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ESUP	TITLE: HYDRAULIC VALVES REMOCON UNIT (HULL SYSTEMS)		INTERNAL
			ESUP

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1. INTRODUCTION

1.1. OBJECTIVE

The purpose of this technical specification is to describe the minimum requirements for the design, manufacturing, assembly, supply, installation, and tests of HYDRAULIC VALVES REMOCON UNIT (HULL SYSTEMS) in conformance with relevant regulations and basic design documentation.

1.2. DEFINITIONS

PACKAGE: It is defined as an assembly of equipment supplied interconnected, tested and ready to operate, requiring only the available utilities from the Unit for the Package operation.

PACKAGER: It is defined as the responsible for project, assembly, construction, fabrication, testing and furnishing of the Package.

HYDRAULIC VALVES REMOCON UNIT (HULL SYSTEMS) the package name.

OWNER: PETROBRAS.

All definitions are found on I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS

1.3. ABBREVIATIONS

CS……..Classification Society

FAT……Factory Acceptance Tests

FPSO……Floating Production Storage and Offloading Unit

HPU…… Hydraulic Power Unit

SOS……Supervisory and Operation System

SOS-HMI…… Human Machine Interface of SOS

2. NORMATIVE REFERENCES

2.1. INTERNATIONAL CODES, RECOMMENDED PRACTICES AND STANDARDS

The equipment will be designed and manufactured in accordance with the following codes and standards, if not mentioned otherwise.

- ASME B31.3 – Process Piping
- ASME B16.5 – Pipe Flanges & Flanged Fittings

- AWS D1.1 – Structural Welding Code
- ISO – International Standard Organization
- IMO – International Maritime Organization
- IEC – International Electrotechnical Commission
- SOLAS II-1, Regulation 3-5, and MSC.1/Circ. 1379
- Classification Society defined for the Hull scope.

2.2. BRAZILIAN CODES AND STANDARDS

- NR – Brazilian Federal Government Regulatory Norms (Normas Regulamentadoras NRs).
- NORMAM-201 – Normas da Autoridade Marítima para Embarcações Empregadas na Navegação em Mar Aberto.
- INMETRO Resolution 115, March 21st, 2022 (hazardous areas)

2.3. CLASS APPROVAL AND CERTIFICATION

PACKAGE shall be designed, manufactured, and tested according to the design reference documents, normative requirements and in accordance with the latest editions of Classification Society Rules, Regulations and Standards.

3. REFERENCE DOCUMENTS

3.1. FPSO BASIC DESIGN – HULL SYSTEMS REFERENCE DOCUMENTS

DOC CODE (*)	DOC TITLE
HULL SYSTEMS	
I-DE–HYDRAULIC VALVES REMOCON (HULL SYSTEMS)	HYDRAULIC VALVES REMOCON (HULL SYSTEMS)
I-MD–DESCRIPTIVE MEMORANDUM - HULL SYSTEMS	DESCRIPTIVE MEMORANDUM - HULL SYSTEMS
OUTFITTING	
I-DE-3010.2Q-1351-140-P4X-001	HULL GENERAL NOTES AND TYPICAL DETAILS
GENERAL	
I-DE-AREA CLASSIFICATION – GENERAL	AREA CLASSIFICATION – GENERAL
I-DE-GENERAL ARRANGEMENT	GENERAL ARRANGEMENT

I-ET-AUTOMATION INTERFACE OF PACKAGE UNITS	AUTOMATION INTERFACE OF PACKAGE UNITS
I-ET-METOCEAN DATA	METOCEAN DATA
I-RL-GENERAL SPECIFICATION FOR AVAILABLE UTILITIES	GENERAL SPECIFICATION FOR AVAILABLE UTILITIES
I-RL-MOTION ANALYSIS	MOTION ANALYSIS

Table 1 – FPSO basic design reference documents.

- (*) Note: the above documents code number is intentionally omitted since this technical specification is issued for different basic design projects. The actual document code shall be checked across the contractual basic design document list. Title naturally may vary slightly from one project to another.

3.2. TYPICAL DOCUMENTS

DOC CODE	DOC TITLE
GENERAL	
I-ET-3000.00-0000-940-P4X-002	SYMBOLS FOR PRODUCTION UNITS DESIGN
I-ET-3000.00-1200-940-P4X-001	TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN
I-ET-3010.00-1200-940-P4X-002	GENERAL TECHNICAL TERMS
CONSTRUCTION	
I-ET-3010.00-1200-200-P4X-115	REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING
I-ET-3010.00-1200-200-P4X-116	REQUIREMENTS FOR BOLTED JOINTS ASSEMBLY AND MANAGEMENT
I-ET-3010.00-1200-955-P4X-001	WELDING
I-ET-3010.00-1200-970-P4X-003	REQUIREMENTS FOR PERSONNEL QUALIFICATION AND CERTIFICATION
MECHANICAL	
I-ET-3010.00-1352-130-P4X-001	FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS
I-ET-3010.00-1200-300-P4X-001	NOISE AND VIBRATION CONTROL REQUIREMENTS
PAINTING	
I-ET-3010.00-1200-956-P4X-002	GENERAL PAINTING
DR-ENGP-I-1.15	COLOR CODING

SAFETY	
I-ET-3010.00-5400-947-P4X-002	SAFETY SIGNALING
DR-ENGP-M-I-1.3	SAFETY ENGINEERING GUIDELINE
PIPING	
I-ET-3010.00-1200-251-P4X-001	REQUIREMENTS FOR BOLTING MATERIALS
I-ET-3010.00-1200-200-P4X-115	REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING
ELECTRICAL	
I-DE-3010.00-5140-700-P4X-003	GROUNDING INSTALLATION TYPICAL DETAILS
I-ET-3010.00-5140-700-P4X-001	SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-002	SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-003	ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-007	SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-009	GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS
I-ET-3010.00-5140-712-P4X-001	LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS
I-ET-3010.00-5140-741-P4X-004	SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS
INSTRUMENTATION AND AUTOMATION	
I-ET-3010.00-1200-800-P4X-002	AUTOMATION, CONTROL, AND INSTRUMENTATION ON PACKAGE UNITS
I-ET-3010.00-1200-800-P4X-013	GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS
I-ET-3010.00-1200-800-P4X-015	REQUIREMENTS FOR TUBING AND FITTING (ALIGNED TO IOGP-JIP33 S-716)
I-ET-3010.00-5520-888-P4X-001	AUTOMATION PANELS

Table 2 – FPSO basic design typical documents.

4. DESIGN REQUIREMENTS

4.1. DESIGN CONDITIONS

4.1.1. PACKAGE Equipment shall be designed for a design lifetime defined on I-MD-DESCRIPTIVE MEMORANDUM – HULL SYSTEMS and in a corrosive offshore environment without the need for replacement of any major component due to wear, corrosion, fatigue, or material failure.

4.1.2. PACKAGER shall design the equipment for the full range of operational conditions as specified in this technical specification.

4.1.3. PACKAGE Equipment shall be designed with the compliance of the normative and design requirements as stated in this specification and complying with the technical parameters stated on the above item 3 with the basic design reference documents.

4.2. SAFETY REQUIREMENTS

4.2.1. Personnel safety protection shall be provided according to Brazilian Regulatory Norms (NR) issued by Brazilian Government.

4.2.2. Warning signs in Brazilian Portuguese language shall be provided where risk of personnel injury exist.

4.2.3. Rotating equipment outer parts, such as pulleys, couplings, belts and flywheels, shall have rigid protection, manufactured with aluminum ASTM B211 and shall be capable of being easily removed.

4.2.4. In accordance with the requirements of SOLAS II-1, Regulation 3-5, and MSC.1/Circ. 1379, all equipment and material to be supplied by PACKAGER shall be “asbestos free”.

4.2.5. Safety signalling shall be in full compliance with I-ET-3010.00-5400-947-P4X-002 – SAFETY SIGNALLING.

4.2.6. For additional safety requirements refer to DR-ENGP-M-I-1.3 – SAFETY ENGINEERING GUIDELINE.

4.3. NOISE AND VIBRATIONS

4.3.1. Noise and vibrations limits shall be in conformance with I-ET-3010.00-1200-300-P4X-001 – NOISE AND VIBRATION CONTROL REQUIREMENTS.

4.4. MOTIONS AND ACCELERATION

4.4.1. All equipment shall be able to withstand with the UNIT subjected to 100-year return period environmental conditions.

4.4.2. All equipment shall be able to operate with the UNIT subjected to 1-year return period environmental conditions.

4.4.3. All environmental conditions are defined in I-ET-METOCEAN DATA.

4.4.4. For the Hull loading conditions details and the maximum designed operational trim and heel inclinations refer to I-ET-3010.00-1350-960-P4X-001 – DESIGN REQUIREMENTS – NAVAL ARCHITECTURE.

4.4.5. For the design data and information regarding motion requirements refer to I-RL–MOTION ANALYSIS.

4.4.6. PACKAGE is also to withstand inertial forces during transportation from construction site to the final offshore location.

5. PACKAGE SCOPE OF SUPPLY

5.1. SCOPE OF SUPPLY

5.1.1. PACKAGE shall be composed by the following equipment / components which are the PACKAGER minimum scope of supply:

a) Hydraulic power unit (HPU) – 1 x 100%

b) Hydraulic power unit control panel 1 x 100%

c) Hydraulic oil filter for remocon unit filling – 1 x 100%

d) Engine room solenoid valve rack – 3 x 100%.

e) Main deck cargo area solenoids box – 8 x 100%.

f) Main deck aft area solenoids box – 1 x 100%.

g) Local hydraulic actuation pump – 1 x 100% (*)

h) Portable hydraulic pump – 4 x 100% with hoses for the connection with the solenoid valves racks and boxes.

i) Pump for fixed filtering system – 1 x 100%

j) Hydraulic valves remotely actuated with position indication system.

k) Manual valves position indication system.

(*) quantity to be confirmed across the basic design P&ID drawings where each local hydraulic actuation pump is identified.

5.1.2. Hydraulic power unit (HPU) shall be supplied within a skid with the minimum below mentioned components with the purpose to provide power for the Hull systems hydraulic system:

- control panel,

- accumulator banks,
- hydraulic power / circulation pumps,
- hydraulic reservoirs (supply / return),
- a fixed filtering system (with an independent pump included),
- a portable cartridge filter skid, called Hydraulic Oil Filter For Remocon Unit Filling to treat and feed the hydraulic oil supplied in drums to the HPU reservoir with an adequate NAS parameter.

5.1.3. Hydraulic Valves Remocon Unit (Hull Systems) system is detailed on I-DE–HYDRAULIC VALVES REMOCON (HULL SYSTEMS).

5.2. PACKAGE LOCATION

5.2.1. HPU skid with its components detailed on 5.1.2 shall be installed in specific room on Engine Room.

5.2.2. Engine Room solenoid valve racks shall be installed on a specific room on Engine Room.

5.2.3. Solenoid boxes shall be installed on Main Deck and Main Deck aft area, respectively.

5.2.4. For hazardous areas refer to I-DE-AREA CLASSIFICATION – GENERAL

5.2.5. I-DE-GENERAL ARRANGEMENT shall be used as reference for equipment location.

6. PACKAGE SPECIFICATION

6.1. GENERAL REQUIREMENTS

6.1.1. PACKAGE design and installation shall be submitted to the PACKAGER for approval.

6.1.2. PACKAGE operational pressure shall be defined by the PACKAGER.

6.1.3. PACKAGE selected material shall be adequate to the preservation of the hydraulic oil quality standard for the UNIT design life.

- Note: PACKAGE and its components material selection shall be defined by PACKAGER unless otherwise indicated within this specification.

6.1.4. Hydraulic oil specification for the Hull hydraulic valves actuation system shall be approved by PACKAGER.

6.1.5. All hydraulic valves remote actuation shall be performed by SOS-HMI.

6.1.6. All instrumentation, logic and automation of the PACKAGE shall be designed by PACKAGER.

6.1.7. PACKAGE/equipment Maximum Allowable Working Pressure (MAWP) shall be higher than the maximum pressure that may occur at PACKAGE/equipment inlet tie-in point.

6.1.7.1. In particular cases where it is not possible to comply with above requirement, it shall be included on PACKAGE scope of supply devices for pressure control together with devices for protection against over pressure, for example, a combination of a self-operated pressure reducing valve and a pressure relief valve.

- Note: This requirement (item 6.1.7) is also applicable for PACKAGE required utilities, such as, but not limited to, seawater/fresh water cooling, compressed air, diesel, nitrogen

6.2. HYDRAULIC VALVES REMOCON UNIT SPECIFICATION

6.2.1. GENERAL

6.2.1.1. HPU shall generate hydraulic power for the actuation (open / close) of the on / off hydraulic actuated valves listed on I-DE–HYDRAULIC VALVES REMOCON (HULL SYSTEMS), as well as to provide hydraulic power for the actuation of the proportional valves (opening from 0 to 100%).

6.2.1.2. HPU shall be made of stainless steel without painting, within a closed skid (s) with three main sections:

a. A panel for pumps control, emergency commands and others.

b. A skid containing: hydraulic fluid reservoirs (supply and return), supply and circulation pumps with filters.

c. A skid containing hydraulic accumulators.

6.2.1.3. All hydraulic lines, connections, valves and other accessories inside the panel and skids shall be made of ASTM A269 Gr. TP 316L or better, except where otherwise specified in this document. All selected material shall be in accordance with I-ET-3010.00-1200-800-P4X-015 – REQUIREMENTS FOR TUBING AND FITTING (ALIGNED TO IOGP-JIP33 S-716).

6.2.1.4. HPU shall have local and remote start / stop command from SOS-HMI.

6.2.2. HYDRAULIC POWER UNIT CONTROL PANEL

6.2.2.1. The dimensions of the panel supplied by PACKAGER shall be minimized to enable a feasible installation inside a specific room on Engine Room.

6.2.2.2. The panel shall be a standalone unit fitted with pad eyes for hoisting. All

surfaces shall be perfectly smooth and free from burrs.

6.2.2.3. All access doors to the interior of the panel shall be in the front, at most 700 mm large and to allow easy access to the whole extension of the HPU. All doors shall be held by means of continuous hinges made of stainless steel AISI-316L. The doorknobs and hinges shall be robust and reinforced.

6.2.2.4. The panel shall be adequately constructed for indoor service use and shall have an IP-22 minimum protection level since will be installed inside Hull Engine Room.

6.2.2.5. Stainless Steel AISI-316L shall be the only material used in the manufacture of the panel, including the supporting skid. The plates that make the HPU control panel shall be free from warping, wrinkling, roughness and signs of rust and corrosion.

6.2.2.6. All cuts and perforations shall be executed cold, and all plates shall be reinforced with steel bars welded internally.

6.2.2.7. The HPU control panel shall include all the electric motor control devices, such as contactors and circuit breakers, PLC Control Panel, motor control center.

6.2.2.8. The internal layout of HPU control panel is under the responsibility of the PACKAGER / MANUFACTURER.

6.2.2.9. HPU control panel shall include starter for motors, as per PACKAGER / MANUFACTURER's standard and in compliance with the Rules and Regulations defined in item 2 Regulations Codes and Standard of this Specification, with at least the below control functions:

- Local starting / stopping.
- Remote starting / stopping by SOS-HMI.
- Hydraulic Power Unit pressure indication.
- Pump 1 running indication.
- Pump 2 running indication.
- Hydraulic oil temperature local indication.

6.2.2.10. As well, at least the following supervision functions shall be provided:

- Low level alarm in hydraulic oil tank.
- Low hydraulic oil pressure alarm.
- High hydraulic oil temperature alarm.

− Pump 1 failure alarm.

− Pump 2 failure alarm.

− Other as per PACKAGER's standard.

6.2.3. HPU SKID FOR ACCUMULATOR BANKS

6.2.3.1. The accumulator bank shall be installed on an AISI-316L stainless steel supporting skid, capable of supporting its weight and still allow movements and installation on the unit.

6.2.3.2. The skid plates shall be free from warping, wrinkling, roughness and signs of rust and corrosion.

6.2.3.3. Accumulators' banks shall be designed to perform 02 (two) open or close complete operations of the 04 (four) Hull systems hydraulic actuated larger valves, totaling eight (8) valve operations.

- Note: A complete operation is from the totally opened position to the totally closed position or vice-versa at a maximum duration as defined on I-ET-3010.00-1200-800-P4X-013 – GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS (item 14.1.1.3).

6.2.3.4. The accumulator sizing calculation shall be submitted to owner for appraisal. It shall be specified the pre-charge pressure, work pressure, cut-on and cut-off pump pressure, accumulators nominal and effective volume, leakage rate, actuators required volume and correction change factors (for Adiabatic, Isothermal or Polytropic change). The accumulator effective volume shall be calculated considering the cut-on and cut-off pump pressure.

6.2.3.5. The hydraulic accumulators shall be of the bladder type pre-charged with nitrogen, maximum operation pressure, according to the pressure level to which it is associated. The accumulator's chassis shall be made of AISI-316L stainless steel or carbon steel and internally covered with Nickel coating.

6.2.3.6. All materials, such as gaskets and bladders and their coatings shall be compatible with hydraulic fluid used. It shall be provided with facilities (spaces, quick connections, manometers, etc.) to allow the individual recharging of each accumulator by means of nitrogen cylinders.

6.2.3.7. The minimum pressure used to calculate the accumulator units shall be equal to or in excess of the highest pressure acceptable at the pressure regulator valve outlets.

6.2.3.8. The accumulator bank shall be provided with complete and independent manifold block for each accumulator with 3/4" NPT bulkhead coupling, ball valves and piping in AISI-316L stainless steel.

6.2.3.9. The accumulator bank shall be provided with one (1) manometer with glycerin

filling in the nitrogen pre-charge circuit of each accumulator to be designed and supplied by PACKAGER / MANUFACTURER.

6.2.3.10. PACKAGER shall supply a bladder charging kit with connectors / adapters for the correct recharging of the bladders with nitrogen. The charging kit shall be provided with pressure regulator valve, pressure gauge and any other components considered necessary by PACKAGER.

6.2.3.11. All hydraulic fluid drains shall converge to the same outlet.

6.2.3.12. Each accumulator of the bank shall have a block, bleed and safety valves and a safety drain.

- Note: It shall be possible to isolate each accumulator for inspection with the HPU in operation using a double block and bleed valve arrangment.

6.2.3.13. Accumulator banks design and installation shall comply with NR-13 Brazilian Regulation for Pressure Vessels.

6.2.3.14. The hydraulic system shall be sized to replenish the pressure of the accumulators from minimum to maximum pressure in 5 (five) minutes.

6.2.4. HPU SKID FOR HYDRAULIC RESERVOIRS

6.2.4.1. The reservoir shall be composed by two (02) tanks:

a) one to receive the return fluids and

b) other one to handle the fluids supply.

6.2.4.2. The hydraulic oil supply shall be performed from the hydraulic reservoir directly, no intermediary tanks shall be provided.

- Note 1: hydraulic oil supply shall be performed by a specific hydraulic oil feeding unit which shall ensure the specified NAS and humidity standard to be used by the system.

- Note 2: this hydraulic oil feeding unit shall be able to qualify the hydraulic oil supplied in drums to avoid the direct feeding of oil not enough qualified from them.

6.2.4.3. Hydraulic Reservoirs material shall be with AISI 316L or similar.

6.2.4.4. The hydraulic fluid reservoirs, together with the loading and circulation pumps, shall be assembled on an AISI 316L Stainless Steel supporting skid, capable of holding its weight and still allowing transportation and installation of the unit.

6.2.4.5. The hydraulic supply reservoir shall be geometrically vertical, allowing

detection of hydraulic fluid leaks in the system, through variation of fluid level in the tank.

6.2.4.6. The plates and sheets shall be free from warping, wrinkling, roughness and signs of rust and corrosion.

6.2.4.7. The overflow of each reservoir shall be connected to the drainage line.

6.2.4.8. The hydraulic fluid reservoirs shall have at least the following monitoring equipment / instrument:

a) level sight and level transmitters,

b) drains, vents and other necessary accessories for the safe operation of the system.

6.2.4.9. The return reservoir shall be sized to store a volume two (02) times the hydraulic oil inventory which includes actuators and the accumulator header volumes, to ensure enough capacity for the oil return during the de-pressurization of the HPU.

6.2.4.10. The supply reservoir shall be sized to store all the fluid necessary for the actuation volume of all valves and the accumulator header. This capacity shall be at least 1.5 times the total charge volume of the accumulators.

6.2.4.11. The supply and return reservoirs vent piping shall be provided with flame arresters, installed at the top of the vent(s) pipe(s). These flame arresters are PACKAGER scope of supply.

6.2.5. HPU HYDRAULIC PUMPS

6.2.5.1. HPU shall have a loading and recirculation pump with the minimum capacity of 40 l/min, to re-circulate the hydraulic fluid of the return reservoir tank with purpose to replenish the hydraulic fluid to the reservoirs and to transfer the fluid from the return reservoir tank to the supply reservoir tank through the filter.

6.2.5.2. This loading and recirculation pump shall be sized to re-circulate all volume of reservoirs in less than 6 (six) hours.

6.2.5.3. All hydraulic components shall be carefully selected to guarantee a level of tightness to the HPU (zero leakage) during the working life of the UNIT.

6.2.5.4. For the hydraulic system sizing criteria, the following parameters shall be taken into consideration:

a) At least, 2 (two) electric pumps shall be provided.

b) The two (2 x 100%) electric pumps shall have the overall capacity of hydraulic fluid supplying to the system (flow rate and pressure).

c) The second electrical pump is a stand-by of the first one and shall be automatically started in case of failure or the need for back-up of the first one.

d) The selection of which pump shall be the primary one shall be made from the HPU local control panel.

6.2.5.5. Relief valves shall be provided on the pump discharge, adjusted 10% higher than maximum work pressure of the line. They shall permit the fluid return to the reservoir in case of system overpressure.

6.2.5.6. HPU hydraulic system shall also be provided with filters on the pump suction, safety valves, retaining and/or block valve when necessary and a manometer on the front panel of the HPU to indicate the levels of hydraulic supply.

6.2.5.7. The hydraulic supply pumps intake shall be done through a “fishing” U-tube with a retention valve and filter.

6.2.6. HPU FILTERING SYSTEM

6.2.6.1. A filter shall be supplied installed at the HPU intake and other one at the discharge of the pumps. Filters specification shall be PACKAGER’s standard design.

- Note: the pumps discharge filters shall be duplex type to allow the filter maintenance without stopping the remocon system operation.

6.2.6.2. A fixed filtering system shall be provided to the HPU with the purpose to ensure the removal of water and impurities from the hydraulic oil down to a level accepted by the PACKAGER standard. HPU fixed filtering shall be performed in a closed circuit with the hydraulic oil reservoir and an independent pump.

6.2.6.3. PACKAGER shall supply spare filter kits for start-up and commissioning (minimum 02 per filter).

6.3. SOLENOID VALVES RACKS AND BOXES

6.3.1. All solenoid valves for hydraulic actuators shall be installed in Engine Room solenoid valves racks, in Main Deck cargo area solenoid boxes and in Main Deck aft area.

6.3.2. All solenoid valves installed on solenoid valves racks and boxes shall have connections for portable hydraulic pumps. For valves in submerged area, the connection to be installed upstream the indirect position indication devices to allow the valve position monitoring.

6.3.3. All solenoids and valve limit switches shall follow project's hazardous area classification. All solenoids shall be installed in the solenoid valves racks.

Valve limit switches shall be installed in accordance with subitem bellow:

6.3.3.1. Valves that are installed inside the tanks, cofferdam, void spaces, double bottom shall be provided with indirect position indication devices, based on volume of oil displaced (VPI), to be defined in the detailed design phase.

a) “On-off” valves (XV valves) shall be provided with contacts for “open” and “close” indications on SOS-HMI.

b) As well, “Partial opening” valves (HV valves) shall be provided with 4-20 mA output for position indication on SOS-HMI (0 to 100%).

6.3.3.2. Valves installed in other areas, not covered by 6.3.3.1 shall be provide with limit switches attached on top end of actuator with SPDT contacts for open and close position, with 3D 90° yellow-black (open-close) visual position indication.

6.3.4. Engine Room solenoid valves racks shall be designed to control the hydraulic valves installed inside Engine Room. These valves shall be designed to operate in non-classified area and shall have an ingress protection rating of at least IP56.

a. Solenoid valve boxes design and components are subject to CS approval.

6.3.5. Main Deck cargo area / Aft area solenoids boxes shall be designed to control the hydraulic actuated valves installed on Main Deck cargo area and Main Deck Aft area, respectively. Since these solenoids boxes shall be installed in an exposed area (Main Deck classified area) the following requirements shall be complied:

b. Electric components inside the boxes (i.e., solenoid valves, valve positioners, valve position indicators) shall be explosion proof or intrinsically safe designed for zone 1.

c. The solenoid boxes shall be in AISI 316L intrinsically safe.

d. Solenoid valve boxes design and components are subject to CS approval.

e. Solenoid valve boxes design and components shall have maintenance watertight doors IP56.

f. In case of intrinsically safe, safety barrier/galvanic insulator shall be supplied.

g. Main Deck cargo area / Aft area solenoids boxes shall be painted external and internally with marine corrosion resistant painting scheme. For painting requirements and Color Coding, refer to item 8.3 of this technical specification.

6.3.6. Solenoid valves racks and boxes panels shall have internal layout design with

the responsibility of the PACKAGER / MANUFACTURER.

6.3.7. For the distribution of hydraulic actuated valves controlled by the solenoid valve racks and boxes refer to I-DE–HYDRAULIC VALVES REMOCON (HULL SYSTEMS).

6.3.8. The calculation of the torque required by actuators shall be according to I-ET-3010.00-1200-800-P4X-013 – GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS (item 14.1.4.9.1).

6.3.9. For electric equipment and electric accessories installed inside the tanks, they shall, as an obligation, have an IP-68 protection level for at least 4 meters water depth.

6.3.10. It shall be provided one (1) filter at inlet pressure line of each solenoid valves racks and boxes. The filter shall be provided with clogging indicator, isolation valves and by-pass line with block valve.

6.3.11. The solenoid valves shall be equipped with a push button for manual override.

6.3.12. The ballast tank valves shall be Fail Latch (FL) in case of loss of hydraulic pressure and Fail Close in case of loss of power supply or ESD event. Each ballast tank valve shall be provided with a set of solenoid direction valves to allow this configuration.

6.3.13. The manifolds of solenoids valves racks and boxes shall have spare connection properly blocked for future installation of solenoids valves. The spare number shall be at least 10% of total number of valves installed in the rack/box or three (3) whichever is higher.

6.3.14. Some valves, as indicated in I-DE–HYDRAULIC VALVES REMOCON (HULL SYSTEMS) shall be monitored and controlled both from HULL SOS and TOPSIDE SOS. The monitoring shall be performed through the valve positioner devices.

6.4. HYDRAULIC ACTUATED VALVES

6.4.1. As mentioned on 5.1, PACKAGER shall supply all the hydraulic actuated valves which shall be controlled by the Hull Systems remocon system. Those valves are listed on I-DE–HYDRAULIC VALVES REMOCON (HULL SYSTEMS) with some minimum design parameters informed for reference.

6.4.2. The hydraulic actuators shall be directly assembled on the valves with mechanical indication of the opening and “open / close” position on the top end of the valve shaft.

6.4.3. Flanged valves shall be fitted with flanges as per ASME B16.5.

6.4.4. All hydraulic actuated valves shall be remotely driven through SOS-HMI.

6.4.5. All remotely actuated hydraulic valves shall have the position indication monitored by SOS, indicated on SOS-HMI and on the valves themselves.

6.4.6. All manual valves with positioning monitored shall have the position indication monitored by SOS, indicated on SOS-HMI, on the valves themselves (valves installed in dry area) and on the solenoid valves racks and boxes where they are connected (for all valves).

6.4.7. All valve indicators shall be on/off type (XV or SDV) except where indicated for partial opening / closing (HV).

6.4.8. All materials specified for the valves shall be suitable for the fluid handled.

6.4.9. Valves indicated with “Class Type” shall be covered by Classification Society Certificate.

6.4.10. All valves positioning indication system components placed on cargo area (ahead the ER fwd bulkhead) shall be designed to operate in hazardous area Zone 1.

6.4.11. Hydraulic actuators shall be quarter turn balanced rotary type, including connection block and the following accessories:

a. Double pilot operated check valve.

b. Double release valve.

c. Double throttle valve.

d. Quick connections for the portable pump (item 6.6).

6.4.12. Valves actuating hydraulic design shall be according to PACKAGER’s / MANUFACTURER’S standard.

6.5. LOCAL HYDRAULIC ACTUATION PUMP

6.5.1. Local Hydraulic Actuation Pump have the purpose to provide hydraulic power to valves installed on restricted areas, as shipside valves.

6.5.2. Local Hydraulic Actuation Pump shall have solely manual operation performed with hydraulic oil through a hydraulic circuit assembled from the pumps themselves to the corresponding assisted hydraulic valve actuator with no any connection with the remote control valves headers. Block valves shall be provided to isolate the valve actuator from the main system when using the hydraulic actuation pump.

6.5.3. Local Hydraulic Actuation Pump panel shall have indirect position indication device for position monitoring in SOS, indicated on SOS-HMI and with local indication of the position status of the corresponding controlled valve. This

device shall be used to monitoring the valve position both when it is actuated by the solenoid valve or the manual pump. The solenoide indirect position indication device shall be used to local monitoring.

6.5.4. Local Hydraulic Actuation Pump shall be installed on safe and accessible areas on Main Deck and Engine Room close to the corresponding valve assisted and with the dedicated hydraulic circuit assembled with tubing.

- Note 1: Tubing material shall comply with I-ET-3010.00-1200-800-P4X-015 – REQUIREMENTS FOR TUBING AND FITTING (ALIGNED TO IOGP-JIP33 S-716).

- Note 2: Tubing is not to be PACKAGER scope, but PACKAGER shall provide all recommendations for the tubing design, connection and assembly from the Local Hydraulic Actuation Pump and the corresponding valve.

6.5.5. Local Hydraulic Actuation Pump flow rate shall be 6.0 cm^3/s per double stroke/max 135 bar.

6.5.6. Local Hydraulic Actuation Pump shall have proper protection for operation on open areas submitted to different weather conditions.

6.6. HYDRAULIC PORTABLE PUMPS

6.6.1. The four (4 x 100%) hydraulic portable pumps shall allow the remotely actuated valves to be controlled in emergency conditions.

6.6.2. Hydraulic portable pumps shall be supplied for the emergency opening of the largest valve of the remocon system.

6.6.3. Hydraulic portable pumps shall be equipped with the minimum devices:

a. A manual piston pump.

b. Oil reservoir.

c. Relief valve.

d. Pressure gauge.

e. Flexible hoses with self-seal connections of quick acting type to allow operation of the valves in the event of the hydraulic power unit failure, directly either from the solenoid valves boxes or panel, or directly connected to the valve's actuators.

6.6.4. Hydraulic portable pumps shall be connected to the existing terminations on each solenoid valves rack and solenoid box and directly to the valve actuator.

7. HYDRAULIC REQUIREMENTS

7.1. GENERAL

7.1.1. The hydraulic power to open/close the hydraulic actuated valves and for the operation of all components shall be defined by PACKAGER.

7.1.2. Each HPU header shall have pressure transmitters with local indication as well as pressure safety valves (PSVs).

7.1.3. All components material of the hydraulic circuit shall be defined by PACKAGER / MANUFACTURER, except where otherwise specified in this document. Material selection shall ensure the compatibility with the hydraulic oil standard applied to the system to ensure the hydraulic oil quality degree for the whole UNIT design life.

7.1.4. Pressure regulator valves shall be sized to supply a flow compatible with the required for the opening of the large valves and other consumers of the HPU.

7.1.5. All hydraulic connections in the HPU shall be made of double ferrule compression type fittings, capable of preserving their sealing for at least 30 years of service.

7.2. HYDRAULIC FLUID

7.2.1. The hydraulic fluid selected for the UNIT Hull hydraulic remocon system operation shall be approved by the PACKAGER.

- NOTE: water based type production control fluids **shall not be used** for the hydraulic remocon system. Also, during Hull hydraulic system commissioning phase, hydrostatic tests with water based fluids are prohibited, N_2 shall be used for tests.

7.2.2. The cleanliness class of the hydraulic fluid shall be specified by the PACKAGER / MANUFACTURER.

7.2.3. It shall be supplied a fluid cleanliness analyses kit with consumables slides for a two (02) year period of operation with two samples per week for use on the HPU.

7.2.4. Compatibility Certificates with the mineral oil specified for the HPU shall be required for all components of the hydraulic system it shall attend.

7.3. HPU HYDRAULIC DIMENSIONING CALCULATION RECORD

7.3.1. PACKAGER shall submit the calculation record for the HPU hydraulic dimensioning, including the volume of reservoirs, volume of the accumulator units (number x capacity), volume of the actuators, operating pressures, flow capacity of all pumps, inner diameter of main headers and maximum considered distance from the valve actuators it served.

7.4. HYDRAULIC PARTS REQUIREMENTS

7.4.1. All components of the hydraulic systems shall be made of stainless steel, ASTM A 269 Gr. TP 316L, including the valve actuators, etc., except when expressly specified otherwise.

7.4.2. All components of the hydraulic systems shall have permanent stainless steel identification and name plates, with lettering in low relief according to the HPU flowchart.

7.4.3. All solenoid valve actuators shall be encapsulated in epoxy to avoid corrosion, with a minimum of class F isolation.

7.4.4. All pressure instruments in the pump header ahead of the regulators shall be fitted with pulse dampers.

7.5. CONNECTIONS AND TUBING

7.5.1. All hydraulic tubing shall comply with I-ET-3010.00-1200-800-P4X-015 – REQUIREMENTS FOR TUBING AND FITTING (ALIGNED TO IOGP-JIP33 S-716).

7.5.2. All connections shall follow materials indicated in I-ET-3010.00-1200-800-P4X-

015 – REQUIREMENTS FOR TUBING AND FITTING (ALIGNED TO IOGP-JIP33 S-716).

7.5.3. The connections between each solenoid valve rack and between any solenoid valve rack and the field instruments / valves shall be done through the lower part of the rack.

7.5.4. The connections with the racks shall be made by means of bulkhead type unions, in line, or, at least, in two lines. Each line shall be shifted related to the other by a distance corresponding to a half distance between two consecutive connections, to permit the connection and disconnection of any line without affecting any other.

7.5.5. The mounting and dismounting of any component in the rack shall be done through the front part of the panel and in no way will require the dismounting of other circuit unless the one under maintenance.

7.5.6. All lines shall be properly supported and arranged to avoid damage during operation, facilitate maintenance and keep the respective lengths as short as possible. Tubing and connections shall have protection against mechanical damage.

7.5.7. HPU HYDRAULIC CONNECTIONS INTAKES AND OUTLETS

7.5.7.1. The HPU shall provide power for the two (02) segregated circuits as below described:

a. From / to the Engine Room solenoid valve racks and.

b. From / to the Main Deck Cargo Area / Aft Area solenoids boxes.

7.5.7.2. HPU intake hydraulic connections

a. Two (02), one as reserve. The 1” intakes for return header of all hydraulic distribution racks (production facilities hydraulic actuators), shall be done through suitable unions. This diameter (1”) shall be confirmed by PACKAGER.

b. One (01) 3/4" diameter intake with quick coupling connector for charging the hydraulic fluid. A hose shall be supplied for charging, also fitted with quick coupling at one end and a check valve at the other end.

   - Note: the fluid return to the reservoir shall be free from any obstruction and the routing of the lines shall remain independent, without reductions in diameter. The lines shall be built so as to lead direct into the reservoir.

7.5.7.3. Solenoid Racks and Boxes intake hydraulic connections

c. One (01) supply inlet of hydraulic fluid, for controlling the valves, in 1/2" outside diameter tubing with bulkhead union type adapter.

7.5.7.4. Outlets HPU

a. 1/4" diameter drains shall be provided for the air filter regulators through compression type connections.

b. 1/2" drain shall be provided for the supply reservoir through a compression type connection.

c. 1" drain shall be provided for the return reservoir, through compression type connection.

d. As a minimum, 02 outlets, one as reserve, 1” outside diameter for the supply header shall be supplied. The connection shall be of bulkhead union type adapter, class 6000 psig. The definition about the diameter and the number of outlets shall be by detail engineering design.

e. One (01) 2" diameter overflow line shall be provided at the return reservoir.

7.5.7.5. Outlets Hydraulic Distribution Racks

a. One (01) return outlet of hydraulic, through 1" diameter tubing and compression type unions.

b. The outlets to drive the valves shall be with bulkhead union type adapter, class 6000 psig.

- Note: the quantity of outlets shall be defined during detail engineering design. Scope of the supplier is performing the calculations of head losses required for the return of hydraulic fluid.

7.5.7.6. Interconnection with the Accumulator Banks

a. Two (2) connections, 1" minimum diameter, compression type fitting. The definition on the number of interconnections shall be by detail engineering.

7.5.7.7. Interconnection with the Reservoirs Skid

a. One (1) hydraulic fluid supply line, 1" minimum diameter, compression type fitting.

b. Two (2) 3/4" lines for the return to the return reservoir.

- Note 1: the return of the drains from the accumulator bank shall be routed to the return reservoir.

- Note 2: the electric signals and commands shall be routed to a junction box in the HPU panel.

8. GENERAL REQUIREMENTS

8.1. ELECTRICAL REQUIREMENTS

8.1.1. PACKAGE electrical equipment, material, low voltage induction motors, and grounding installation shall comply with the following references:

a) I-DE-3010.00-5140-700-P4X-003 – GROUNDING INSTALLATION TYPICAL DETAILS.

b) I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

c) I-ET-3010.00-5140-700-P4X-002 – SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS.

d) I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.

e) I-ET-3010.00-5140-700-P4X-007 – SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS.

f) I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

g) I-ET-3010.00-5140-712-P4X-001 – LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS.

h) I-ET-3010.00-5140-741-P4X-004 – SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS.

8.2. INSTRUMENTATION AND AUTOMATION REQUIREMENTS

8.2.1. PACKAGE criteria for instrumentation, automation, interface and control design shall follow the below technical specifications:

a) I-ET-3010.00-1200-800-P4X-002 – AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS.

b) I-ET-3010.00-1200-800-P4X-013 – GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS.

c) I-ET- AUTOMATION INTERFACE OF PACKAGE UNITS.

d) I-ET-3010.00-5520-888-P4X-001 – AUTOMATION PANELS.

8.3. PAINTING REQUIREMENTS

8.3.1. PACKAGE painting and coating shall be performed in accordance with I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING and DR-ENGP-I-1.15 COLOR CODING.

8.3.2. All components shall be delivered fully painted/coated, unless otherwise indicated on this specification.

8.3.3. The performed pre-treatment and complete coating shall be in accordance with the paint manufacturer's data sheets.

8.4. NAMEPLATES AND TAG NUMBERING

8.4.1. PACKAGER / MANUFACTURER Equipment shall have nameplates in Brazilian Portuguese language, made of stainless steel AISI 316L, with 3 mm minimum thickness and fixed by stainless steel (AISI 316L) bolts or fasteners on visible and accessible location.

- Note 1: additional nameplates shall be provided as per NR13 rules.
- Note 2: for further requirements refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.

8.4.2. Tagging of all instruments, electrical, mechanical, and piping items, including valves, shall be carried out as detailed on I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN.

9. PACKAGE MANUFACTURING AND DELIVERY REQUIREMENTS

9.1. GENERAL

9.1.1. All materials and equipment supplied by PACKAGER / MANUFACTURER shall be brand new (not overhauled), field proven, free from defects and accepted by Owner and the Classification Society.

9.1.2. Materials and equipment shall be manufactured according to internationally recognized standards for the offshore oil drilling and production industries and shall be in conformance with the basic design related specifications and requirements.

9.1.3. Field proven definition as EXHIBIT V – DIRECTIVES FOR PROCUREMENT: systems and equipment shall demonstrate satisfactory operation at least in 3 floating offshore installation units, operating under process conditions (pressure, flow, capacity and similar fluids) for a minimum of 24,000 hours. For rotating equipment, they must demonstrate operation with fluid, flow and discharge pressure similar to the design. Unproven designs or prototypes (including components) without offshore service will not be accepted.

9.2. MANUFACTURING

9.2.1. PACKAGE equipment, structures and piping welding, welding inspection, non-destructive testing (NDT), bolted joints assembly and piping fabrication and commissioning activities shall be performed in compliance with the technical specifications mentioned on item 3 – Construction.

9.3. DOCUMENTATION

9.3.1. For the PACKAGE documentation and data-book requirements refer to EXHIBIT III – DIRECTIVES FOR ENGINEERING and to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.

9.4. SPARE PARTS

9.4.1. For the PACKAGE, spare parts, special tools, CS required spare parts and spare parts list recommended for two (2) years of operation refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.

9.5. INSPECTION AND TESTS

9.5.1. For PACKAGE Inspection and Test Plan (ITP), Factory Acceptance Test (FAT), Inspection Release Certificate (IRC) and Site Acceptance Test (SAT), refer to EXHIBIT V - DIRECTIVES FOR PROCUREMENT, EXHIBIT VII - DIRECTIVES FOR QUALITY ASSURANCE SYSTEM and EXHIBIT VIII - DIRECTIVES FOR COMMISSIONING.

9.6. PRESERVATION, PACKING AND TRANSPORTATION

9.6.1. For PACKAGE preservation, packing and transportation requirements refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.