

SK E&S Plug Power	Liquid Hydrogen Refueling Station Project	DOC. NO. : SK-SP-IC-0001
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Specification for Package Instrument

PROJECT NAME : Liquid Hydrogen Refueling Station Project

CLIENT : SK E&S Plug Power

**Contractor
(Tech. advisor)** : Korea Gas Technology Corporation(KOGAS-Tech)

LOCATION : South Korea

REV. NO.	DATE	DESCRIPTION	PREPARED BY	CHECKED BY	APPROVED BY
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1. CODE AND STANDARD

1.1 Relevant Standards and Codes of practice

The latest edition of the following standards and codes should be used. The requirements of this and any other relevant project specifications take precedent over the requirements of the listed standards.

ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
ASME B16.10	Face-to-Face and End-to-End Dimensions of Valves
ASME B16.34	Valve-Flanged, Thread and Welding End
ASME B46.1	Surface Texture (Surface Roughness, Waviness, and Lay)
ASME PTC19.3	Temperature Measurement
API 550	Manual on Installation of Refinery Instruments and Control Systems
API 670	Vibration, Axial Position and Bearing Temperature Monitoring System.
API 678	Accelerometer Based Vibration System.
API RP520	Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries
FCI 70.2	Control Valve Seat Leakage
ISA.RB31.1	Specification, Installation & Calibration of Turbine Flow Meters
ISA.S75.01	Flow equations for sizing control valves
ISA.S5.1	Instrumentation in symbols and identification
ISA.S5.2	Primary logic diagrams for process operation
ISA.MC96.1	Temperature Measurement Thermocouples
ISA RP3.2	Flange Mounted, Sharp-Edged Orifice Plates for Flow Measurement
IEC 60034-1	Rotating Electrical Machines - Rating and performance motor operated valves
IEC 60073	Basic and Safety Principles for Man-Machine Interface, Marking and Identification-Coding Principles for Indication Devices and Actuators
IEC 60079	Electrical apparatus for explosive gas atmosphere

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IEC 60529	Classification of degrees of protection provided by enclosures
IEC 60584	Thermocouples for temperature measurement
	Part 1 : Reference tables
	Part 2 : Tolerances
IEC 60654	Operating conditions for industrial-process measurement & control equipment
IEC 60751	Industrial Platinum Resistance Thermometer Sensors.
IEC 60801	Electromagnetic compatibility for process measurement and control equipment
IEC 61508	Functional safety of electrical/electronic/programmable electronic safety related systems
IEC 61511	Functional safety - safety instrumented systems for the process industry sector
ISO 5167-1	Measurement of fluid flow by means of pressure differential devices Inserted in circular cross-section conduits running full
ISO 8310	Refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels
ISO 17089	Measurement of fluid flow in closed conduits - Ultrasonic meters for gas
ISO 5167	Measurement of fluid flow by means of pressure differential devices inserted in circular
ISO 9951	Measurement of gas flow in closed conduits – Turbine meters
NFPA 59A	Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)
NFPA 70	National Electric Codes
NFPA 72	National Fire Alarm Code
NFPA 496	Purged Enclosures for Electrical Equipment
EN 1473	Installation and Equipment for Liquefied Natural Gas – Design of Onshore Installations
EN 1532	Installation and Equipment for Liquefied Natural Gas – Ship to Shore Interface
KS C 3341	Halogen free flame retardant poly-olefin power control insulation wire
KS C 60331-11	Tests for electric cables under fire conditions - Circuit integrity -

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Part 11: Apparatus - Fire alone at a flame temperature of at least 750 °C

KS C 60331-21

Tests on Electric Cables under Fire Conditions-Circuit Integrity.
-Part 21 : Procedures and requirements-Cable of rated voltage up and including 0.6/1.0kV

- 1.2 It shall be the responsibility of Vendor that all aspects of the design, fabrication, inspection and testing conform to the requirement of the specified code and standard.
- 1.3 All applicable Korean local regulations (laws, acts, regulations, etc.) shall be applied, if applicable. Vendor shall be responsible for determining and complying with the requirements of all applicable local regulations (laws, acts, regulations, etc.)
- 1.4 Where there are any conflict between Contractor's data sheets (drawings) and the specified codes and standards, such conflicts shall be promptly referred to Contractor.
- 1.5 Explosion proof type electric equipment & instruments are required to be certified by Korean Authorities (KOSHA, KTL or KGS) for usage in Korea.

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2. GENERAL REQUIREMENTS

2.1 Instruments and Materials

2.1.1 The Vendor shall supply the complete set of instruments mounted, piped, wired and shipped as an integral part of the package, including all instruments, local control panels, local gauge boards, junction boxes, cables and erection materials necessary for the operation of the packaged equipment.

2.1.2 The Vendor shall supply instruments specially adapted to the equipment being furnished by reason of special connections or other special feature not available from instrument suppliers on the open markets, such as special thermocouples or RTD's for bearing temperatures, vibration monitoring heads with parts integral with the equipment.

2.1.3 The Vendor shall supply those instruments that, although mounted remotely from the packaged equipment, are required for any acceptance or performance testing called for by the Contractor.

2.1.4 The Vendor shall supply Sunshade for electric instruments, junction boxes, Local Control Panel(LCP), Local Control Station(LCS), Push Button Box and Local Gauge Board, if required.

2.2 Installation, Inspection and Test

2.2.1 Installation, calibration, inspection and testing of the instruments shall be carried out at the vendor's shop by the Vendor, including necessary preparation for the execution, unless otherwise specified in the Requisition.

2.2.2 Acceptance criteria shall be in accordance with the applicable codes and standards or the vendor's standard which is approved by the Company.

2.3 Vendor's Drawings, Documents and Data Required

The Vendor shall submit to the Company the drawings and documents as called for in the Company's requisition. The Contractor's approval for such drawings and documents shall not relieve the Vendor of his responsibility to meet all requirements of the purchase order, applicable codes and standards.

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3. DESIGN

3.1 Design General

3.1.1 Selection of Instrument

- 1) Instruments shall be selected for industrial quality, optimum accuracy, and durability. All instruments, devices and installation materials shall be chosen from the ones, which are used by up-to-date practice, and shall be suitable for process characteristics of fluids to be measured, climatic conditions of the plant site, the requirements on electrical area classification and safe operation.
- 2) Instrument installation design shall follow the provisions of API RP 551 "Process Measurement Instrumentation".
- 3) Replacements, spare parts, and services shall be readily available for all instruments.
- 4) The selection of the instruments except those specified shall be determined by the Vendor in accordance with his good practice and proven experience, but the instruments the Vendor shall be submitted for the Company's approval.
Vendor shall select all instrumentation and control systems taking into account site standardization and to reduce spare parts.
- 5) Electric signal transmitter shall be supplied smart type with HART protocol for signal transmission with integral Digital indicators. Transmitter should be smart type with self-diagnosis.
- 6) The Vendor shall supply RTD's(Dual element type) with transmitter(Hot-Backup). RTD's sensor element and transmitter shall be supplied separated type.
- 7) All temperature transmitters which be supplied by package the Vendor shall have backup function for automatically switches-over from the primary to the backup upon sensor failure.
- 8) Surge protection terminals for all input/output signal(5kA), Power(20kV) and Communication as"Weidmuller, Phoenix contract or equivalent". Surge Protection devices shall be provided at the field instrument and at the controller end for the

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instrument loops. Field instruments shall be provided with transient protectors to prevent damage from lightning, welding, high voltage, etc.

- 9) All instruments and systems (including package equipments) shall be supplied with models which are compatible and interchangeable with each other for maintenance.

3.1.2 Control System Outline

- 1) The Vendor shall provide all the necessary equipment to perform the control and monitoring of the packaged equipment.
- 2) For the control system, PLC shall be used for the control and monitor of the mechanical package. Packaged equipment which under controlled by its own PLC shall be provided with dedicated safety logic solver in order to manage any safety related signal.
- 3) Fail-safe design of instrument and control system shall be considered for safety of personnel and equipment of the unit under the failure of instrument air and/or electric power.
- 4) The PLC shall include redundant CPU, IO module, Communication module, and power supply for All package items. (System Redundancy : CPU, I/O module, Communication Module and Power Supply)
- 5) PLC & HMI
 - The Vendor shall supply to the Company the Configuration software, Programming source, PLC program editing software and HMI(minimum 15" display screen with intuitive touch screen)
 - The Vendor shall provide state of art computer system model with OS of PLC and HMI and security patch and anti virus program.
 - The Vendor shall provide software license key for PLC & HMI System.

3.1.3 Explosion Proof Protection

- 1) Electrical and electronic instruments, control valves, control equipment (e.g. panels) and their accessories to be installed in electrical hazardous area shall have suitable explosion proof constructions.

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- 2) Type of explosion-protection for the equipment shall normally be chosen from the following criteria.
 - Flame Proof Type (Ex-d, IEC60079-1) : General instruments
 - Intrinsically Safe Type (Ex-i, IEC60079-3) : Instruments for which the explosion-proof type is not applicable and special instruments which are agreed by the Contractor in advance.
 - Purged Type (Ex-p, NFPA 496 , ISA-S12.4 or IEC60079-2) :Local Control Panel, etc. agreed by the Contractor in advance. The Vendor shall be applied “X”, “Y”, “Z” type according to hazardous classification.
- 3) Explosion proof type electric equipment & instruments are required to be certified by Korean Authorities (KOSHA, KTL or KGS) for usage in Korea.

3.1.4 Electric Power Supply for Instruments

- 1) The specification for the power shall be as follows.
Voltage and frequency, and their variation shall be as specified on the Data Sheets. The variation of voltage and frequency will be expected $\pm 10\%$ and $\pm 3\%$ respectively, unless otherwise specified on the Data Sheets.
 - 220V AC 1ph 60Hz(UPS) : PLC, Instrument, control panels
 - 220V AC 1ph 60Hz(Normal): Illumination for local panel
 - 24V DC : Alarm unit, Interlock/Shut down circuit, Instrument, SOV
- 2) The redundant power supply unit(24VDC) for alarm, interlock circuit and field instruments etc. shall be provided by the Vendor.

3.1.5 Materials

The component parts of the instrument shall be of material suitable for process.

3.2 Control Panel and Gauge Board

The specification of panel(s) to be provided by the Vendor shall be as follows.

3.2.1 Type

- 1) Control panels mounted in substation or field shall be of free-standing closed type with hinged doors at the rear or front.
 - Unit Control Panel(UCP, including PLC) is located in Substation.

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- Local Control Panel(LCP, including PLC) is located in field.

2) Single door will be acceptable for the panel width 800 mm and below. multiple doors shall be provided for the panel width over 800 mm. The multiple doors shall be no wider than 600 mm.

3) Local control panel mounted in field shall be of self-standing and weather proof type (IP 65 or equivalent) with explosion proof, corrosion protection and illuminator, and shall be of explosion proof type or air purged and pressurized type according to hazardous classification.

The purge and pressurized panel mounted operators such as push buttons and selector switches shall be NEMA Type 4 rated or oil-tight and should not contain illumination devices, unless they are protected.

- Eye bolts shall be provided at top of panels.
- The gauge board may be of open type.
- Material and thickness of Local Control Panel(located in the field) shall be Stainless steel and front door 3.0t, side and rear 2.0t

3.2.2 Prefabrication

All of the instruments, their components and internal wiring and tubing shall be completely prefabricated at shop before shipment.

3.2.3 Dimensions

1) Overall dimensions of the panels mounted in control room shall be 800W * 2,100H * 800D(mm) including 100 mm height of channel base(Rittal or equivalent).

Overall dimensions of the local control panels or gauge board shall be in accordance with Manufacturer's standard, unless otherwise specified in the Requisition.

2) The instruments on the gauge board front shall be fitted between a height of 1 m and 2 m with no part lower and higher.

3.2.4 Color

Finish color of panel inside shall be of manufacturer standard unless otherwise specified. Finish color of panel external shall be Munsell No. 7.5 BG 6/1.5 and shall be subject to the Contractor's approval.

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3.2.5 Wiring and Tubing

- 1) Internal wiring and tubing in local control panel shall preferably be contained in plastic ducts for wiring and raceway for tubing routed in an orderly manner to instruments or apparatus. Wiring and tubing marker shall be installed.
- 2) Cables for control panel, local panel and junction box shall enter from the bottom.

3.2.6 Instrument Air Supply System

- 1) Each local pneumatic instrument shall have an individual air set (filter and regulator with output gauge) with the block valve.
- 2) Air set (filter and regulator with supply and output gauge) shall be provided for air purge or pressurizing into local control panel in accordance with NFPA 496 or ISA S.12.4 whenever it is required.

3.2.7 Allocation of Panel

Local control panel or gauge board shall be located at the vibration-free place suitable for operation and maintenance.

3.2.8 Unit Control Panel and Local Control Panel

When UCP/LCP or Interlock rack/panel is provided for the control and/or protection of equipment (or packaged system), all alarm and interlocking system shall generally be provided in the UCP/LCP or Interlock rack/panel.

4. ACCESSORIES

- 4.1 All normally-furnished manufacturer's standard accessories for each instrument shall be provided.
- 4.2 All field mounted instruments shall be provided with mounting bracket with stainless steel U-bolt and nuts for 2 inch (50 mm) pipe, unless other installation methods are applied.
- 4.3 5-way/2-way manifolds shall be provided for the differential pressure instruments/pressure gauge except for the diaphragm seal type. The rating and material shall meet the process conditions.

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4.4 Diaphragm seal shall be furnished when required by the process conditions. Capillary tubing extension length, when required for remote diaphragm seal type pressure or differential pressure instruments, shall be as short as possible but suitable for installation. And material of tube and armor shall be stainless steel.

4.5 Air Filter Regulator

4.5.1 An air filter regulator assembly shall be supplied for each pneumatic instrument.

4.5.2 The air filter regulator assembly shall incorporate a filter, a regulator with set screw adjustment, and a pressure gauge (MPa) to indicate the regulated air pressure.

4.5.3 The air filter regulator assemblies shall be mounted and piped to the instrument at factory.

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5. INSTALLATION

5.1 Installation of Instruments

As a rule, field-mounted instruments shall be prefabricated in the packaged equipment prior to shipment, and the pressure piping, air supply piping, signal tubing/wiring etc. shall be also be installed as far as possible.

5.2 Cable Way and Wiring

5.2.1 Unless otherwise specified in the requisition, the Vendor shall be responsible for the provision of all cables, cabling materials, ladder rack, trays, lugs, conduits and fittings, cable glands (certified as appropriate) and all associated accessories which are required to interconnect items within his supply or battery limits.

5.2.2 Overhead cable tray with protection cover shall be used for main cable way. For protection of branched cables, conduit pipes shall be used. Cable tray shall be made of hot-dip galvanized steel plates and/or frames. Cable tray cover shall be made of stainless steel plates.

5.2.3 Conduit System.

- 1) Hot dipped galvanized rigid steel conduit and fittings system shall be applied to, all the wiring in the unit. Closed conduit system shall normally be applied.
- 2) Flexible conduit connections shall be used to avoid transmission of vibration from vibrating equipment to the conduit system. It shall also be used to terminate periodically removable connections such as to instruments, and thermocouples. Maximum length of flexible conduit connections shall be 1000 mm (40 inches).
- 3) Conduit bodies and junction boxes shall be accessible from platforms, ladders, and stairways and shall be supported independent of conduit system. Whenever practical, horizontal conduits shall be sloped for drainage. Conduit shall not be installed behind the ladder rungs or at platform levels in such a manner as may cause false and insecure step. Drain plugs (or breathers) shall be installed at lowest point of vertical conduit runs.

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- 4) Cable and conduit entrances into enclosures shall be positioned only for bottom or side entry into enclosures.
- 5) When the units are divided and consist of two or more sections (or skids), the Vendor shall provide terminal boxes on each section of the unit for wiring between sections.
- 6) Flexible conduit and packing type cable gland that were made of stainless steel(316SS) shall be used flameproof-Ex 'd' type

5.2.4 Instrument cable specifications shall be as follows

- 1) Analogue signal wiring Stranded copper conductor, twisted pair or triad, flame retardant with aluminum mylar tape or copper tape shield with drain wire, PVC insulated and PVC overall jacketed type for analog signal wiring including RTD and frequency and digital pulse signal(CVVS, CVV-I/C AMS type).
The cable shall be approved by vertical tray flame test.(KS C 3341, IEEE 383 or equivalent) Twisted pair, triad, Multi-conductor cable : 1.5 mm² (16 AWG) core size
- 2) Power supply and contact signal cables including those for solenoid valves shall be stranded copper wire, binder tapes over core assembly, flame retardant with PVC overall jacket type.
Core size shall be designed by the Vendor but not smaller than 2.5 mm². (CVV type)
The cable shall be approved by vertical tray flame test.(KS C 3341, IEEE 383 or equivalent)

5.2.5 Field mounted junction boxes (and/or terminal-blocks mounted in local control panel) shall be provided in the packaged equipment in order to connect multi-conductor cable from/to the control room. Terminal shall be provided for all cable cores and screens and including minimum 20% spare.

5.3 Instrument Pressure Piping

- 5.3.1 1/2 inch pipes, socket weld valves and fittings as per the applicable piping specification shall be used for the pressure gauge.

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5.4 Pneumatic Signal Tubing

316 stainless steel tube of 1/4 inch or 1/2 inch out-diameter x 0.049" thickness and 316 stainless steel compression fittings with double ferrules shall be used.

6. PAINTING

The manufacturer's standard painting shall be applied for instruments.

7. NAME PLATES

Each instrument shall have a nameplate made of corrosion-resistance metal and all data shall be clearly and deeply stamped into the metal by raised letters. The nameplate shall be permanently attached to the instrument housing and bearing the following information.

- 1) Instrument tag number
- 2) Pressure Rating
- 3) Manufacturer's name and Model Number
- 4) Model number
- 5) Materials & Size (for control valves, PSV's and in-line flow elements)
- 6) Degree of Explosion Proof & Certificate Number
- 7) Calibrated Range (If applicable)