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	JOB:	REFERENCE BASIC DESIGN	1001056398 0010
	AREA:	BÚZIOS	
DP&T-SRGE	TITLE:	FLARE GAS RECOVERY COMPRESSION UNIT	NP-1 ESUP

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PRELIMINARY

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1. GENERAL

- 1.1. Flare Gas Recovery Liquid Ring compressor shall be in accordance with API std 681, last edition.
- 1.2. PACKAGER shall consider all documents listed in Material Requisition as mandatory. Electrical, automation and safety requirements for package are described in these documents.
- 1.3. All components of the system shall be suitable for offshore environment, throughout the whole platform service life, under all operational conditions and submitted to Unit motions and accelerations described in PURCHASER specifications.
- 1.4. PACKAGER shall be entirely responsible for material selection on items not specified by PURCHASER and shall inform material of all main parts according to ASTM code. All bolts and nuts shall be supplied with PACKAGER certificates and fully marked according to applicable ASTM standard.
- 1.5. All shop punch lists shall be cleared before shipment.
- 1.6. Equipment shall be prepared for outdoor storage according to PURCHASER specifications.
- 1.7. PACKAGER shall specify the products to be used for preservation of the equipment components and spare parts, their removal and reapplication methods and the application date. Such data shall be summarized on two tags to be securely fastened on all equipment and outside of each crate. If rust preventives are required, volatile products shall not be applied.
- 1.8. Hazardous and toxic materials with associated adverse health effects shall be avoided or minimized. PACKAGER and sub-suppliers are encouraged to promote their replacement. Asbestos has been identified as detrimental to human health, especially regarding serious and often fatal diseases such as lung cancer, asbestosis and mesothelioma. Therefore, it shall not be used in the materials and equipment supplied for this project or for this plant or facility. As the use of such materials will not be tolerated, PURCHASER strongly recommends PACKAGER and sub-suppliers to take all necessary measures to ensure their use is fully avoided throughout this project. Material safety data-sheets may be required by PURCHASER any time, to demonstrate that a particular material has not been, is not and will not be used throughout all stages of this project.
- 1.9. All equipment, components and panels shall have a nameplate easy to access, to view and read. Nameplate shall be made in AISI 316 stainless steel and bolted (with stainless steel elements) to the equipment. Layout drawings shall be submitted to PURCHASER approval. Nameplates shall contain the following information, in Brazilian Portuguese language:

<ul style="list-style-type: none"> . Client name; . Client job; . Client area; . Supplier name; . Series number and model; . Year of manufacturing; . Main design and test data: pressure, temperature, voltage, rotation, etc; 	<ul style="list-style-type: none"> . Specific data; . Tag number; . Purchaser's requisition number (RM); . Purchaser's request for quotation number (RFQ); . Purchaser's order number (PO); . Empty weight; . Design code.
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1.10. All safety signals shall be in Portuguese language.

2. CONSTRUCTION FEATURES

- 2.1 The Flare Gas Recovery System Compression Unit will be part of the Flare System and it will be designed to recover low pressure flare gas as well as high pressure flare gas. It will be connected to the pipeline downstream both High Pressure Flare Knock Out Drum (V- 5412001) and Low Pressure Flare Knock Out Drum (V-5412002) and it will be located as close as possible to the Flare (TA-5412001) base.
- 2.2 The Flare Gas Recovery System Compression Unit must operate over wide ranges, usually within narrow suction pressure bands. The Flare Gas Recovery Compressor should be equipped with compressor recycle valve. Suction pressure is maintained by pressure control of a recycle valve, with additional loading and unloading of the compressors when limits of valve opening/closing or suction pressure are reached. Usually, the controls are set up to sequentially load and unload the compressor.
- 2.3 PACKAGER shall deliver his standard production line equipment. This specification contains the standards normally applied by the PURCHASER and the information required from MANUFACTURER/PACKAGER to assess the use of the equipment. The PURCHASER may therefore accept equipment to other recognized standards than those defined. Prototypes and equipment not field proven will not be accepted.
- 2.4 The complete package shall be designed, manufactured, tested, inspected and certified to conform to the requirements of this specification and be designed to meet the duty as stipulated on the project data sheets.
- 2.5 PACKAGER shall assume full unit responsibility for the complete package, including the driver and all ancillaries.
- 2.6 The package, including all ancillary equipment, shall be assembled to the maximum extent possible, aligned and pre-checked in MANUFACTURER/PACKAGER'S shop, allowing shipment to the conversion yard with minimal fieldwork.
- 2.7 Compressor connections and nozzle flanges shall be provided by removable spools to facilitate compressor remove and disassembly.
- 2.8 PACKAGER shall consider all operational cases, gas compositions and corrosive components content (H₂S and CO₂) for the compressor materials specification. PACKAGER shall also consider the compressor non running, cold and pressurized (with process gas) conditions and the presence of free water (even when not specified in the gas composition).
- 2.9 All materials that are exposed to hydrocarbons containing hydrogen sulphide must follow the requirements of ISO 15156 for sour service. This requirement also must be applied in systems that are located downstream of Dehydration Unit.

3. ACCESSORIES AND AUXILIARIES**3.1 Piping**

- 3.1.1 Except where indicated, all piping and accessories within equipment package limit shall be in accordance with PACKAGER piping specification and international standards.

- 3.1.2 All auxiliary piping requiring field connections shall be brought to the skid edge and shall be flanged.
- 3.1.3 Manual block valves and spectacle / blind flanges shall be provided at all battery limits such as inlet and outlet nozzles, drain lines, etc. **PACKAGER considering piping standards as in I-ET-3010.1M-1200-200-P4X-001 – PIPING SPECIFICATION FOR TOPSIDE.**
- 3.1.4 All equipment shall have sufficient flexibility in all pipe and duct connections.
- 3.1.5 The interconnecting pipework between auxiliary skid and the main baseplate shall be provided by PURCHASER.
- 3.1.6 A temporary basket particulate filter for machine starting, removable without disassembly of the piping, shall be installed in the suction line, close to each stage of compression.

3.2 Couplings and coupling guards

- 3.2.1 PACKAGER is responsible for all couplings within the package, including those for auxiliary equipment.
- 3.2.2 Coupling for main equipment shall be a stainless steel flexible-element, non-lubricated type.
- 3.2.3 PACKAGER shall submit to PURCHASER main equipment coupling data sheet according to API 671.
- 3.2.4 All coupling guards (including those for auxiliary equipment) shall be rigid, fully enclosed, in non-sparking material and solely fitted to equipment baseplates, not fastened. Safety coupling guards (without feet) are also acceptable. In case of failure, guards shall be able to retain broken parts, for personnel protection. Coupling guards shall be designed to allow removal without disassembling the coupling and shall be constructed so that routine inspections are performed by means of strobe light, with the equipment running.
- 3.2.5 Coupling guard drains shall have sight glasses in horizontal drain lines. The coupling guard shall not be used as a normal operating lube oil drain path.

3.3 Baseplate

- 3.3.1 Main baseplate shall be capable of supporting the stresses arising from platform motions and shall be provided with three (3) point supports and Anti-Vibration Mounting (AVM).
- 3.3.2 Baseplate shall be rigid enough to avoid permanent distortion during lifting, shipment and operation. When the baseplate is lifted, with all equipment mounted, beam deflection shall not exceed L/400 (L is the total baseplate length).
- 3.3.3 Driver, driven machine and transmission shall be mounted on a single baseplate. Other auxiliaries shall be mounted on the same baseplate (preferable) or provided with their own skid. PACKAGER shall submit layout to PURCHASER comments and approval.
- 3.3.4 The baseplate shall have a removable solid checkered plate or open grating top floor where required for maintenance.
- 3.3.5 All furnished skids shall be sufficiently stiff to withstand all vibration loads induced by the equipment and transfer them to the deck beams.

- 3.3.6 Skid mounted assemblies shall be constructed in order to not allowed equipment or parts be dismantled during lifting.
- 3.3.7 No equipment / component shall protrude beyond the skid limits. In cases where it cannot be avoided, required protection against mechanical damage shall be provided.
- 3.3.8 Each skid shall be provided with facilities (pad-eyes, lugs, bollards) for lifting, having suitable access for rigging. The estimated lifting load and safety factor for each point shall be informed in PACKAGER proposal. Main lifting points shall not be welded to the beam flange, unless the strength level is low enough or if the beam flange has a suitable thickness.
- 3.3.9 All equipment to be mounted on skids shall allow on-field leveling and alignment using jacking screws (in both plane directions) and precision type shims. Total shim thickness shall not exceed 6.35mm and the number of shims shall be kept to a minimum. Any additional height shall be made up of solid stainless steel plate.
- 3.3.10 All skid mounted equipment containing liquids that shall be drained onto the skid area, shall be fitted with drip pan underneath the equipment and provided with flanged nozzle with sufficient slope. Drip pans draining system shall be designed considering the total deluge flow over the skid. A single drain nozzle shall be located at the skid edge with appropriate piping, blocking valve, strainer and water seal.
- 3.3.11 Fasteners (including washers) and shims shall be constructed in AISI 316L stainless steel.

3.4 Support system

- 3.4.1 All required supporting system (including spring supports, structure, etc.) shall be supplied (for on-skid elements) or specified with all design requirements (such as loads, position, forces, etc.) by PACKAGER.

3.5 Insulation

- 3.5.1 All required insulation for personnel protection or machine thermal efficiency shall be applied and provided by PACKAGER.
- 3.5.2 Insulating shall ensure a temperature below 60°C over the external surface for personnel protection.
- 3.5.3 To prevent corrosion under insulation, only non hygroscopic insulation material shall be used.
- 3.5.4 In order to avoid damages during transportation and erection insulation shall be carried out after final installation in place.

3.6 Seal system

- 3.6.1 Compressor shall be fitted with double mechanical cartridge type seals.
- 3.6.2 The seal system shall be is a pressurized seal barrier system according to API standard 682, Plan 53-B.
- 3.6.3 Each of the mechanical seal packages shall consist of the following main components:
- Pressure control valve to maintain correct pressure in the seal system;
 - Bladder-type accumulator, with barrier fluid;
 - Pressure transmitter with high, low and low-low alarms;

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- Temperature indicator;
- Air Finned Cooler;
- Manual valves and check valve.

4. AUTOMATION

4.1 General requirements

- 4.1.1 All instruments and controls shall be fit for purpose, suitable for marine environmental for which they are intended, according to the same standards and requirements applicable for this project. PACKAGER shall ensure that the equipment is properly certified for the specified classification.
- 4.1.2 Package equipment shall be provided with PACKAGER'S control system and the safeguarding incorporated. PACKAGER shall assume total responsibility for the instrumentation, design, engineering, operational philosophy, and the PLC based control and safeguarding systems. These are part of PACKAGER'S scope, unless specified otherwise.
- 4.1.3 The control system PN-UC-5412001 (Flare Gas Recovery System Compressor Unit Panel) shall be considered as a P2 package, according to I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS and to I-MD-3010.1M-5520-800-P4X-001 – AUTOMATION AND CONTROL SYSTEM FUNCTIONS - TOPSIDE. These panels shall be installed at the Automation and Electrical Panels Room (AEPR) by others.
- 4.1.4 All requirements listed in that Specification for P2 packages shall be met.

4.2 Panel PN-UC-5412001 (Flare Gas Recovery System Compression Unit Panel)– External Interfaces

- 4.2.1 This panel shall have all the external interfaces simulated and tested during commissioning and leave the logic completely ready for the integration with the FLARE SYSTEM. The external interfaces are described below:
- The Flare Gas Recovery System Compression Unit Panel receives independent request signals of opening of each one of Quick Open Valve associated to HP or LP flare Collecting Header to shut down associated one of Shut Down Valve to HP or LP Flare interconnected Inlet to the Compression Unit. When both Quick Open Valves is requested to be open, the Compression Unit shall lead to be shut down;
 - UAS (Compression unit shutdown status) shall deliver signal to CSS – PSD;
 - Compression unit shutdown status shall deliver signal to PN-5412001;
 - ESD-2 (Process Plant shut down status), Vapor Recovery Unit shut down, and Separated Gas Cooler cooling water side very high pressure shall lead to Compression Unit shut down;
 - All the parameters monitored by the Compression Unit Panel need to be made available at Central Control Room;
 - The confirmed fire signal at the Compression Unit Area is made available to Compression Unit Panel. This signal shall be considered to applied to the Compression Unit shutdown and blowdown;

- The Flare Gas Recovery System Compression Unit Panel shall give permission to close HP and LP QOVs by solenoid valves connected to PN-UC-5412001 in case of compression unit start;
- The signals that shall be sent to CSS through network shall be defined during Detail Engineering Design, in strict agreement between PURCHASER and PACKAGER.

4.3 Minimum Safety Requirements


4.3.1 Safeguarding functions may be implemented according to API RP14C. All Flare Gas Recovery system shall be fail-safe.

4.4 Instrumentation Minimum Requirements

4.4.1 All instrumentation and alarms mentioned are the minimum required by PURCHASER. PACKAGER shall indicate other instrumentation and alarms for general protection and monitoring according to their experience and submit in technical proposal to PURCHASER for approval.

5. ELECTRICAL

- 5.1 Electrical equipment and materials shall comply with requirements of I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.
- 5.2 Electrical installations inside the package and the voltages to be supplied for electrical loads (motors, heaters, control panels, etc.) shall comply with requirements of I-ET-3010.00-5140-700-P4X-003 - ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.
- 5.3 Electrical motors shall comply with requirements of I-ET-3010.00-5140-712-P4X-001 - LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS and I-ET-3010.00-5140-712-P4X-002 – MEDIUM-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS. The electrical motors shall be fed from platform normal panels.
- 5.4 The electrical interfaces of the package shall comply with requirements of I-DE-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIAGRAM and I-ET-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE and I-LI-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.
- 5.5 Equipment, accessories, piping and structures shall be grounded according to requirements of I-DE-3010.00-5140-700-P4X-003 - GROUNDING INSTALLATION TYPICAL DETAILS, I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECYTRICAL DESIGN FOR OFFSHORE UNITS, IEC 61892-6 and IEC-60092-502. Besides these standards, for installations in hazardous area, the grounding requirements of IEC 61892-7 shall be complied.
- 5.6 Auxiliary MCCs (Motor Control Center) shall comply with requirements of I-ET-3010.00-5140-741-P4X-001 - LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS and I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEMS OF OFFSHORE UNITS.

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6. OPERATION AND MAINTENANCE REQUIREMENTS

- 6.1 PACKAGER shall make the applicable recommendations to optimize operation and maintenance, taking into account the remote location and platform general conditions. Any changes to equipment design, materials or specific spares that may improve the equipment operability, availability or reliability shall be submitted to PURCHASER for review and approval. But PACKAGER shall always comply with PURCHASER requirements before suggest any modification.
- 6.2 The packages shall be designed so that all maintenance can be carried out with standard tools as much as possible.
- 6.3 Equipment layout shall enable easy and safe access for maintenance to all components and parts. PACKAGER shall provide suitable walkways, ladders and handrails for all packages, including auxiliaries. All equipment and peripherals, especially oil reservoirs, shall have full access and inspection doors / hatches.
- 6.4 Equipment layout attached documents shall be used as a reference, but any solution adopted shall be within the footprint limits indicated.
- 6.5 Instruments and piping accessories shall be arranged in proper location in order to allow easy access by maintenance and operation personnel. Installation of piping and cable supports next to couplings, bearings and seals shall be avoided, for instance.
- 6.6 PACKAGER shall prepare detailed assembly, disassembly and maintenance procedures, describing the use of all involved lifting apparatus and including all required preventive and corrective maintenance tasks. PACKAGER shall inform the need for disassembling any component or equipment in order to facilitate access for maintenance. Suitable maintenance routes shall be provided to remove the main components and auxiliaries, avoiding interference with structures, piping, cabling, electric conduits and supports, equipment, etc. This plan shall be submitted to PURCHASER for approval.
- 6.7 PACKAGER shall provide special tools for all maintenance activities including tools for compressor and driver assembly, disassembly and removal.
- 6.8 PACKAGER shall include in proposal a schedule stating the expected time between major overhauls.
- 6.9 Noise control requirements
 - 6.9.1 Noise control analysis is a mandatory item to be carried-out. PACKAGER shall present noise data regarding items included in scope of supply.
 - 6.9.2 The maximum allowable sound level shall be 90 dB(A) at one (1) meter around the unit and up to two (2) meters from the floor.
 - 6.9.3 The noise control system for the package shall consider the noise radiated by inlet / outlet piping, equipment enclosure and equipment casings.
 - 6.9.4 Whenever electric motor drivers are used, it shall be verified if motor fan design can be modified (e.g., use of unidirectional blades, etc.) before any apparatus are applied for noise attenuation.

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- 6.9.5 In case of expected noise are higher than allowable limits, the equipment must be furnished with some noise control reduction measure and the maximum noise allowable value will be 85 dB(A). PACKAGER may consider the best solution, which may include or not the supply of an acoustic walls (open roof) and safety system requirements. The use of device to comply with noise requirement must be proved to be efficient and submit to PURCHASER approval.
- 6.9.6 For all equipment installed without acoustical enclosure, the following data will be required during proposal phase:
- Sound power level of the equipment;
 - Sound pressure level, in each of the four main directions and in one point of the top.
- 6.9.7 For all equipment installed inside acoustic enclosure, the following data will be required during proposal phase:
- Sound power level of the equipment without enclosure;
 - Sound pressure level, in each of the four main directions and in one point of the top, for the equipment plus enclosure;
 - Acoustical data of enclosure and silencers (when applicable).

7. INSPECTION AND TESTS

7.1 General requirements

- 7.1.1. PURCHASER is entitled to inspect the package anytime during fabrication to ensure that material and workmanship are in accordance with the specifications.
- 7.1.2. Inspection of materials and / or equipment will be made by PURCHASER or its authorized representatives.
- 7.1.3. Unless otherwise established by PURCHASER inspector, all equipment shall be available for inspection in an unpainted state.
- 7.1.4. PURCHASER inspector shall have the right to request inspections to ensure that the equipment complies with the relevant classification society requirements.
- 7.1.5. All process gas system welds shall be 100 % radiographically inspected and submitted to magnetic particle examination.
- 7.1.6. Prior to execution, PACKAGER shall submit for PETROBRAS approval the planning and test procedures.
- 7.1.7. Testing, performance validation, verification and commissioning activities shall demonstrate that the Safety Requirement Specification designed for the Flare Gas Recovery Compression Unit has been reached.
- 7.1.8. PACKAGER shall be responsible for providing personnel, material, necessary equipment and instruments for all the tests, independent of the place where they are carried out, until the final commissioning and acceptance of the unit by PETROBRAS.
- 7.1.9. Any component of hardware or software failed during a test shall be re-tested as necessary to prove rectification has been completed satisfactorily.

7.1.10. The devices shall have self-diagnosis features to detect on-line failures. Input signals line monitoring and partial stroke test routine shall be available.

7.2. Hydrostatic test (HT)

7.2.1. For all trains, parts being tested shall be externally coated with a layer of white lead carbonate or any other suitable powder to help leakage detection.

7.2.2. No vises or clamping devices shall be used for pressing of nozzle flanges.

7.2.3. PTFE tape or thread compounds shall not be used to prevent leakage of threaded plugs and connections.

7.3. Performance Test (PT)

7.3.1. PT shall be performed on each unit according to API STD 681.

7.4. Mechanical Running Test (MRT)

7.4.1. MRT shall be performed on each unit according to API STD 681.

7.5. Site Acceptance Test (SAT)

7.5.1. An offshore functional test with process gas shall be performed, in order to verify operational points and capacity control at least.

7.5.2. Probes and monitors shall be tested and calibrated before SAT, during commissioning. Calibration curves shall be plotted and checked according to probes standards tolerances.

7.5.3. PURCHASER will perform a SLT during SAT.