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INDEX OF REVISIONS										
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0	ORIGINAL ISSUE									
A	REVISED ITEMS 6.7.5, 6.7.6 AND 9.3.2									
B	REVISED WHERE INDICATED ACCORDING TO CONSISTENCY ANALYSIS									
C	GENERAL REVISION. REVISED WHERE INDICATED.									
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DESIGN	ESUP	ESUP	ESUP	ESUP	ESUP					
EXECUTION	U4T4	U4T4	U4T4	HR7O	HR7O					
CHECK	CXLB	CXLB	CXLB	UPF8	CXLB					
APPROVAL	CXM6	CXM6	CXM6	CXM6	CXM6					
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1. OBJECTIVE

1.1. This technical specification covers the minimum technical requirements for the design, materials, fabrication, inspection, testing, preparation of shipment, installation, pre-commissioning and commissioning of SEA WATER LIFT PUMPS and START-UP SEA WATER LIFT PUMP.

1.2. These requirements shall be complied with, in conjunction with other applicable SUPPLIER's Documents and Standards.

2. DEFINITIONS AND ABBREVIATIONS

2.1. Definitions

All terms and definitions are established in the latest revision I-ET-3010.00-1200-940-P4X-002 – General Technical Terms.

2.2. Abbreviations

CS:	Classification Society
DAM:	Dynamic Acquisition Module
FRP:	Fiber Reinforced Plastic
g	Gravitational acceleration
MMS:	Machinery Monitoring System
MPS:	Machinery Protection System
NPSH:	Net Positive Suction Head
P&ID:	Piping and Instrumentation Diagram
RPVC:	Rigid Polyvinyl Chloride
SS:	Stainless Steel
UCP:	Unit Control Panel

3. SCOPE OF SUPPLY

PACKAGER's scope of supply shall include, but not necessarily be limited to the following items:

- Submerged Centrifugal Pump/Motor with anodes;
- Design of anodic protection, in order to ensure the system's protection for 10 (ten) years;
- Flanged riser pipes (pipe stack) with internal & external anodes, centralizers and coating;
- Centralizers for pump and pipe stack;
- Cartridge type Mechanical Seal;
- Pump top plate to interface with caisson top plate with built-in power tube and discharge pipe;
- Long radius discharge elbow with junction box;
- Air release valve and drain with valves;
- Cu-Ni 90/100 pump suction strainer;
- Cooling, lubrication and sealing systems;
- Check valve between pump discharge and first section of pipe stack;
- Hypochlorite injection line on the suction of the pumps to prevent marine microorganisms and bacteria.
- Power and control junction boxes of stainless steel (SS 316), copper free aluminum or non-metallic materials, to interfaces topside/caissons.
- All necessary instrumentation, including accessories and supports;
- Electrical and instrumentation installation (including cable termination details, motor terminal box details, and grounding);
- All raw materials and consumables;
- Gaskets;
- Tightening bolts and nuts;
- Nameplates manufactured in SS 316 in Portuguese for all equipment and instruments;
- Surface preparation and painting proper for offshore installation, according to I-ET-3010.00-1200-956-P4X-002 – General Painting and DR-ENGP-I-1.15 – Color Coding;
- Spreader bars and specific handling devices for installation;
- Technical assistance during installation, pre-commissioning, start-up and commissioning phases;
- Safety signaling in Portuguese;
- All required tests at MANUFACTURER's shop;
- Coupling, assembly and alignment;



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- Preparation for shipment and preservation, including equipment handling conditioning and storage at job site;
- Consumables and special tools for assembly, disassembly, maintenance, commissioning and start-up;
- Spare parts recommended for commissioning, pre-operation, start-up, NR-13 tests and by Classification Society;
- Warranty;
- A complete engineering package including design, fabrication, inspection, testing, commissioning documentation, certification and data required on this specification and pump data sheets issued by OWNER;
- Other items included in data sheets SEA WATER LIFT PUMP and START-UP SEA WATER LIFT PUMP.


4. NORMATIVE REFERENCES**4.1. General**

- 4.1.1. All equipment shall comply with the requirements of this technical specification, data sheets, documents, codes and standards as stated below and with those referred to herein.
- 4.1.2. All equipment parts and details not complying with any of these requirements shall be informed on a "Deviation List". Otherwise they will be considered as "Agreed", and so required.
- 4.1.3. Any conflict between the requirements of this specification and related codes and standards, specification, etc. shall be presented in writing for OWNER's resolution prior to manufacturing.

4.2. Applicable Codes, Standards and Governmental Regulations

The following codes and standards shall be fully complied with:

API RP 582	Welding Guidelines for the Chemical, Oil, and Gas Industries
API STD 610	Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries
API STD 614	Lubrication, Shaft-sealing and Oil-control Systems and Auxiliaries
API STD 670	Machinery Protection Systems
API STD 671	Special-Purpose Couplings for Petroleum, Chemical, and Gas Industry Services
API STD 677	General-Purpose Gear Units for Petroleum, Chemicals and Gas Industry Services
API STD 682	Pumps – Shaft Sealing Systems for Centrifugal and Rotary Pumps
API-RP-2A	Planning, Designing and Constructing Fixed Offshore Platforms Working Stress Design
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
ASME B31.3	Process Piping
AISC 335-89	Specification for Structural Steel Buildings Allowable Stress Design And Plastic Design
ASME BPVC VIII-1	Rules for Construction of Pressure Vessels
ASME PTC 8.2	Centrifugal Pumps
AWS D1.1/D1.1M	Structural Welding Code – Steel
ANSI/HI 14.6	Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
IEC 60034	Rotating Electrical Machines
IEC 60092-502	Electrical Installation in Ships-Tankers-Special Features
IEC 61508/all parts	International Electrotechnical Commission – Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 61511/all parts	International Electrotechnical Commission – Functional safety - Safety instrumented systems for the process industry sector
IEC 61892-all parts	Mobile and Fixed Offshore Units – Electrical Installation
INMETRO	Resolution 89, February 23rd 2012
INMETRO	Resolution 179, May 18th 2010
ISO 15156-all parts	Petroleum and Natural Gas Industries: Materials for Use in H2S-Containing environments in Oil and Gas Production
NR-10	Brazilian Government Regulation – Norma Regulamentadora N° 10, Segurança em Instalações e Serviços em Eletricidade)
NR-12	Brazilian Government Regulation – Norma Regulamentadora N° 12, Segurança em Instalações e Serviços em Máquinas e Equipamentos)

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NR-13	Brazilian Government Regulation – Norma Regulamentadora N° 13, Caldeiras, Vasos de Pressão, Tubulações e Tanques Metálicos de Armazenamento)
NR-26	Brazilian Government Regulation – Norma Regulamentadora N° 26, Sinalização de Segurança)
NR-37	Brazilian Government Regulation – Norma Regulamentadora N° 37, Segurança e Saúde em Plataformas de Petróleo)
TEMA	Standards of Tubular Exchanger Manufactures Association Classification Society Rules for Offshore Facilities

Brazilian Government regulations are mandatory and shall prevail, if more stringent, over the requirements of this specification and other references herein. PACKAGER/MANUFACTURER shall comply with any other government regulations stated in the Contract and not listed above.

4.3. Applicable Documents

The following design documents shall be fully complied with:

4.3.1. Typical Documents

- **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-3010.00-1350-940-P4X-001	Systems Operation Philosophy

- **Safety**

DR-ENGP-M-I-1.3	Safety Engineering
I-ET-3010.00-5400-947-P4X-002	Safety Signaling

- **Mechanical**

DR-ENGP-I-1.15	Color Coding
I-ET-3010.00-1200-251-P4X-001	Requirements for Bolting Materials
I-ET-3010.00-1200-540-P4X-001	Requirements for Pressure Vessels Design and Fabrication
I-ET-3010.00-1200-955-P4X-001	Welding
I-ET-3010.00-1200-200-P4X-115	Requirements for Piping Fabrication Assembly and Commissioning
I-ET-3010.00-1200-956-P4X-002	General Painting
I-ET-3010.00-1200-751-P4X-001	Anodes Specification for Mechanical Equipment
I-ET-3010.00-1200-200-P4X-003	Design, Construction and Assembly of FRP Piping
I-ET-3010.00-1200-300-P4X-001	Noise and Vibration Control Requirements

- **Electrical**

I-DE-3010.00-5140-700-P4X-003	Grounding Installation Typical Details
I-DE-3010.00-5140-797-P4X-001	Electrical System Automation Architecture Diagram
I-ET-3010.00-5140-700-P4X-002	Power Installation Typical Details
I-ET-3010.00-5111-712-P4X-001	Submersible Induction Motors for Sea Water Lift Pumps for Offshore Units
I-ET-3010.00-5140-797-P4X-001	Electrical System Automation Architecture
I-ET-3010.00-5140-700-P4X-003	Electrical Requirements for Packages for Offshore Units

- **Instrumentation and Automation**

I-ET-3010.00-1200-800-P4X-002	Automation, Control and Instrumentation on Package Units
I-ET-3010.00-5500-854-P4X-001	Machinery Monitoring System (MMS).

- **Naval**

I-ET-3010.00-1350-960-P4X-001	Design Requirements – Naval Architecture
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4.3.2. Specific Project Documents

This section specifies documents that are referenced along the text and are part of a specific project. For that reason, the document's identification number is not yet defined and may vary according to project. The document title may also vary slightly from one project to another. Project's DOCUMENT LIST shall be consulted in order to verify the correct document number and title.



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- **General**

- DOCUMENT LIST
- GENERAL ARRANGEMENT (DRAWING)
- METOCEAN DATA

- **Process / Safety**

- SEA WATER LIFT PUMP (DATASHEET)
- START-UP SEA WATER LIFT PUMP (DATASHEET)
- SEA WATER LIFT FILTER (DATASHEET)
- START-UP SEA WATER LIFT FILTER (DATASHEET)
- GENERAL SPECIFICATION FOR AVAILABLE UTILITIES
- SEA WATER LIFT PUMP (P&ID)
- SEA WATER LIFT FILTER (P&ID)
- AREA CLASSIFICATION – GENERAL

- **Mechanical**

- PIPING SPECIFICATION FOR TOPSIDE
- TECHNICAL SPECIFICATION FOR SEA WATER LIFT PUMPS - FLEXIBLE INTAKE PIPE
- TOPSIDE'S MECHANICAL HANDLING PROCEDURES

- **Structure**

- SEAWATER CAISSONS (DRAWING)

- **Instrumentation and Automation**

- AUTOMATION INTERFACE OF PACKAGE UNITS

- **Naval**

- MOTION ANALYSIS

5. PACKAGER RESPONSIBILITY

5.1. PACKAGER / MANUFACTURER is responsible for the complete design, fabrication, inspection, testing, and supply of the components and spares, in full compliance with the requirements of this specification, its attachments and all applicable codes, standards and regulations referenced and, where applicable, the requirements of the Classification Society.

5.2. PACKAGER / MANUFACTURER is responsible for equipment certification and approval as required by Classification Society rules. CS rules may only be waived upon the formal approval from the CS itself and from OWNER.

5.3. PACKAGER / MANUFACTURER shall communicate directly with Classification Society and provide all documentation necessary to obtain approvals. OWNER shall be copied on all correspondence between PACKAGER / MANUFACTURER and Classification Society.

5.4. PACKAGER / MANUFACTURER shall obtain approval for all parts of their work as required by Classification Society before shipment of the equipment to the shipyard.

5.5. PACKAGER shall assume sole contractual and total engineering responsibility for the items supplied.

5.6. PACKAGER's responsibility shall also include but not be limited to:

- Resolving all engineering questions and/or problems relating to design and manufacture.
- Providing details as requested, for the main and auxiliary equipment, relating to design and manufacturing.
- Training.

5.7. Compliance by the PACKAGER with the provisions of this specification does not relieve the PACKAGER's responsibility to furnish equipment and accessories of a proper mechanical design suited to meet the specified service conditions.



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5.8. PACKAGER is responsible for all coordination with MANUFACTURERS and collections of all details, drawings and data to achieve optimum design and full submission of all documents requested in this specification.

5.9. PACKAGER / MANUFACTURER shall indicate all installation and commissioning activities that require PACKAGER / MANUFACTURER's supervision, and submit them for OWNER approval.

6. DESIGN REQUIREMENTS

6.1. Design Life

6.1.1. Equipment shall be designed for a 30-year life in a corrosive offshore environment without the need for replacement of any major component due to weather, corrosion, fatigue, or material failure.

6.1.2. PACKAGER / MANUFACTURER shall include a schedule stating the expected time between major overhauls.

6.2. Safety Requirements

6.2.1. Personnel safety protection shall be provided according to Brazilian Government Regulations (NR).

6.2.2. All safety signs, warning signs and notices shall be in Brazilian Portuguese language and shall be provided where risk of personnel injury exist.

6.2.3. Safety signaling shall be in full compliance with I-ET-3010.00-5400-947-P4X-002 – Safety Signaling.

6.2.4. For area classification see the drawing AREA CLASSIFICATION – GENERAL [document supplied by OWNER].

6.2.5. Mandatory safety items, as established in DR-ENGP-M-I-1.3 – Safety Engineering, shall be considered complementary requirements, to the pertinent extent. In case of items in conflict with this document, OWNER shall be consulted.

6.2.6. HAZOP and PHA shall be performed according to DR-ENGP-M-I-1.3 – Safety Engineering.

6.2.7. Double block & bleed arrangements are required for isolation of equipment in piping classes of 300# and above.

6.3. Environmental Conditions

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

6.4. Motion and Acceleration Requirements

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

6.4.2. PACKAGE shall be able to withstand and operate in accordance with I-ET-3010.00-1350-960-P4X-001.

6.4.3. PACKAGER / MANUFACTURER shall design the PACKAGE to operate under the conditions of inclination established by Classification Society rules. These conditions may occur simultaneously.

6.4.4. Motion and acceleration requirements shall reflect in proper pump pipe stacks design, in order to avoid impacts against internal caisson wall and avoid damage to auxiliary piping (cooling, sealing, etc.).

6.5. Equipment Location

6.5.1. The pumps shall be installed submerged inside of steel caissons, at the location defined on GENERAL ARRANGEMENT drawing [document supplied by OWNER], supplied and fitted by SUPPLIER. The steel caissons will be lengthened until the vessel base line.

6.5.2. PACKAGE layout and arrangement shall be designed to provide sufficient access for ease of operation and maintenance, and to maximize safety.

6.6. PACKAGE Requirements

- 6.6.1. The utility requirements and consumption of the equipment shall be clearly defined by PACKAGER. This information shall also be included in the quotation. The consumption of utilities shall comply with the requirements of GENERAL SPECIFICATION FOR AVAILABLE UTILITIES [document supplied by OWNER].
- 6.6.2. Pump PACKAGES, including all auxiliary equipment, shall be assembled to the maximum extent possible, aligned and pre-checked in MANUFACTURER'S/ PACKAGER'S shop, allowing shipment to the integration yard with minimal fieldwork.
- 6.6.3. Pump PACKAGES shall be manufactured, inspected and verified to comply with all specifications mentioned in Normative References and the Classification Society regulations. Pump PACKAGES shall be supplied complete, approved by CS and ready for erection on board.
- 6.6.4. For foreign made equipment, the standard manufacturing parts (couplings, mechanical type seals, bearings) shall be purchased from Manufacturers with representative branches located in Brazil, with service parts and maintenance workshops.
- 6.6.5. The design of both Lift Pumps shall comply with standards and reference documents of the NORMATIVE REFERENCES
- 6.6.6. The Lift Pumps shall be Electrical Submersible Pump (ESP) type installed inside of steel caissons, supplied and fitted by SUPPLIER.
- 6.6.7. PACKAGER / MANUFACTURER shall supply and install a check valve between the discharge of the pump and the lowest section of the piping stack, to guarantee that the piping stack is full at start-up.
- 6.6.8. PACKAGER shall design and supply a minimum flow assurance system including all necessary valves and instruments.
- 6.6.9. Sodium hypochlorite shall be routed to the pump suction through the top plate, along the pipe stack.
- 6.6.10. Material selection for hypochlorite injection piping shall be sent for OWNER approval. For FRP piping system requirements refer to I-ET-3010.00-1200-200-P4X-003 – Design, Construction and Assembly of FRP Piping.
- 6.6.11. PACKAGER / MANUFACTURER shall provide strainers at the inlet of the pump and any other opening that communicates with the inlet.
- 6.6.12. Pump PACKAGE shall be provided with all necessary instruments to operate safely, adequately and without interruption in a tropical marine environment.
- 6.6.13. Pump re-assembling after the motor or pump disassembly shall require alignment only in radial direction. The motor-pump assembly parts shall provide alignment in the axial direction. Alignment-positioning jackscrews shall be provided in accordance with API Std 610 requirements for vertically suspended pumps.
- 6.6.14. Anti-corrosion system shall comply with the following requirements:
 - a) The system shall ensure the corrosion protection of the entire extent of the lift pumps, including pipe stack, and the submerged sections of the caissons considering at least 10 years of operational availability.
 - b) The system shall include sacrificial anodes and pump coating to be designed, supplied and installed by the pump PACKAGER / MANUFACTURER.
 - c) Sacrificial anodes shall comply with I-ET-3010.00-1200-751-P4X-001 - Anodes Specification for Mechanical Equipment and pump coating shall comply with I-ET-3010.00-1200-956-P4X-002 - General Painting.
 - d) PACKAGER / MANUFACTURER shall provide a descriptive report detailing the analyses performed and obtained results which ensure adequate cathodic protection of the entire section of the pumps and caissons.
- 6.6.15. The design of selected anodes shall also be suitable to pumped flow erosive action.

6.7. Performance

- 6.7.1. Pump PACKAGE shall be designed for the full range of operational conditions as specified in datasheets SEA WATER LIFT PUMP [document supplied by OWNER] and START-UP SEA WATER LIFT PUMP [document supplied by OWNER] and in the P&ID SEA WATER LIFT PUMP [document supplied by OWNER].
- 6.7.2. Pumps shall be designed considering the minimum draft and the variation of the sea wave height.
- 6.7.3. Pumps with constant speed drivers shall be capable of providing a head increase of at least 5% at rated capacity by installing a larger diameter impeller.
- 6.7.4. The Sea Water Lift Pumps speed shall not exceed 1800 rpm.
- 6.7.5. The Start-Up Sea Water Lift Pump speed should be preferably up to 1800 rpm. When a hydraulic selection cannot be matched at 1800 rpm, or there is an exceptional advantage in running at 3600 rpm, this can be accepted if the supplier proves the supply for at least 2 equipment operating in similar conditions, in which case OWNER design team shall be consulted for approval.
- 6.7.6. Pumps shall have stable head / capacity curves with a continuous head rise to shutoff of at least 10% from rated head. When parallel operation is specified, the rise shall be at least 15% of the rated head, but not more than 25% of the head at BEP of rated impeller diameter, as confirmed during performance test. Discharge orifices to achieve these criteria are not acceptable.
- 6.7.7. Rated flow shall be within the region of 80% to 110% of best efficiency flowrate of the pump as furnished.
- 6.7.8. Efficiency at the rated flow shall be at least 79% for pumps driven by electric motor with power above 150kW.
- 6.7.9. The NPSH required shall be at least 2m less than the NPSH available. Correction factors are not allowed. OWNER may accept differences between 1m and 2m, but a witnessed NPSH required test shall be performed.

6.8. Pump Casing

The whole pump casing shall have a pressure rating allowing it to be tested at the hydrostatic test pressure of the discharge side by mounting blinds to the suction and to the discharge flange.

6.9. Motor


If pump and motor rotors are not designed to allow reverse rotation, a non-reverse rotation ratchet shall be installed in the submerged electric motor.

6.10. Coupling and Guards

- 6.10.1. Coupling shall be provided between the lift pumps and their submerged electric motors.
- 6.10.2. PACKAGER / MANUFACTURER shall install a rigid screen in the region of the motor-pump coupling, to avoid entry of foreign objects in the coupling area.

6.11. Cooling, Lubrication and Sealing Systems

- 6.11.1. Fluid shall be provided to the submerged electric motor to ensure adequate cooling, lubrication and sealing during pump operation.
- 6.11.2. Cooling and lubrication systems may be oil-based or water-based. Electric motors filled with oil or when forced circulation unit (auxiliary pump + motor) is specified for the sealing / cooling liquid (oil or glycol), sampling points shall be provided to allow inspection of their conditions.
- 6.11.3. Cooling and lubrication systems fluid pressures shall always be higher than the seawater back pressure into the caisson, avoiding ingress of seawater during installation and operation.
- 6.11.4. If oil-based systems are used, mixing different circulation oils is not acceptable.
- 6.11.5. Cooling, lubrication and sealing/return fluid lines shall be supplied in metallic tubing. Flexible hoses can only be used in sections above the maximum water line.
- 6.11.6. Mechanical seal design shall be suitable for pump pressure surges during normal starting procedures, avoiding sea water motor contamination and debris accumulation.

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6.11.7. Mechanical seal shall prevent leakage of hydraulic oil to sea water and vice-versa, if oil-based motor cooling/isolation/lubrication is used.

6.12. Piping and Caisson

6.12.1. All piping, with sea water as process fluid, shall be designed, fabricated, and inspected in accordance with ASME B31.3 and the PIPING SPECIFICATION FOR TOPSIDE [document supplied by OWNER]. Threaded connections shall not be used.

6.12.2. All connections shall be located above the top plate and provided with flanged connections according to ASME B16.5 and the PIPING SPECIFICATION FOR TOPSIDE [document supplied by OWNER]. Locations, size and rating of all connections shall be clearly defined by PACKAGER / MANUFACTURER.

6.12.3. PACKAGER / MANUFACTURER shall install centralizers with reduced clearance between the pump and the internal wall of the caisson. Radial clearance shall not exceed 10 mm. The centralizer pads shall be made of nonmetallic material and shall be designed to withstand the mechanical loads of normal operation and assembly / disassembly procedures, still ensuring that no direct metal to metal contact will occur between pump and caisson.

6.12.4. PACKAGER / MANUFACTURER shall provide in advance the drawing of the centralizer, with dimensional tolerances, from which a template shall be manufactured by SUPPLIER. This drawing shall contain the dimensional tolerances of the caisson, both in diameter and length. Template manufactured by SUPPLIER shall be used to check if the dimensions of caisson are correct.

6.12.5. Sealing/return lines and external power/instrumentation cables shall be positioned close to the central region of the centralizers, away from the inner wall of the caisson, and routed along the length of the pipe stacks.

6.12.6. The submerged electric motor shall be provided with adequate clearance between centralizers and the internal wall of the caisson to guarantee the stiffness of the set against lateral movements inside the caisson, without compromising the assembly / disassembly.

6.12.7. PACKAGER / MANUFACTURER shall provide a report with modal analysis and structural calculations for the fatigue analysis of the top support of the pipe stacks, considering permanent / transient operation, their submergence and movements of the UNIT.

6.12.8. PACKAGER / MANUFACTURER shall present calculation report for vent valves (air release), considering that, for normal starting procedures at shut off conditions, they will be suitable to perform withstanding pressure surges, under following criteria: pumped water elevation rate shall be limited without consequences to electric motor cooling.

6.13. Manufacturing

6.13.1. All materials and equipment shall be new and from OWNER's Approved Manufacturer's List. Any materials used in the fabrication of the PACKAGE from an unapproved MANUFACTURER will be rejected, removed and replaced at PACKAGER/ MANUFACTURER's expense.

6.13.2. All equipment and components shall be manufactured up to two years before the delivery date at most.

6.14. Noise and Vibration

Noise and vibration control concerning human exposure shall be performed according to I-ET-3010.00-1200-300-P4X-001 – Noise and Vibration Control Requirements. Noise data is required for the final proposal and after the FAT.


6.15. Pressure Vessels

Pressure vessels within pump PACKAGE shall be in accordance with I-ET-3010.00-1200-540-P4X-001 – Requirements for Pressure Vessels Design and Fabrication.

6.16. Special Tools and Spare Parts

6.16.1. All special tools necessary for the installation, alignment, operation or maintenance of the equipment shall be supplied with the delivery of the PACKAGE.

6.16.2. Spare parts required for NR-13 tests and those recommended by Classification Society shall be provided.

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6.16.3. If the Classification Society has no requirements but only a guide list for spare parts, this guide list shall be understood by PACKAGER / MANUFACTURER as a mandatory requirement together with MANUFACTURER's recommendation and shall be furnished at no extra cost to OWNER.

6.16.4. All special tools and spare parts shall be detailed in the packing list and shall be consistent with the lists issued for the engineering documentation. These items shall have an item number in the packing list, which shall match the item number fixed on the packing.

6.17. Maintenance Handling

6.17.1. PACKAGER / MANUFACTURER and SUPPLIER shall follow the requirements for maintenance handling on TOPSIDE MECHANICAL HANDLING PROCEDURES [document supplied by OWNER].

6.17.2. PACKAGER / MANUFACTURER shall supply spreader bars, slings and specific handling devices for installation and maintenance with the applicable certificates.

6.17.3. All necessary maintenance lift beams shall be provided to facilitate safe and easy maintenance.

6.17.4. SUPPLIER shall design all structural components, including calculation report and detailing drawings. SUPPLIER shall fabricate and assembly the support structures in accordance with AISC 335-89 – Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design and API-RP-2A - Planning, Designing, and Constructing Fixed Offshore Platforms Working Stress Design. Lifting pad eyes shall be designed in accordance with project Classification Society or Marine Warranty Surveyor Rules.

7. MATERIALS

7.1. Material selection for lift pumps shall be according to API Std 610 Table H Class D2 or Bronze Nickel Aluminum alloy.

7.2. Submersible suction strainer's material shall be Cu-Ni 90/10 alloy and it shall be electrically isolated. The strainer design shall provide flow velocities within Cu-Ni 90/10 alloy velocity limit. Polymeric materials are not accepted.

7.3. Dissimilar materials in contact with an electrolyte shall be isolated to avoid galvanic corrosion. The only exception shall be the interface of pump and caisson, which shall be electrically connected to ensure the effectiveness of the cathodic protection.

8. ELECTRICAL

8.1. All electrical equipment shall be manufactured and tested in compliance with Classification Society and IEC requirements, unless otherwise stated.

8.2. Electrical equipment and materials shall comply with I-ET-3010.00-5140-700-P4X-002 – Specification for Electrical Material and Equipment for Offshore Units and I-ET-3010.00-5140-700-P4X-003 – Electrical Requirements for Packages for Offshore Units.

8.3. Electric motors for SEA WATER LIFT PUMPS and START UP SEA WATER LIFT PUMPS shall comply with I-ET-3010.00-5111-712-P4X-001 – Submersible Induction Motors For Sea Water Lift Pumps For Offshore Units.


9. CONTROLS AND INSTRUMENTATION

9.1. General

9.1.1. PACKAGER / MANUFACTURER shall ensure that the equipment is properly certified for the specified classification. For further information see FIELD INSTRUMENTATION specification [document supplied by OWNER].

9.1.2. PACKAGE automation type classification shall be according to AUTOMATION INTERFACE OF PACKAGE UNITS specification [document supplied by OWNER].

9.1.3. The PACKAGE automation, control and instrumentation shall fully comply with I-ET-3010.00-1200-800-P4X-002 – Automation, Control and Instrumentation on Package Units and I-ET-3010.00-1350-940-P4X-001 – Systems Operation Philosophy.

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9.2. Automation, Control and Instrumentation System Cabling

- 9.2.1. All wiring within the limits of the enclosure shall be clearly marked on the wire and at the terminal.
- 9.2.2. All cabling between the driver and the local gauge board shall be furnished. All cables and cable routes shall contain at least 20% of the extra capacity.

9.3. Alarms and Shutdown


- 9.3.1. The minimum alarm and shutdown functions shall be as required on the P&ID SEA WATER LIFT PUMP [document supplied by OWNER] and on the specification AUTOMATION INTERFACE OF PACKAGE UNITS [document supplied by OWNER].
- ~~9.3.2.~~ PACKAGER/MANUFACTURER shall provide temperature monitoring system for electric motor bearings, and signals shall be addressed to MPS. PACKAGER/MANUFACTURER shall inform temperature sets for alarm and shutdown.
- 9.3.3. A hardwired output signal, related to “start request” and a hardwired input signal, related to “start permission” shall be available on equipment (UCP or skid) to allow implementation of automatic field forcing in main generators, in order to reduce voltage, drop during starting.
- 9.3.4. Suitable instrumentation shall provide an alarm in the event of either seawater ingress or loss of motor cooling fluid.
- 9.3.5. Local start shall always remain possible even when the pumps automatic start is inhibited.
- 9.3.6. Relays shall be provided in the control panels to isolate the remote start and stop contacts from the control panel’s voltage.
- 9.3.7. For a list of signals exchanged between sea water lift packages and the automation systems, consult the specification for AUTOMATION INTERFACE OF PACKAGE UNITS [document supplied by OWNER].
- 9.3.8. SUPPLIER shall demonstrate that alarms and trips can be tested without the need to disconnect piping and/or electrical connections or use jump wires.

9.4. Monitoring Requirements

- 9.4.1. The equipment that shall be monitored and the monitoring requirements shall be according to I-ET-3010.00-5500-854-P4X-001 – Machinery Monitoring System (MMS).
- 9.4.2. Monitoring sensors for motors shall be in accordance with 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.
- 9.4.3. All monitoring sensors shall be compatible with MPS/DAM, as described in I-ET-3010.00-5500-854-P4X-001 – Machinery Monitoring System (MMS).
- 9.4.4. All monitoring sensors shall be supplied installed, configured, and connected to a junction box located on the pump skid. MANUFACTURER shall provide complete documentation of the sensors installed in the equipment.
- 9.4.5. The PACKAGE shall have a salinity / conductivity sensor to identify the contamination of the electric motor sealing fluid with sea water. The sensor shall be installed in a position that allows the effective identification of any sea water contamination.
- 9.4.6. PACKAGES whose electric motors have rolling element bearings shall have an oil condition monitoring device to enable real-time indication of oil contamination with water and metallic residue. This device shall be compatible with and connected to the MMS.

10. PAINTING AND COLOR

- 10.1. PACKAGER / MANUFACTURER paint system shall be according to I-ET-3010.00-1200-956-P4X-002 – General Painting.
- 10.2. Color code adopted shall be in accordance DR-ENGP-I-1.15 – Color Coding.

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10.3. Defects arising within the guarantee period shall be subject to an allowance of 1%, representing wear and tear. For system failure in excess of this, PACKAGER / MANUFACTURER's liability shall include complete pre-treatment and repainting.

11. NAMEPLATES

11.1. PACKAGER / MANUFACTURER shall attach corrosion resistant SS 316 nameplates on main and auxiliary equipment in an accessible location, fastened with corrosion resistant SS 316 pins, and in Brazilian Portuguese language.

11.2. For pressure vessels, columns and filters the nameplates shall be according to I-ET-3010.00-1200-540-P4X-001 – Requirements for Pressure Vessels Design and Fabrication.

11.3. For other equipment the nameplates shall include, as a minimum, the following information:

- Petróleo Brasileiro S.A. – PETROBRAS;
- Installation identification;
- Tag number;
- Service;
- Purchase order number;
- Manufacturer and year of build;
- Equipment serial number and type;
- Main data for design, operation and testing (power, pressure, volume, temperature, speed, flow rate), where applicable;
- Specific requirements;
- Design code;
- Empty and operating weight.

11.4. Valves, instruments and orifices shall have a nameplate with tag number and serial number.

11.5. All technical data on nameplates shall be in metric units. Pressure shall be indicated in kPa for pressure vessels.

11.6. Auxiliary equipment shall have nameplates in accordance with respective technical specifications defined on NORMATIVE REFERENCES.

12. TAG NUMBERING

12.1. Tagging of all instrumentation, electrical, mechanical and piping items, including valves, shall be according to I-ET-3000.00-1200-940-P4X-001 – Tagging Procedure for Production Units Design.

12.2. Tag plates shall be supplied with number and description in Portuguese.

12.3. All tag plates shall be made from SS 316 material.

12.4. Valves, instruments and orifices shall be tagged with the applicable number only.

12.5. Tag numbers for remaining auxiliary equipment shall be defined in detail design after approval of OWNER.

13. CERTIFICATION REQUIREMENTS

13.1. Class Certification


PACKAGER / MANUFACTURER shall supply a Classification Society Certificate of compliance with Rules requirements for the pump PACKAGE

13.2. Material Certification

13.2.1. PACKAGER / MANUFACTURER shall obtain all necessary certification of the equipment.

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

13.2.3. Certificates for pressure-containing parts, impellers and shafts shall include chemical analysis and mechanical properties of the materials.

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14. INSPECTION, TESTING AND COMISSIONING

14.1. Inspection and Testing

- 14.1.1. PACKAGER / MANUFACTURER shall perform all required inspection and testing in accordance with the referenced design code, considering also as a reference the test code mentioned on NORMATIVE REFERENCES. In addition to those, PACKAGER / MANUFACTURER shall comply with the applicable project specifications listed herein, at datasheet and Material Requisition.
- 14.1.2. PACKAGER / MANUFACTURER shall submit the Inspection and Test Plan (ITP) based on the technical datasheet with witnessed inspections and tests identified.
- 14.1.3. PACKAGER / MANUFACTURER shall ensure that all the witnessed inspection requirements by the Classification Society are fully accommodated and the due notice requirements are satisfied.
- 14.1.4. OWNER shall witness SEA WATER LIFT PUMP and START-UP SEA WATER LIFT PUMP performance test and hydrostatic test of vessels classified in NR-13 within the PACKAGE.
- 14.1.5. The following tests or certificates shall be included in PACKAGER / MANUFACTURER scope and will be verified by OWNER:
- Materials of construction of the PACKAGE (vessels, heat exchangers, pumps, motors, etc.) for conformity with the requirements of the specification.
 - Piping, fittings and valves materials and fabrication, which shall conform to specification.
 - Radiographic, dye penetrant, magnetic particles, ultrasonic inspection of welds on the pressure retaining parts of the equipment, and steel structures.
 - Approval of the relief valve settings and witness of their testing after setting.
 - A visual check of the assembly of the PACKAGE, with special notice to:
 - The thickness of the pressure retaining parts meets or exceeds the quoted design thickness.
 - Any repairs.
 - Dry-film thickness quoted.
 - The general appearances, materials, workmanship and standard of finish are acceptable.
 - Dimensional check.
 - Alignment to be demonstrated.

14.2. PACKAGE Functional Test

- 14.2.1. A full functional test of each completed package shall be performed. The satisfactory operation of all indicators, selectors and controllers shall be demonstrated.
- 14.2.2. The correct operation of all controllers, alarm and fault protection equipment and indicators shall be demonstrated and if necessary fault simulations.
- 14.2.3. In addition, following tests shall be included in PACKAGER / MANUFACTURER scope:
- Electrical continuity and insulation checks on all wiring and earthing continuity;
 - Functional checks on all instruments and valves;
 - Control panel tests.

14.3. Factory Acceptance Test (FAT)

- 14.3.1. PACKAGER / MANUFACTURER shall prepare a FAT procedure for the package and submit for OWNER approval. FAT procedure shall consider as a reference the test code mentioned on NORMATIVE REFERENCES.
- 14.3.2. PACKAGER / MANUFACTURER shall make preliminary test to ensure that all parts of the equipment are operating satisfactory prior to the arrival of the OWNER's representative.
- 14.3.3. OWNER representatives will witness the FAT. PACKAGER / MANUFACTURER shall invite Classification Society surveyor for FAT.
- 14.3.4. PACKAGE shall undergo a 4 hours mechanical run test with the conditions established on the pump datasheet.
- 14.3.5. As a minimum, each pump rotor, including spares if purchased, shall undergo a witnessed 4 hours continuous mechanical run at the duty point. During this run, PACKAGER / MANUFACTURER



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shall record and approve records of vibration and temperature of mutually agreed parameters. Vibration and bearing temperature measurements shall be included on FAT report.


- 14.3.6. A performance test shall be carried out on each pump/motor PACKAGE. This performance test shall include a minimum of five (5) test points, one of which will be at shut off head; one at duty point; one at the end of allowable operating region; one at the minimum flow allowable; and one intermediate point. The performance test acceptance criteria shall be as per API Std 610.
- 14.3.7. Where there is less than two (2) meters between NPSH available and NPSH required, a witnessed NPSH required test shall be performed on each pump type. If the pump selected fails to meet the design NPSH required, all pumps of that type shall undergo witnessed NPSH required testing, and PACKAGER / MANUFACTURER shall provide acceptable means of correction. A correction factor is not acceptable.
- 14.3.8. At least one set of SEA WATER LIFT PUMP and the START UP SEA WATER LIFT PUMP shall be tested as a complete train (Complete Unit Test) according to API Std 610.
- 14.3.9. If it is found necessary to dismantle any equipment during a test, because of malfunction, the test may then be invalidated, and a full test shall be required after the repair of the fault.
- 14.3.10. Acceptance of shop tests shall not constitute a waiver of requirements to meet the field tests under specified operating conditions, nor shall inspection relieve the PACKAGER / MANUFACTURER of his responsibilities in any way whatsoever.
- 14.3.11. Acceptance of the FAT will not be considered as the final acceptance test of the package unit.

14.4. Commissioning

- 14.4.1. SUPPLIER is responsible for pre-commissioning and commissioning of the equipment/system. Final acceptance will be on satisfactory completion of commissioning tests as specified by OWNER.
- 14.4.2. PACKAGER / MANUFACTURER shall provide any necessary support for installation and commissioning of the equipment either at a shore based fabrication yard or on the UNIT, including monitoring systems of the PACKAGE.
- 14.4.3. SUPPLIER shall provide all consumables necessary to allow commissioning in the environment conditions of the shipyard.
- 14.4.4. SUPPLIER shall inform PACKAGER / MANUFACTURER regarding any specific commissioning conditions for the equipment, i.e., conditions in which the equipment will have to operate temporarily, including environmental conditions such as extreme ambient temperatures, if they are different from the conditions defined in the data sheet. The PACKAGE shall be designed to withstand such conditions.
- 14.4.5. PACKAGE shall undergo a Reliability Acceptance Test Criteria (SAT) on site, in accordance with the requirements of Annex A.

15. PREPARATION FOR SHIPMENT**15.1. Marking**

- 15.1.1. All items supplied to this specification shall be adequately marked for identification against a certificate or relevant test documentation. Marking shall be such that it will not damage or impair the component.
- 15.1.2. Items that cannot be identified shall be rejected. Rejected items may be re-certified by carrying out all relevant testing, with prior approval of the OWNER.
- 15.1.3. As a minimum, the following identification shall be provided:
- Project number;
 - Manufacturer's name;
 - Purchase order number;
 - Shipping weight;
 - Item number;
 - Classification Society surveyor's stamp.

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15.2. Shipment Packing

- 15.2.1. The equipment shall be supplied tested, flushed and preserved and, if practical, already charged up with coolant and lubricants.
- 15.2.2. The equipment shall be securely packed for shipment from PACKAGER / MANUFACTURER's location to the actual equipment destination. All items shall be protected from handling damage either by protective packing with cartons, crates, etc. or by securing to pallets. All material shall be packed in a way that handling with forklift truck or crane is possible.
- 15.2.3. If there is a risk of damage to valves and other appurtenances during transportation, they shall be disconnected and tagged. All components shall then be securely packed as above.
- 15.2.4. Vulnerable instruments shall be removed and separately packed for shipment.
- 15.2.5. The preparation shall make the equipment suitable for 24 months outdoor storage from the time of shipment. The PACKAGE shall be protected from corrosion.
- 15.2.6. All openings shall be covered or capped to protect the inside from dust, rust and moisture. Dryer shall be enclosed in the package for absorption of moisture.
- 15.2.7. Flanged openings shall be provided with gasketed metal closures securely fastened with bolts or clamps.
- 15.2.8. All internally unpainted carbon steel pressure vessels and piping shall be protected with corrosion inhibitor prior to shipment. If necessary, PACKAGER / MANUFACTURER shall provide instructions to remove the corrosion inhibitor prior to the commissioning.
- 15.2.9. PACKAGER shall submit the packing design and packing list to the OWNER for approval. PACKAGER shall issue during engineering stage the packing list, which shall contain the item number of each part supplied loose.
- 15.2.10. The packing list shall clearly show:
- UNIT name;
 - OWNER's order number;
 - OWNER's item number;
 - Partial or complete delivery for each order number;
 - Description;
 - Number of packages;
 - Gross weight of each package.
- 15.2.11. Spare parts and special tools packed separately shall be clearly marked with "Spare Parts" or "Special Tools" respectively.
- 15.2.12. PACKAGER shall inform the declared weight, rigging plan, materials and type of pesticide used in the package.
- 15.2.13. Each package shall be clearly marked with its gross weight, to enable safe handling.
- 15.2.14. Packing shall be in accordance with the requirements of the country to which the equipment is being shipped.
- 15.2.15. PACKAGER shall provide the procedures for unpacking, handling and installation, as well as repacking, and long-term storage requirements.
- 15.2.16. PACKAGER shall specify any limitations applicable to the transport and installation phase.
- 15.2.17. Unless otherwise advised, each item of equipment shall be checked for its suitability to resist horizontal and vertical acceleration of 0.8g in any direction during sea transportation.
- 15.2.18. The rust preventives list shall give instructions for removal of preventives where required, and necessary procedures to be imposed during storage.
- 15.2.19. Transportation bracing/support should be used where necessary and shall be clearly identified as temporary.
- 15.2.20. PACKAGER / MANUFACTURER shall provide a Delivery Specification, which shall describe all loose items furnished in a completely or not completely assembled condition. Delivery Specification



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shall clearly indicate OWNER's order number in the headlines and item number for each loose item shipped by the SUPPLIER. One copy of the delivery specification shall follow the goods, one copy to be sent to the shipyard and one copy to be sent to the OWNER.

16. REQUIRED DOCUMENTATION

16.1. PACKAGER / MANUFACTURER shall provide original documents in PDF format for all required documents. Extracted figures from catalogue or manual, especially for the outline drawings of components such as couplings, mechanical seals and auxiliary equipment will not be accepted. Whenever required by OWNER, source files shall also be provided.

16.2. All documents required in this section shall be text searchable, including PDF files.

16.3. Before any document is issued by PACKAGER / MANUFACTURER, a document list shall be issued and approved by OWNER. This is required in order to guarantee the correct document numbering.

16.4. Drawings and diagrams shall use the symbols defined on I-ET-3000.00-0000-940-P4X-002 – Symbols for Production Units Design.

16.5. The following documents shall be provided during technical proposal by PACKAGER / MANUFACTURER in their preliminary version:

- General arrangement drawing;
- Cross section drawing;
- Datasheet;
- Performance curves, including Head, Power, efficiency and required NPSH versus flowrate.

16.6. Title of all documents to be issued by PACKAGER / MANUFACTURER shall have the following format:

- First part – tag number;
- Second part – service description;
- Third part – document description

EXAMPLE: B-5111001A/F – Sea Water Lift Pumps – General Arrangement Drawing

16.7. If PACKAGER / MANUFACTURER issues documents which contain information valid for more than one pump tag, pump tag and service description shall be omitted and replaced by “Sea Water Lift Pumps”

EXAMPLE: “Sea Water Lift Pumps” – Inspection and Test Plan.

16.8. The following documents shall be issued and approved before FAT execution. Otherwise, OWNER will not attend the FAT and will not accept its execution:

- Piping and instrumentation diagram;
- General arrangement drawing;
- Cross section drawing with part list;
- Main and auxiliary equipment datasheets;
- Weight and center of gravity datasheet;
- Noise datasheet;
- Performance curves;
- Utility consumption list and heat dissipation;
- Inspection and Test Plan (ITP), including auxiliary equipment;
- Hydrostatic test procedure;
- Painting and insulation specification;
- Rotor dynamics analysis report (according to requirements of API Std 610);
- Fatigue analysis report for pipe stack top support, considering normal operation and transient events;
- Air release valves calculation report;
- FAT procedure.

16.9. The following documents shall be issued and approved before delivery of the PACKAGE. Otherwise, OWNER will not attend to the receiving inspection, and will not accept the PACKAGE:

- Nameplate drawings;
- Noise report;



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- FAT report;
- Handling drawing for installation;
- Installation manual;
- Instruments and instrumented valves datasheets;
- Packing list.

16.10. The following documents shall be issued and approved before issuance of the Databook. Otherwise, OWNER will not accept the Databook:

- Mechanical seal drawing;
- Coupling drawing;
- Outline drawings of auxiliary equipment;
- Operation and maintenance manuals for main and auxiliary equipment;
- List of spare parts for commissioning and start up;
- List of recommended spare parts for two years of operation;
- List of special tools;
- List of instruments and instrumented valves;
- List of set points, alarms and shutdown;
- Logic diagrams;
- Cause and effect charts;
- Loop diagram
- Electromechanical panel drawing;
- Memory maps;
- Automation architecture;
- Interconnection wiring diagram;
- Calculation notes of control valves, PSVs and flowmeters;
- I/O List;
- HMI screen layout;
- Calibration certificates of instruments;
- Fabrication procedures of pressure vessels classified in NR-13;
- NDT procedures of pressure vessels classified in NR-13;
- Hydrotest reports for pressure vessels classified in NR-13;
- Hydrotest report of pumps;
- NDT reports;
- Material certificates;
- Heat treatment records;
- Databook index.

16.11. Documents for electric motors shall be according to 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.

16.12. Installation, operation and maintenance manuals shall be issued in Portuguese. PACKAGER / MANUFACTURER may choose to issue one single manual with installation, operation and maintenance instructions.


16.13. Installation manual shall contain all recommendations for preservation during storage on erection stage. If PACKAGER / MANUFACTURER fails to provide this information on the installation manual, any damages due to the lack of preservation will be PACKAGER / MANUFACTURER's responsibility.

16.14. Installation manual shall contain a list of all consumables to be used for erection, commissioning and start up.

16.15. Maintenance manual shall contain the specification of lubricant fluids and periodicity of replacement.

16.16. Maintenance manual shall contain instructions to assemble and disassemble each major piece of the equipment, such as mechanical seal, rotor and bearings. This information may be provided on a separate manual for the piece as well.

16.17. PACKAGER / MANUFACTURER may choose to include specific commissioning instructions on the operation manual, or to issue a separate document, such as a procedure, for commissioning instructions.

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16.18. Operation manual shall contain, among other information, the control system description of the PACKAGE.

16.19. General arrangement drawings shall contain the connection list, i.e., a list with all connection tie-in points of the skids, which shall have the following minimum information: Connection identification number (which shall be represented in the drawing), connection description, tie-in connection specification that is, pressure rating, manufacturing standard, flange face type, connection nominal diameter and fluid.

16.20. Mechanical seal drawings shall contain a list with all connections on the seal, including identification code (which shall be represented on the mechanical seal drawing), connection description and fluid. Mechanical seal drawings shall contain also a part list with identification number of the part, description of the part and material of each part. Identification number of seal parts shall be different from the identification code of the connections. For example, identification codes can be letters and parts identified by numbers.

16.21. PACKAGER / MANUFACTURER shall inform either in the datasheet or in the performance curve the flow rates defining the preferred operation region and the allowable operation region of the equipment.

16.22. Each material certificate and NDT report provided shall be preceded by a PACKAGER / MANUFACTURER sheet, informing to which part of the equipment the document refers.

16.23. All inspections, NDTs and tests predicted by PACKAGER in the Inspection and Test Plan shall have a report, which shall be included in the Databook.

17. ANNEXES

Annex A – Rotating Equipment Reliability Test.



ANNEX A –
ROTATING EQUIPME