TECHNICAL SPECIFICATION

Nº I-ET-3010.1M-1200-800-P4X-014

CLIENT: SRGE

JOB: REFERENCE BASIC DESIGN

AREA: BÚZIOS

TITLE: AUTOMATION INTERFACE OF PACKAGE UNITS

DP&T-SRGE

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1 INTRODUCTION

1.1 OBJECT

1.1.1 This specification describes the minimum requirements for the adequate interfacing of the Main Packages’ Automation and Instrumentation System with the UNIT.

1.1.2 This technical specification deals exclusively with the interfaces related to Automation and Instrumentation. For interface with the other systems, see respective discipline project documentation.

1.2 DEFINITIONS

1.2.1 Refer to I-ET-3010.00-1200-940-P4X-001 - GENERAL TECHNICAL TERMS.

1.3 ABBREVIATIONS, ACRONYMS AND INITIALISMS

AEPR Automation & Electrical Panels Room
CCR-ATR Central Control Room – Automation and Turbomachinery Room
CSS Control and Safety System
DIO Optical Internal Distributor
ESD Emergency shutdown
FAT Factory Acceptance Test
I/O Input / Output
LAN Local Area Network
MMS Machinery Monitoring System
MPA Automatized Procedures Module (Portuguese: Módulo de Procedimentos Automatizados)
MPS Machinery Protection System
PAS Package Automation System
PCS Process Control System
PLC Programmable Logic Controller
PSD Process Shutdown System
RESD Emergency Shutdown Relay
RIO Remote I/O
SAT Site Acceptance Test
SIT Site Integration Test
SOS Supervision and Operation System
TAP Performance Acceptance Test
TCP/IP Transmission Control Protocol/Internet Protocol
UCP PACKAGE UNIT Control Panel
Vac Unit for AC voltage
Vdc Unit for DC voltage
2 REFERENCE DOCUMENTS, CODES AND STANDARDS

2.1 EXTERNAL REFERENCES

2.1.1 International Codes, Recommended Practices and Standards

IEC - INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60079 ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES – ALL PARTS
IEC 60092-350 ELECTRICAL INSTALLATIONS IN SHIPS – PART 350 - GENERAL CONSTRUCTION AND TEST METHODS OF POWER, CONTROL AND INSTRUMENTATION CABLES FOR SHIPBOARD AND OFFSHORE APPLICATIONS
IEC 60092-376 ELECTRICAL INSTALLATIONS IN SHIPS – PART 376 - CABLES FOR CONTROL AND INSTRUMENTATION CIRCUITS 150_250 V (300 V)
IEC 60079-25 EXPLOSIVE ATMOSPHERES – PART 25: INTRINSICALLY SAFE ELECTRICAL SYSTEMS - EDITION 2.0
IEC 60092-504 ELECTRICAL INSTALLATIONS IN SHIPS - PART 504: SPECIAL FEATURES - CONTROL AND INSTRUMENTATION
IEC 60529 DEGREE OF PROTECTION (IP CODE)
IEC 60533 ELECTRICAL AND ELECTRONIC INSTALLATIONS IN SHIPS - ELECTROMAGNETIC COMPATIBILITY
IEC 61000 ELECTROMAGNETIC COMPATIBILITY (EMC) SERIES - ALL PARTS
IEC 61280 FIBRE OPTIC COMMUNICATION SUBSYSTEM BASIC TEST PROCEDURES – ALL PARTS
IEC 62337 COMMISSIONING OF ELECTRICAL, INSTRUMENTATION AND CONTROL SYSTEMS IN THE PROCESS INDUSTRY – SPECIFIC PHASES AND MILESTONES
IEC 62381 AUTOMATION SYSTEMS IN THE PROCESS INDUSTRY - FACTORY ACCEPTANCE TEST (FAT), SITE ACCEPTANCE TEST (SAT) AND SITE INTEGRATION TEST (SIT)

2.1.1.1 All - Ministério da Economia regulations (NRs) shall be followed.

2.1.2 Classification Society

2.1.2.1 The DETAIL DESIGN PHASE shall be submitted to approval by Classification Society. The design and installation shall take into account their requirements and comments.

2.1.2.2 The design, installation and operation shall strictly follow the classification society requirements, along with the specific requirements identified in this document, including also all referenced documents' requirements.
### 2.2 INTERNAL REFERENCES

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2.2.1 When more restrictive, Brazilian regulation (MTE section) and INMETRO regulation superpose all codes and regulations listed in item 2.2, since they are enforced by Brazilian law.
3 GENERAL – INFORMATION COMMON TO ALL PACKAGES

3.1 GENERAL REQUIREMENTS

3.1.1 For each package type requirements and definitions, refer to I-ET-3010.00-1200-800-P4X-002 – AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS.

3.1.2 During detailed engineering design, PACKAGER shall issue three additional documents regarding cables:
   - Cable List;
   - Cable Code list;
   - Cable Gland Code List.

3.1.2.1 Document I-ET-3010.00-1200-800-P4X-010 – CRITERIA FOR ESTABLISHING CABLE CODES AND CABLE GLAND CODES, contains the criteria for emitting such documents.

3.1.3 Redundant network cables shall have segregated routing in such a way that a cause of damage to one of the cables will not affect the other.

3.1.4 Each package skid, except P0 PACKAGES, shall have its own UCP.

3.1.5 UCP shall be installed at the Automation and Electrical Panels Room (AEPR), Central Control Room – Equipment Ambiance (CCR-EA) or at field (where designated) while RIO Panels (where applicable, as in item 3.1.4) shall be installed at field. For UCPs and RIOs locations, see I-LI-3010.1M-1200-940-P4X-002 – EQUIPMENT LIST.

3.1.6 All PACKAGE UNIT Fire and Gas signals shall be sent to the UCP.

3.1.7 For operational and environmental conditions additional to this section, see I-ET-3010.1M-1200-800-P4X-001 - INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS.

3.1.8 The available power supply for UCP and RIO panels shall be 220 Vac. The available power to be supplied by panels for instrumentation shall be 24 Vdc unless otherwise specified on I-ET-3010.1M-1200-800-P4X-005 - FIELD INSTRUMENTATION.

3.1.9 All panels, materials, instruments and equipment proper to be used in hazardous areas, shall have conformity certificates according to I-ET-3010.1M-1200-800-P4X-001 - INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS. All electrical and instrumentation equipment and controls installed in hazardous areas or in external area, but kept turned on during ESD-3 situation, shall be certified for installation in hazardous areas, certified for Zone 1. All INMETRO certificates for these equipment shall be provided by PACKAGER before FAT for PETROBRAS approval.

3.1.10 Main, Exportation, CO2 and Injection Compressors and Vapor Recovery Unit shall have a package RIO Panel each. For more information on UCP and RIO Panel specifications and required functionalities, see its respective PACKAGE TECHNICAL SPECIFICATION.
4 INTERFACE SIGNALS HARDWIRED TO CSS

4.1 SIGNALS

4.1.1 The interface signals between PACKAGE UNITs and CSS are according to table 1, below.

4.1.2 Whenever a signal is mentioned for a package that has multiplicity, such as a compression unit composed of 3 compression trains, UC-1231001A/C for example, the signal is applicable to each one of the identical packages. For example, the signal for the aforementioned case should be XSL-1231001A/C – one per identical PACKAGE.

5 INTERFACE SIGNALS SENT VIA NETWORK TO CSS

5.1 SIGNALS

5.1.1 All P2, P2S, P2C and P2SC PACKAGE UNIT shall send through the network interface, at least, the following signals:

- All process variables (including totalizers)
- All valve statuses (limit switch, position indicator, commands to valves)
- All alarm set points
- All alarm statuses
- All controller set points (PID internal variables like Kp, Ki, Kd and internal accumulators are not needed)
- All equipment (pumps, compressors etc.) statuses (on/off)
- All equipment (pumps, compressors etc.) VSD set point (for those with VSD)
- All equipment (pumps, compressors etc.) stepped capacity set point (for those with stepped capacity set point)
- Timers for batch processes cycles (ex.: adsorption cycles, membrane cycle etc.)

6 FIELD INSTRUMENTS INTERFACE

6.1 INTERFACE

6.1.1 All skid instruments shall be connected to the specific junction box on the skid according to I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS and PACKAGE TECHNICAL SPECIFICATION.

6.1.2 At least one interface junction box shall be provided on the module for each skid. These junction boxes shall be specified and segregated according to I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS.

6.1.3 All signals provided by instruments on process plant related to anti-surge and capacity control will be connected by multicables to the corresponding module’s
interface junction boxes and from these junction boxes to the respective UCPs on AEPR.

6.1.4 All BDVs related to process plant that require UCP actuation signals shall be actuated by the CSS and by the UCP. This must be achieved by the use of two solenoid valves. This shall be used in order to guarantee that the CSS shall always be able to depressurize regardless of the UCP malfunction.

6.1.5 All cables connecting to the BDV and SDV solenoid valves and limit switch SDVs shall be fire resistant (see I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS).

7 NETWORK INTERFACE

7.1 GENERAL

7.1.1 PETROBRAS will inform to INTEGRATOR, and then PACKAGER shall request to INTEGRATOR, during project’s detailing design phase, a list of available IP addresses to be used for the connection between the PACKAGE UNIT and PACKAGE UNIT LAN, according to I-MD-3010.1M-5520-800-P4X-003 - AUTOMATION NETWORK DESCRIPTION and I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS.

7.1.2 Each UCP of the PACKAGE UNIT shall be connected to PACKAGE UNIT LAN at panel PN-5523001 (TOPSIDES SOS SERVERS PANEL, in case of a Topsides PACKAGE) or to panel PN-5523501 (HULL SOS SERVERS PANEL, in case of a Hull PACKAGE) through a redundant Gigabit Ethernet link, according to I-DE-3010.1M-5520-800-P4X-004 – NETWORK INTERCONNECTION DIAGRAM and I-ET-3010.1M-5520-800-P4X-004 – AUTOMATION NETWORK REQUIREMENTS. PACKAGER shall provide optical connections in UCP and RIO panels, whereas the connection itself will be made by INTEGRATOR.

7.1.3 Ethernet connections between PACKAGE UNIT and SOS shall be according to I-ET-3010.1M-5520-800-P4X-004 – AUTOMATION NETWORK REQUIREMENTS.

7.1.4 PACKAGER shall provide UCP controllers with 2 OPC UA server drivers. These OPC UA drivers shall be installed by INTEGRATOR in PACKAGE UNIT DATA SERVERS, in order to standardize the communication between PACKAGER controller and PACKAGE UNIT DATA SERVERS. The OPC UA driver shall be OPC Foundation™ compliant. Only in case the PACKAGER controller doesn’t support OPC UA Server driver, PETROBRAS accepts Modbus/TCP driver or a dedicated communication driver for communication between PACKAGER controller and PACKAGE UNIT DATA SERVERS. In all cases, INTEGRATOR shall liaise with PACKAGER and with manufacturer of PACKAGE UNIT DATA SERVERS Supervisory Software, in order to define the adequate communication driver version.
7.2 AMS INTERFACE

7.2.1 AMS System shall acquire data from PACKAGE UNIT through the PACKAGE UNIT LAN. For more information on AMS System, see I-ET-3010.00-1200-850-P4X-002 – ASSET MANAGEMENT SYSTEM (AMS).

7.2.2 Each UCP shall provide information acquired from the instruments by means of a connection of its network switches to the TOPSIDE SOS SERVERS PANEL (PN-5523001) in order to make it available to the PACKAGE UNITs LAN.

7.3 MMS INTERFACE

7.3.1 In case the RIO Panel for PACKAGE UNITS does not exist (see item 3.1.10), the machinery monitoring signals will be connected to Hull Protection and Acquisition Panel (PN-5500506), in case of a Hull Machine, or Topsides Protection and Acquisition Panel (PN-5500509), in case of a Topsides Machine. This connection will be made by INTEGRATOR, whereas the PACKAGER shall provide all necessary means for connection in RIO Panel.

7.3.2 In case the RIO Panel for PACKAGE UNITS exists (see item 3.1.10), the RIO Panel for PACKAGE UNITS shall provide connection from MPS inside RIO Panel to MMS Server Panel (PN-5500507). This connection will be made by INTEGRATOR through redundant communications. If necessary, conversion between fiber optic and twisted pair shall be performed in a converter mounted inside DIOs panel.

7.4 IHM INTERFACE

7.4.1 All P2S (according to classification on appendix I) UCPs will be connected to a network switch in the AEPR that will be connected to its HMI at the CCR-OA, such as defined in I-DE-3010.1M-5520-800-P4X-002 - AUTOMATION AND CONTROL ARCHITECTURE.

7.4.2 For the main, exportation, CO2 and injection compressors, the aforementioned switch will be connected to the workstations PN-5500010A/D (COMPRESSOR CAPACITY CONTROL SYSTEM WORKSTATIONS) at the CCR-OA, such as defined in I-DE-3010.1M-5520-800-P4X-002 - AUTOMATION AND CONTROL ARCHITECTURE.

7.4.3 The connections mentioned in items 7.4.1 and 7.4.2 will be made by INTEGRATOR, whereas the PACKAGER shall provide all necessary means for connection in UCP.

7.5 UCP AND RIO PANEL INTERFACE

7.5.1 Where applicable (see item 3.1.10) Control RIO, Safety RIO and Overspeed Protection shall be connected to a DIOs PANEL by a redundant optical fiber network connection and from the aforementioned DIOs Panel to UCP by twisted pair network cables. These connections may be proprietary.

7.5.2 This RIO panel shall be certified as Ex-px, certified for Zone 1, according to IEC-60079.

7.5.3 For Main, Exportation, CO2 and Injection Compressors and Vapor Recovery Unit, the internal components of the UCP and RIO are depicted in figure 1, below.
Figure 1 – Internal Components
7.6 **COMPRESSOR CONTROL MPA INTERFACE**

7.6.1 Main, Exportation, CO2 and injection compressors and Vapor Recovery Unit will have an interface with MPA software to perform advanced control. This MPA software will be installed at PCS RTDS.

7.6.2 All signals necessary to MPA software will be sent through network interface from PACKAGE UNIT UCP and PACKAGE UNIT RTDS. PACKAGER shall make these signals available in the PACKAGE UNIT communication map. For more information on these signals, see item 5.1.1.

7.6.3 The MPA software, running in PCS RTDS, will read these data from PACKAGE UNIT RTDS through SOS LAN. The result of the MPA control will then be sent to PCS via network (CSS LAN), and then to the PACKAGE UNIT UCP via hardwired analog signals. PACKAGER shall provide the necessary interface to receive these signals from PCS. For more information on these signals, see 4.1.1.

7.6.4 Since these signals will command loops from the PACKAGE UNIT UCP, there shall be a selection logic between the signal from the PACKAGE UNIT itself and the signal from MPA software. This selection logic shall be done in PACKAGE UNIT UCP. For more details, see I-ET-3010.1M-1225-323-P4X-001 - VAPOR RECOVERY UNIT, I-ET-3010.1M-1231-321-P4X-001 - MAIN GAS MOTOCOMPRESSOR, I-ET-3010.1M-1231-321-P4X-002 - EXPORTATION GAS MOTOCOMPRESSOR, I-ET-3010.1M-1252-321-P4X-002 - INJECTION GAS MOTOCOMPRESSOR and I-ET-3010.1M-1254-321-P4X-002 - CO2 TURBOCOMPRESSOR.

7.6.5 The aforementioned communications are depicted in figure 2, below:

![Figure 2 – MPA Communications](image)
8 PACKAGE RIO PANEL AND UCP HARDWIRED INTERFACE

8.1 INTERFACE
8.1.1 For PACKAGE UNITS where such panel exists (see item 3.1.10), there shall be a hardwired connection between the Emergency Shutdown Relay (RESD) installed on RIO Panel and the one installed on UCP. For more information regarding the RESD and its functionality, see PACKAGE TECHNICAL SPECIFICATION.

9 PNEUMATIC/HYDRAULIC INTERFACE

9.1 INTERFACE
9.1.1 Essential air supply shall be made available by the UNIT to the PACKAGE UNITS that need it and to the RIO Panels (where such panel exists, see item 3.1.10). For details about specifications for service air, see I-ET-3010.1M-1200-800-P4X-001 - INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS and I-RL-3010.1M-1200-940-P4X-001 - GENERAL SPECIFICATION FOR AVAILABLE UTILITIES.

9.1.2 Hydraulic fluid shall be made available by the UNIT to the PACKAGE UNITS that need it. For details about specifications for hydraulic fluid, see I-ET-3010.00-5139-390-P4X-001 - HYDRAULIC POWER UNIT (HPU) FOR TOPSIDES VALVES.

9.1.3 Service air tubings diameters and hydraulic fluid tubings diameters shall be defined during Detailing Engineering Design.

9.1.4 INTEGRATOR is responsible for connection of essential air and service air supply lines and hydraulic fluid lines to the skids and Compressor’s RIO panels.

10 SCOPE OF SUPPLY

10.1 PACKAGER’S SCOPE OF SUPPLY
10.1.1 PACKAGER shall provide to INTEGRATOR, at least the following:
- A table identifying for each signal type, the required cable cross-section as a function of to cable length;
- Estimated instrument air consumption (for each service and essential air);
- Tie-in positions for tubings, junction boxes and cable trays,
- Arrangement drawing of UCP and RIO Panel (where such panel exists, see item 3.1.10) structural bases;
- Instruments datasheets;
- Resistance, Inductance and Capacitance parameters from Ex-i circuits up to interface junction Box and the requirements of destination panel, in order for INTEGRATOR to calculate Ex-i circuits in accordance with IEC 60079-11 and IEC 60079-14
- All necessary memory maps;
• All panels’ thermal dissipation calculation
• All necessary documentation required by NR-10 and NR-13 dossier.

10.1.2 The interface JB’s shall be supplied with a removable gland plate in its lower part.

10.1.3 For information regarding PACKAGER scope of supply, see PACKAGE TECHNICAL SPECIFICATION and I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS.

10.2 INTEGRATOR’S SCOPE OF SUPPLY

10.2.1 All other instruments represented on the P&ID that are not PACKAGER’s scope of supply.

10.2.2 All module interface junction boxes described on item 6.1.3.

10.2.3 INTEGRATOR shall provide to PACKAGER a range and set points list from instruments furnished by INTEGRATOR that are connected to PACKAGER System.

10.2.4 In addition to documentation listed on PACKAGE TECHNICAL SPECIFICATION, the following documents shall be supplied by INTEGRATOR during project's detailing design phase and in an AS BUILT version after commissioning of the complete system:

• Interconnection diagram for connections described in this technical specification;
• Loop Diagrams including alarms and virtual signals from PACKAGE UNIT Control Panel to field instruments (including those on skid);
• List of interface signals exchanged between connected system components;
• Documentation of any interface component supplied by INTEGRATOR required by NR-10 and NR-13 dossier.

10.2.5 Final AS BUILT documentation shall be supplied in digital media (USB thumb drive) and in as many copies as requested by INTEGRATOR documents.

11 SCOPE OF SERVICE

11.1 PACKAGER SCOPE OF SERVICE

11.1.1 Supervise assembly on skid of loose items supplied by PACKAGER.

11.1.2 Supervise the receipt inspection of Skids and Loose Items on INTEGRATOR Site

11.1.3 Execute FAT, SAT and SIT in accordance with IEC 62381, IEC 62337 and Classification Society Rules.

11.1.4 For more information regarding PACKAGER scope of service and tests, see PACKAGE TECHNICAL SPECIFICATION and I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS.

11.1.5 PACKAGER is responsible for connection and mounting of all necessary cables and cable trays from PACKAGE UNIT up to Skid junction boxes.
11.2 INTEGRATOR SCOPE OF SERVICE

11.2.1 Install all cables and multicables (and cable glands on each cable end) mentioned on this technical specification except for those regarding skid instruments that connect to skid’s junction box.

11.2.2 Execution of receipt inspections to ensure that equipment were delivered in accordance with specifications and without any damages.

11.2.3 Execution of PACKAGE UNIT preservation in accordance with PACKAGER procedures and recommended practices.

11.2.4 Installation on site of PACKAGE UNIT Control Panels and Compressor RIO Panels. The installation shall include the manufacturing of the panels’ base upon the drawing supplied by the PACKAGER.

11.2.5 Installation of instruments furnished by PACKAGER that shall be installed on module or process plant.

11.2.6 Calibration of all instruments (including instruments on PACKAGER scope of supply), according to respective documentation.

11.2.7 Cable pulling and connection of all cables mentioned on item 11.2.1.

11.2.8 Cable tests, including: continuity test and megger, for electrical and instrumentation cables and for fiber optics cables an optical integrity test in accordance with IEC 61280.

11.2.9 Execution of Loop Test for all instrumentation items. Loop test shall be done applying process variable on instrument sensors in order to ensure the integrity of impulse lines and sensors.

11.2.10 INTEGRATOR shall be responsible to inform to PACKAGER all instrument connections information and process data, in order to PACKAGER to calculate its instruments.

11.2.11 INTEGRATOR shall be responsible to provide all resources needed for PACKAGER to perform all planed tests for Onshore and Offshore Commissioning listed on PACKAGE TECHNICAL SPECIFICATION.

11.2.12 INTEGRATOR is responsible for updating the INSTRUMENTATION CABLES technical specification according to cable types needed for integration or defined by PACKAGER.

11.2.13 INTEGRATOR is responsible for manufacturing and installing UCP and RIO Panel on module / AEPR in accordance with I-ET-3010.00-1200-800-P4X-013 – GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS.

11.2.14 INTEGRATOR is responsible for connection of all air supply lines to the skids and RIO panels.

11.2.15 INTEGRATOR is responsible for mounting all necessary cable trays up to Skid junction boxes. If necessary, PACKAGER shall be consulted for technical clarifications regarding cable tray routing and support inside skid.

11.2.16 INTEGRATOR is responsible for commissioning the PACKAGED UNIT and to guarantee its correct operation.
12 WARRANTY

12.1 GENERAL

12.1.1 INTEGRATOR is responsible for any damages to PACKAGE UNIT after receipt inspection.

12.1.2 For information regarding PACKAGE UNIT warranty, see PACKAGE TECHNICAL SPECIFICATION.

I - APPENDIX I – PACKAGE CLASSIFICATION

The classification of each package according to the definition from I-ET-3010.00-1200-800-P4X-002 – AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS.