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	CLIENT: SRGE				SHEET: 1 of 11				
	JOB: -								
	AREA: -								
SRGE	TITLE: REQUIREMENTS FOR PRINTED CIRCUIT HEAT EXCHANGER SPECIFICATION				INTERNAL ESUP				
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1 OBJECTIVE

1.1 This Technical Specification contains the minimum requirements for the design, engineering, materials, fabrication, inspection, testing and certification of all Printed Circuit Heat Exchangers for the FPSO's topsides.

1.2 The use of Printed Circuit Heat Exchangers is accepted only for coolers in the gas and CO₂ compression systems, as well as for dew point control system.

1.3 The requirements herein listed are applicable to all players performing such related activities within the scope of this unit, including CONTRACTORS, main contractor, subcontractors, manufacturer, packager, suppliers, sub suppliers, integrators, constructors, and all technical personnel involved. Within the scope of this document, they are all referred to as being a CONTRACTOR.

1.4 In addition to the requirements of this technical specification, CONTRACTOR shall follow all the requirements of the Exhibit I (Scope of Work), as well as Exhibit III (Directives for Engineering Execution), Exhibit IV (Directives for Construction and Assembly), Exhibit V (Directives for Procurement), Exhibit VI (Directives for Planning and Control), Exhibit VII (Directives for Quality Management System) and Exhibit VIII (Directives for Commissioning Process).

2 CODES AND STANDARDS

2.1 CLASSIFICATION SOCIETY


2.1.1 CONTRACTOR shall perform the work in accordance with the requirements of the Classification Society.

2.1.2 CONTRACTOR is responsible submit to the Classification Society the documentation in compliance with stated Rules.

2.2 CODES AND STANDARDS

Unless noted, the latest edition and addenda of each document listed below shall be used.

API 6A	Specification for Wellhead and Christmas Tree Equipment
ASME BPVC	Sections II, V, VIII and IX
ASME B16.47	Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard
API RP 582	Welding Guidelines for the Chemical, Oil, and Gas Industries.
ISO 27509	Compact flanged connections with IX seal ring
NORSOK R-001	Mechanical equipment

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ISO 15156 (all parts)

Petroleum and natural gas industries - Materials for Use in H₂S-containing Environments in Oil and Gas Production

2.3 GOVERNMENT REGULATION

NR-13

“Caldeiras, Vasos de Pressão, Tubulações e Tanques Metálicos de Armazenamento” (Boilers, Pressure Vessels, Piping and Metal Storage Tanks)

NR-37

“Segurança e Saúde em Plataformas de Petróleo” (Safety and Health in Oil Platforms)


Brazilian Government regulations are mandatory and shall prevail, if more stringent, over the requirements of this specification and other references herein.

2.4 REFERENCE DOCUMENTS

DR-ENGP-I-1.15	COLOR CODING
I-ET-3010.00-1200-540-P4X-001	REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION
I-ET-3010.00-1200-251-P4X-001	REQUIREMENTS FOR BOLTING MATERIALS
I-ET-3010.00-1200-956-P4X-002	GENERAL PAINTING
I-ET-3010.00-1200-956-P4X-003	THERMAL SPRAY COATING APPLICATION ALUMINUM
I-ET-3010.00-1200-431-P4X-001	THERMAL INSULATION FOR MARITIME INSTALLATIONS
I-ET-3010.00-1200-955-P4X-001	WELDING
I-ET-3010.00-1200-970-P4X-004	NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS
I-ET-3010.00-1200-970-P4X-003	REQUIREMENTS FOR PERSONNEL QUALIFICATION AND CERTIFICATION
I-ET-3010.00-1200-970-P4X-013	COMPLIANCE WITH NR-13 AND SPIE REQUIREMENTS
I-ET-3010.00-1200-940-P4X-002	GENERAL TECHNICAL TERMS
I-DE-3010.00-5140-700-P4X-003	GROUNDING INSTALLATION TYPICAL DETAILS

Specific Documents to be supplied by OWNER:

- PIPING SPECIFICATION FOR TOPSIDE
- AREA CLASSIFICATION - GENERAL
- METOCEAN DATA
- MATERIAL SPECIFICATION FOR HEAT EXCHANGERS
- MOTION ANALYSIS

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3 DEFINITIONS

All terms and definitions are established in the latest revision of I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS.

4 GENERAL REQUIREMENTS

4.1 Printed Circuit Heat Exchangers design shall be according ASME BPVC Section VIII Divisions 1 and 2. Other internationally recognized standards or code can be used only with the prior **OWNER** approval.

4.2 All pressure vessels shall comply with the requirements of NR-13 and I-ET-3010.00-1200-970-P4X-013 - COMPLIANCE WITH NR-13 AND SPIE REQUIREMENTS.

4.3 The equipment supplied shall be suitable for the environment and range of ambient condition defined in METOCEAN DATA [document supplied by OWNER].

4.4 The necessary design data and information on motion requirements are given in MOTION ANALYSIS [document supplied by OWNER].

4.5 Exchangers shall be suitable for operation in accordance with the area classification presented in AREA CLASSIFICATION - GENERAL [document supplied by OWNER].

4.6 In addition to the Code described loads and loads due to vessel motion described in MOTION ANALYSIS [document supplied by OWNER] the following design loads shall be considered where relevant:


- Equipment transportation and erection loads
- Nozzle loads as described in this specification
- Thermal loads
- Wind load
- Weight load


4.7 Wind loads shall be calculated as per I-ET-3010.00-1200-540-P4X-001 - REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION.

4.8 CONTRACTOR shall design and fabricate the equipment for a minimum lifetime of 30 years.

5 EQUIPMENT SPECIFICATION

5.1 CONTRACTOR shall be responsible for supplying complete and fully operative printed circuit heat exchangers in accordance with the requirements of this specification, attachments and standards referenced herein.

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5.2 DESIGN REQUIREMENTS				
<p>5.2.1 The heat exchangers shall be designed, manufactured, inspected, and tested in accordance with the requirements stated herein and ASME VIII. The deviations from this Technical Specification shall be previously approved by OWNER.</p>				
<p>5.2.2 The heat exchangers shall be provided with lifting lugs for single point lifting. The lifting lugs shall be designed with a safety factor of 2.0.</p>				
<p>5.2.3 The heat exchangers shall be provided with 2 (two) diametrically opposite earthing bosses according to I-DE-3010.00-5140-700-P4X-003 – GROUNDING INSTALLATION TYPICAL DETAILS.</p>				
<p>5.2.4 Heat Exchangers subjected to temperature of 60°C and above shall receive a personal protection system, by means of stainless steel 316 wire mesh / perforated plates. Alternatively, a thermal insulation may be applied. Equipment in which heat conservation is necessary shall be thermal insulated. The thermal insulation shall be according to latest revision of I-ET-3010.00-1200-431-P4X-001 – THERMAL INSULATION FOR MARITIME INSTALLATIONS.</p>				
<p>5.2.5 Maintenance nozzles shall be included on the exchanger when core length is larger than 600mm. Two maintenance nozzles shall be provided for cores length higher than 2500mm. CONTRACTOR shall recommend size and location of these connections.</p>				
<p>5.2.6 MANUFACTURER shall provide a tap pressure connection between the integral strainer and the PCHE on the gas inlet. Instrumentation herein listed shall be installed and monitored by CONTRACTOR:</p> <ul style="list-style-type: none">• Pressure drops across both streams of PCHE• Pressure drops across coolant strainer and gas strainer• Coolant control valve position• Coolant pressure• Flow rates for both streams• Inlet and outlet temperatures for both streams				
<p>5.2.7 The heat exchangers shall be provided with mounting feet or brackets capable of handling the dynamic forces as stated in MOTION ANALYSIS [document supplied by OWNER].</p>				
<p>5.2.8 CONTRACTOR shall supply an integral T-type (or similar) strainer on the gas inlet and a in line cleanable strainer for the coolant side, which shall allow continuous</p>				

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flow and cleaning without disassembly or interruption of operation. The strainer aperture for both cases shall be specified by CONTRACTOR.

5.2.9 In case of using exchangers connected by manifold, the in-line T-type strainer for gas side shall be installed in the piping, as close as possible to the heat exchanger.

5.2.10 MANUFACTURER shall inform the coolant minimum requirements to be met on design, commissioning, and operation phases in order to guarantee the exchanger performance and satisfactory continuous operation. MANUFACTURER shall also inform minimum cooling water flowrate to avoid thermal fatigue on each PCHE due to thermal cycling.

5.3 PIPING CONNECTIONS

5.3.1 Nozzles shall be designed for the external loads specified in Norsok R-001 or the loads determined by a pipe stress analysis (when available).

5.3.2 Unless otherwise specified, flanges on nozzles shall be compatible with piping from outside the scope of supply and in accordance with Piping Specification for Topsides [document supplied by Owner].

5.3.3 When the use of compact flanges is specified for the equipment nozzles, the compact flange shall comply with ISO 27509. The use of API 6B flanges, as specified in API 6A, is also acceptable.

5.3.4 Flanges not available in ASME B16.5, ASME B16.47, API 6A and ISO 27509 shall be calculated according to ASME BPVC Section VIII.

5.3.5 Custom flanges designed according to ASME BPVC Section VIII, as well as flanges in compliance with ISO 27509 or API 6A shall be supplied with companion flanges.

5.3.6 Studs, bolts, tightening bolts and nuts shall be according to I-ET-3010.00-1200-251-P4X-001 – Requirements for Bolting Materials.


5.4 MATERIAL SELECTION AND CERTIFICATION

5.4.1 Contractor shall refer to Material Specification for Heat Exchangers [document supplied by Owner] for the material selection of the printed circuit heat exchangers.

5.4.2 All stainless steel areas exposed to the environment shall be sheathed with duplex or superduplex stainless steel, as specified in technical Specification Material Specification for Heat Exchangers [document supplied by Owner], mentioned in item 5.4.1 above.

5.4.3 All materials that are exposed to hydrocarbons containing hydrogen sulphide shall follow the requirements of ISO 15156 for sour service.

5.4.4 Bolt material selection shall be evaluated for the possibility of temperature reduction due to flange leakage. When not previously informed, Contractor shall submit a study informing the minimum expected temperature and the bolt material selected for such case.

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5.4.5 The use of asbestos or materials containing asbestos is prohibited.

5.4.6 CONTRACTOR shall be responsible for obtaining all necessary certification of the equipment.

5.4.7 CONTRACTOR through the independent certifying authority shall supply all certificates related to the materials, inspections, tests, and qualification activities detailed in the approved Quality Plan.

5.5 WELDING

5.5.1 All welding shall be performed in compliance with ASME Boiler and Pressure Vessel, API RP 582 and I-ET-3010.00-1200-955-P4X-001 – WELDING.

5.5.2 Only full penetration welds are permitted.

5.6 QUALIFICATION AND CERTIFICATION

5.6.1 Qualification and certification for procedures and personnel shall be in accordance with I-ET-3010.00-1200-970-P4X-003 – REQUIREMENTS FOR PERSONNEL QUALIFICATION AND CERTIFICATION.

6 SURFACE PREPARATION AND PAINTING

6.1 The paint system shall be according to I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING.


6.2 Color code adopted shall comply with DR-ENGP-I-1.15 – COLOR CODING.

7 NAMEPLATES

7.1 CONTRACTOR shall attach a 3mm thick, SS 316 stainless steel nameplate on each equipment, in an accessible location.

7.2 The nameplate information shall include, as a minimum, the following in the Portuguese language:

- All Code and Classification requirements,
- Design code,
- Purchase order-number,
- Tag number,
- CONTRACTOR and year built,
- Equipment's serial number and type,
- Design temperature and pressure,

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- Maximum allowable working pressure,
- Minimum design metal temperature,
- Operating temperature and pressure,
- Thermal duty, volume, etc.,
- Hydrostatic test Pressure,
- Post weld heat treatment, if performed,
- Empty, operational and test weight,
- Service.

All technical data shall be shown in metric units, except for pressure which shall be indicated in 'bar'.

7.3 The exchanger category according to NR-13 shall be fitted in an additional nameplate next to the main nameplate.

7.4 All safety signs shall be in the Portuguese language.

8 CERTIFICATION REQUIREMENTS


8.1 For all heat exchangers, a Classification Society certificate shall be supplied. CONTRACTOR shall be responsible to obtaining all necessary certification of the equipment. CONTRACTOR through the independent certifying authority shall supply all certificates related to the materials, inspections, tests and qualification activities detailed in the approved Quality Plan.

9 INSPECTION AND TESTING

9.1 Non-destructive testing shall be according to latest revision of I-ET-3010.00-1000-970-P4X-004 – NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS and the requirements described in Exhibit Directives for Procurement.

9.2 As minimum, at least, the following non-destructive testing shall be carried out:

- Visual examination:
 - 100% welds shall be subjected to a visual inspection, internal and externally.
- Dye penetrant testing to ASME V Art. 6.
 - 100% final capping welds.
 - 100% lifting attachments.

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- Ultrasonic testing to ASME V Art. 5
 - 100% of 50 mm wide band around all cut openings for set on nozzles (when applicable).
- Radiography to ASME V Art. 2.
 - 100% nozzle longitudinal butt welds.
 - 100% flange to nozzle butt welds
 - 100% header circumferential welds.
 - 100% longitudinal header to block welds where access permits.
- Positive materials identification (PMI), required as indicated below:
 - 100% of all pressure retaining parts.

Note: The PMI shall be carried out with equipment capable to identify the specified type of material in accordance with established procedure. The equipment shall not make burn marks to the material. The PMI shall be done prior the welding to identify the materials which will be welded, but after diffusion bonding of exchanger cores. Optical emission spectroscopy shall be used in cases where the PMI technique is not able to identify the alloy steel material.

9.3 Before the hydrostatic test, a leak test with gaseous fluid shall be performed at a pressure not exceeding the design pressure. The testing methodology and acceptance criteria shall be agreed upon between OWNER and the equipment CONTRACTOR using ASME code Section V as a basis.