever is the greater.
- One (1) off timer or other similar module of each type/ model or one (1) per twenty (20) installed whichever is the greater.
- One (1) off assorted collection of terminal blocks (including ten (10) of each size and type as a minimum) complete with barriers, end stop, etc.
- One (1) off smoke or heat detector head of each type.
- One (1) off gas detector of each type.
- One (1) assorted collection of spare panel pushbuttons, switches, lamp holders etc. including as a minimum one (1) off each type.

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j) Any other commissioning spares as per Vendor's recommendation.

## 16.2 Special Tools

The Package Vendor shall supply one set of any and all special tools required for erection or maintenance of the instrument system provided.

## 17 TRAINING

Vendor shall provide training on the vendor supplied control system to the Purchaser's engineers. Vendor shall quote for the training courses indicating the following details:

- Types of course
- duration of course
- Location, cost per course per person and maximum number of participants (at vendor's works and at site)
- Training documentation that will be provided
- Pre-requisite knowledge of participants
- Scope of work and who should attend.