### TECHNICAL SPECIFICATION

**CLIENT:** SRGE  
**JOB:** REFERENCE BASIC DESIGN  
**AREA:** BÚZIOS  
**DP&T-SRGE**  
**TITLE:** CHEMICAL INJECTION UNITS

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1 INTRODUCTION

This specification covers the minimum requirements for the design, engineering, materials, fabrication, inspection, testing of the CHEMICAL INJECTION UNITS.

The CHEMICAL INJECTION UNITS shall be provided with all necessary auxiliaries and instruments for safe, efficient and uninterrupted operation in a tropical marine environment.

The scope of this Technical Specification comprises the following main items (for detailed scope of supply, see 5.1):

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<tr>
<th>TAG</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>UQ-1261001</td>
<td>OIL AND GAS CHEMICAL INJECTION UNIT</td>
<td>1 x 100%</td>
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<tr>
<td>UQ-1262001</td>
<td>PRODUCED WATER CHEMICAL INJECTION UNIT</td>
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<td>INJECTION WATER CHEMICAL INJECTION UNIT</td>
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2 NORMATIVE REFERENCES AND DESIGN SPECIFICATIONS

All equipment shall comply with the requirements of this technical specification and references stated below.

As a general guideline, in case of conflicting requirements between this technical specification and other cited references, the most stringent shall prevail. If necessary the PACKAGER/MANUFACTURER may revert to PETROBRAS for clarification.

2.1 CLASSIFICATION

PACKAGER/MANUFACTURER shall perform the work in accordance with the requirements of Classification Society. PACKAGER/MANUFACTURER is responsible for submitting to the Classification Society all documentation in compliance with stated Rules.

2.2 CODES AND STANDARDS

The latest editions of the following codes and standards shall be used as design guidelines.

API Specification 12F Specification for Shop-Welded Tanks for Storage of Production Liquids
API STD 2000 Venting Atmospheric and Low-Pressure Storage Tanks
API RP 14 C Analysis, Design, Installation and Testing of Safety Systems for Offshore Production Facilities
API RP 14 E Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems
API RP 14 FZ Recommended Practice for Design, Installation and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class 1, Zone 0, Zone 1 and 2 Locations
API RP 14 J Recommended Practice for Design and Hazard Analysis for Offshore Production Facilities
### CHEMICAL INJECTION UNITS

<table>
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<tr>
<th>Standard</th>
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<tr>
<td>API RP 505</td>
<td>Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1 and Zone 2</td>
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<td>API STD 674</td>
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<td>API STD 675</td>
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<td>ASME B16.5</td>
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<td>ASME BPVC Section IX</td>
<td>Boiler and Pressure Vessel Code: Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators</td>
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<td>ASME BPVC Section V</td>
<td>Boiler and Pressure Vessel Code: Nondestructive Examination</td>
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<td>ASME BPVC Section VIII-1</td>
<td>Boiler and Pressure Vessel Code. Rules for Construction of Pressure Vessels</td>
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<tr>
<td>ASTM F 1940-07A</td>
<td>Standard Test Method for Process Control Verification to Prevent Hydrogen Embrittlement in Plated or Coated Fasteners</td>
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<td>AWS D1.1</td>
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<tr>
<td>HI</td>
<td>Hydraulic Institute Standard</td>
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<tr>
<td>IEC 60092-502</td>
<td>Electrical Installation in Ships – Tankers – Special Features</td>
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<td>IEC 60529</td>
<td>Degrees of Protection Provided by Enclosures (IP Code)</td>
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<tr>
<td>IEC 61892-3</td>
<td>Mobile and Fixed Offshore Units – Eletrical Installations – Part 3: Equipment</td>
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<td>IEC 61892-6</td>
<td>Mobile and Fixed Offshore Units – Electrical Installations – Part 6: Installation</td>
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<td>IEC 61892-7</td>
<td>Mobile and Fixed Offshore Units – Electrical installations – Part 7; Hazardous areas</td>
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<tr>
<td>IEC 60034</td>
<td>Rotating Electrical Machines – all parts</td>
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<tr>
<td>ISA</td>
<td>Handbook of Control Valves, Chapter 7 - Control Valve Noise, Part 2, Universal Valve Noise Prediction Method - 1998</td>
</tr>
<tr>
<td>ISO 13702</td>
<td>Petroleum and natural gas industries - Control and Mitigation of Fires and Explosions on Offshore Production Installations – Requirements and Guide lines</td>
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<tr>
<td>ISO 15156</td>
<td>Petroleum and natural gas industries - Materials for Use in H₂S-Containing Environments in Oil and Gas Production – all parts</td>
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### 2.3 BRAZILIAN GOVERNMENT REGULATION

<table>
<thead>
<tr>
<th>NR</th>
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<tr>
<td>10</td>
<td>Segurança em Instalações e Serviços em Eletricidade (Safety in Electrical Facilities and Services)</td>
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<tr>
<td>13</td>
<td>Caldeiras e Vasos de Pressão (Boilers and Pressure Vessels)</td>
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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
- DR-ENGP-M-I-1.3 SAFETY ENGINEERING
- 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-DE-3010.1M-1200-942-P4X-002 GENERAL ARRANGEMENT
- I-DE-3010.1M-1261-944-P4X-001 PIPING AND INSTRUMENT DIAGRAM – OIL & GAS CHEMICAL INJECTION – HYDRATE INHIBITOR
- I-DE-3010.1M-1261-944-P4X-002 PIPING AND INSTRUMENT DIAGRAM – OIL & GAS CHEMICAL INJECTION – HYDRATE INHIBITOR
- I-DE-3010.1M-1261-944-P4X-003 PIPING AND INSTRUMENT DIAGRAM – OIL & GAS CHEMICAL INJECTION – DEFOAMER
- I-DE-3010.1M-1261-944-P4X-004 PIPING AND INSTRUMENT DIAGRAM – OIL & GAS CHEMICAL INJECTION – SCALE INHIBITOR (SUBSEA)
- I-DE-3010.1M-1261-944-P4X-005 PIPING AND INSTRUMENT DIAGRAM – OIL & GAS CHEMICAL INJECTION – SCALE INHIBITOR (TOPSIDES)
- I-DE-3010.1M-1261-944-P4X-007 PIPING AND INSTRUMENT DIAGRAM – OIL & GAS CHEMICAL INJECTION – WAX INHIBITOR
- I-DE-3010.1M-1261-944-P4X-008 PIPING AND INSTRUMENT DIAGRAM – OIL & GAS CHEMICAL INJECTION – H2S SCAVENGER
- I-DE-3010.1M-1261-944-P4X-010 PIPING AND INSTRUMENT DIAGRAM - OIL & GAS CHEMICAL INJECTION – GAS CORROSION INHIBITOR
| I-DE-3010.1M-1261-944-P4X-011 | PIPING AND INSTRUMENT DIAGRAM - OIL & GAS CHEMICAL INJECTION - SCALE INHIBITOR (SUBSEA) |
| I-DE-3010.1M-1262-944-P4X-001 | PIPING AND INSTRUMENT DIAGRAM – PRODUCED WATER CHEMICAL INJECTION – INVERTED EMULSION INHIBITOR |
| I-DE-3010.1M-1262-944-P4X-002 | PIPING AND INSTRUMENT DIAGRAM – PRODUCED WATER CHEMICAL INJECTION – SCALE INHIBITOR |
| I-DE-3010.1M-1262-944-P4X-003 | PIPING AND INSTRUMENT DIAGRAM – PRODUCED WATER CHEMICAL INJECTION - BIOCIDE/ BIOSTATIC |
| I-DE-3010.1M-1263-944-P4X-001 | PIPING AND INSTRUMENT DIAGRAM – INJECTION WATER CHEMICAL INJECTION – OXYGEN SCAVENGER |
| I-DE-3010.1M-1263-944-P4X-002 | PIPING AND INSTRUMENT DIAGRAM – INJECTION WATER CHEMICAL INJECTION - BIODISPERSANT/BIOCIDE |
| I-DE-3010.1M-1263-944-P4X-003 | PIPING AND INSTRUMENT DIAGRAM – INJECTION WATER CHEMICAL INJECTION – SCALE INHIBITOR |
| I-DE-3010.1M-1425-942-P4X-001 | M-14 – CHEMICAL UNITS AND PRODUCTS STORAGE – EQUIPMENT LAYOUT PLAN |
| I-DE-3010.1M-5400-94A-P4X-001 | AREA CLASSIFICATION – GENERAL |
| I-ET-3000.00-1200-940-P4X-001 | TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN |
| I-ET-3010.00-1200-955-P4X-001 | BOLT MATERIALS |
| I-ET-3010.00-1200-955-P4X-002 | REQUIREMENTS FOR WELDING INSPECTION |
| I-ET-3010.00-1200-956-P4X-002 | GENERAL PAINTING |
| I-ET-3010.00-5140-700-P4X-002 | SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS |
| I-ET-3010.00-5140-700-P4X-003 | ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS |
| I-ET-3010.00-5140-712-P4X-001 | LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS |
| I-ET-3010.00-5140-797-P4X-001 | ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE |
| I-ET-3010.00-5400-947-P4X-002 | SAFETY SIGNALLING |
| I-ET-3010.1M-1200-300-P4X-001 | NOISE CONTROL REQUIREMENTS FOR TOPSIDE |
3 DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

May: indicates a course of action that is permissible within the limits of the standard (a permission).

Shall: an absolute requirement which shall be followed strictly in order to conform to the standard.

Manufacturer: Company responsible for the fabrication of equipment or components internal to the Package.

Package Unit or Package: is defined as an assembly of equipment supplied interconnected, tested and operating, requiring only the available utilities from the FPSO for the Package operation.

Packager: is defined as the responsible for project, assembly, construction, fabrication, test and furnishing of the Package.

Manufacturer: is defined as the responsible by fabrication of equipment or components internal to the Package.

3.2 ABBREVIATIONS

CS: Classification Society
FPSO: Floating Production, Storage and Offloading (vessels)
ITP: Inspection and Test Plan
ITR: Inspection and Test Record
NDT: Nondestructive Testing
NPSHA:  Net Positive Suction Head Available  
NPSHR:  Net Positive Suction Head Required  
SS: Stainless Steel

4 GENERAL REQUIREMENTS

4.1 OPERATION ENVIRONMENT

The equipment shall be suitable for the environment and range of ambient conditions, including, atmospheric pressure, relative humidity, rainfall, dry-bulb air temperature (see Note), characteristic monthly values and wind motions defined in I-ET-3A36.00-1000-941-PPC-001_D - METOCEAN DATA.

Note: For dry bulb air temperature of electrical equipment, use the most critical conditions, among those defined by CS and the specific equipment documentation.

4.2 MOTION REQUIREMENTS

Refer to I-RL-3010.1M-1350-960-P4X-009 – MOTION ANALYSIS.

4.3 DESIGN CONDITIONS

PACKAGER/ MANUFACTURER shall design the equipment for the full range of process conditions as specified in the following Process Data Sheets:

4.3.1 Tanks:
- I-FD-3010.1M-1261-510-P4X-001 OIL AND GAS CHEMICAL INJECTION UNIT – TANKS - M-14
- I-FD-3010.1M-1262-510-P4X-001 PRODUCED WATER CHEMICAL INJECTION UNIT – TANKS - M14
- I-FD-3010.1M-1263-510-P4X-001 INJECTION WATER CHEMICAL INJECTION UNIT – TANKS- M-14

4.3.2 Pumps:
- I-FD-3010.1M-1261-310-P4X-001 OIL AND GAS CHEMICAL INJECTION UNIT – PUMPS- M-14
- I-FD-3010.1M-1262-310-P4X-001 PRODUCED WATER CHEMICAL INJECTION UNIT – PUMPS - M-14
- I-FD-3010.1M-1263-310-P4X-001 INJECTION WATER CHEMICAL INJECTION UNIT – PUMPS - M-14

4.4 EQUIPMENT LOCATION

Refer to I-DE-3010.1M-5400-94A-P4X-001 – AREA CLASSIFICATION – GENERAL to check the respective equipment classification.
4.5 DESIGN LOADS

In addition to Code-described loads and loads due to FPSO motions defined in I-RL-3010.1M-1350-960-P4X-009 MOTION ANALYSIS, the following loads must be considered where relevant:

- Equipment transportation and erection loads;
- Nozzle loads;
- Thermal loads;
- Wind loads (see ET Metocean Data);
- Self weight loads.

4.6 DESIGN LIFETIME

PACKAGER/ MANUFACTURER shall design and fabricate the complete equipment for a minimum service life of 25 years.

4.7 NOISE

Noise control analysis is a mandatory item to be carried out, according to I-ET-3010.1M-1200-300-P4X-001 NOISE CONTROL REQUIREMENTS FOR TOPSIDE.

MANUFACTURER/ PACKAGER shall fill in the attached Forms I and II and submit them to PETROBRAS approval.

5 EQUIPMENT SPECIFICATION

PACKAGER shall be responsible for supplying complete and fully operative items in accordance with the requirements of this specification and the referenced standards and specifications.

English language shall be used for all design and engineering documents, for drawings and for communication with Purchaser.

5.1 SCOPE OF SUPPLY

Items 5.1.1 and 5.1.2 indicate the specific materials and components for tanks and pumps respectively, and 5.1.3 includes general items, common to all equipment within the supply scope.

5.1.1 Tanks

Tanks shall be designed according to I-ET-3010.00-1200-510-P4X-001 METALLIC TANKS DESIGN FOR TOPSIDE.

Tank sizes and quantities shall be in accordance with Process Data Sheets (see 4.3.1).

The scope of supply for all tanks shall include, but not necessarily be limited to the following:

- Nozzle connections;
- Drip pan connections;
- Baffles;
- Manholes;
- Local level indicators (stand pipe type), level transmitters and all required instrumentation;
• Platforms and ladders;
• All necessary clips;

Materials shall be suitable for each fluid handled, such as stainless steel (AISI 316L) or duplex stainless steel (UNS S32750/32760). For corrosion inhibitor tanks stainless steel shall be used.

5.1.2 Pumps

The scope of supply shall include, but not necessarily be limited to the following:

• Pumps and drivers as specified on data sheets (see 4.3.2) I-ET-3010.1M-1200-310-P4X-002 POSITIVE DISPLACEMENT PUMPS SPECIFICATION.
• All electrical equipment including electric motors, grounding system and cable trays within the skid. Cable glands, junction boxes and all other miscellaneous items as required shall be provided, but excluding incoming electrical cables for electrical motors. Note: starters for electric motors shall be installed in platform panels, provided by others, not included in PACKAGER’s scope of supply.
• Suction and discharge pulsation dampeners, complete with overpressure protection (if required);
• Y-type strainers, isolation valves and drain valves on all pumps suction lines;
• Filters, check valves and stop valves on all pumps discharge;
• Calibration pots;
• Pressure safety valves;
• Manometers on each pump head discharge;
• Pressure transmitters, isolation valves, flowmeters/transmitters, if necessary;
• The pumps shall follow API 675 (Controlled Volume Positive Displacement Pumps)

5.1.3 Structure, Piping and General Items

• Skids with drip pans, lifting lugs, earthing lugs and flanged drains with valves;
• Earthing bosses and grounding devices;
• Lifting lugs;
• Maintenance lifting beams and hoists;
• All structural calculations;
• Painting;
• AISI 316 SS nameplates in Portuguese;
• All interconnection piping between tanks and pumps;
• Manual valves;
• All raw materials;
• Certification by CS;
• Hazardous area certificates;
• Classification according to NR-13, where applicable;
• Consumables and special tools for assembly, disassembly, maintenance, commissioning and start up;
• Drawings, documents and manuals for all items;
• Installation, operation and maintenance manuals in Portuguese;
• Data books;
• Inspection, testing and quality assurance;
• Commissioning supervision at job site;
• NDT examination, if applicable;
• Safety signaling in Portuguese, if applicable;
• Spare parts recommended by CS;
• Spare parts recommended for commissioning, pre-operation and start up;
• NR-13 test spare parts;
• Training, if applicable;
• Technical assistance with unit price for working and standby hours and mobilization/demobilization;
• Packing, protection and marking for shipment;
• Preservation, including equipment handling conditioning and storage at job site;
• Total process and mechanical guarantee.

Remarks:
• Detailed drawings and description of the operation of instrumentation and controls, as well as the makes, materials and types of auxiliary equipment shall be provided. The PACKAGER/ MANUFACTURER shall provide a description of the alarm and shutdown facilities to be provided.
• The operation manuals shall contain, in addition to all necessary installation, operating and maintenance information, updated “as supplied” revision of data sheets.
• All information to be provided shall be clear. Manuals for operation and maintenance shall apply specifically to the units installed. Packager is fully responsible for the contents of all Data sheets and documentation.
• Dedicated NR13 file complete with all applicable documentation and certification to prove NR13 compliance (if applicable).
• Cross-sectional drawings shall be provided with the spare parts list, where applicable.

5.2 MECHANICAL AND PIPING

5.2.1 General
The Chemical Injection Units, including all ancillary equipment, shall be assembled to the maximum extent possible, aligned and pre-checked at the MANUFACTURER’s shop, allowing shipment to the installation site with minimal fieldwork.

Ladders and/ or stairs and platforms shall be installed on all operation and maintenance areas (e.g. valves, instruments, etc.) elevated more than 1.75 m above the skid base plate.

All materials for pumps, tanks, piping and accessories shall be suitable for the fluid handled, such as stainless steel (AISI 316) or duplex stainless steel (UNS S 32750/ 32760).

For bolt materials refer to I-ET-3010.00-1200-251-P4X-001 BOLT MATERIALS.

All pressure vessels shall comply with the requirements of NR 13, whenever applicable.

Utilities available on board the FPSO to support the operation of the package are defined in I-RL- GENERAL SPECIFICATION FOR AVAILABLE UTILITIES.

5.2.2 Pumps
Pumps shall be provided with all instrumentation, piping and valves as defined in the reference documents.
PACKAGER/ MANUFACTURER shall select the pumps based on NPSH<sub>R</sub> x NPSH<sub>A</sub>. The safety aspect of chemicals segregation must be taken into account.

All piping shall be routed and terminated with flanges for isolation and maintenance purposes at the skid edge, unless otherwise agreed by PETROBRAS.

All valves, controls and other equipment shall be completely piped and accessible.

Pumps shall be selected well within PACKAGER/ MANUFACTURER actual field experience.

The pumps shall be mounted on a common skid, providing clearance for safety and maintenance.

Metering pumps shall have manual continuous stroke adjustment from 0 to 100%, while in operation.

Unless otherwise specified, double diaphragm pumps shall be provided with means for detecting diaphragm failure. A tapped hole shall be provided for either a conductivity probe in the intermediate fluid or a pressure type detector between diaphragms in a dry design. If the probe detector is not specified, a threaded plug shall be factory installed in the tapped hole.

Couplings shall be in accordance with the respective Pump Data Sheets.

Coupling guards, where applicable, shall be of non-sparking material.

5.2.3 Drivers
The starters for all motors shall be direct on-line start type.

5.2.4 Pulsation Supression Devices
Discharge pulsation bottles shall be provided for all metering pumps.

Pulsation in the liquid flow at the pump suction and discharge shall not exceed ~1.5% of the respective manifold operating pressure.

Full technical data, calculation and drawings shall be provided as part of the document package.

PACKAGER/ MANUFACTURER shall perform a piping analog study for the suction and discharge piping, in order:

- To estimate the pressure pulsation at the pump suction nozzle, upstream and downstream the suction pulsation dampener;
- To verify that no resonance of the fluid occurs at the pump suction and discharge.

5.2.5 Relief Valves
A pressure relief valve shall be provided to protect each pump and its associated piping system.

Relief valves shall be balanced bellow type, supplied as loose items (relief valves integrated to pump casing are not accepted).

5.2.6 Tanks
Tank bottom shall have a slope of 5% towards the pump suction.
Bottom floor drip pan shall be designed to avoid accumulation of liquid spills. Drip pan connections shall be at the skid edge, 2” minimum, provided with blind flange.

Rungs, if required, shall be provided for access to the tanks close to the manholes.

Tanks shall be fitted with baffles or similar devices to restrict fluid sloshing motions.

5.2.7 Skid

For skid mounted equipment, the skid shall be designed to accommodate the entire equipment within the scope of supply. The skid shall be of rigid construction, which will not distort during hoisting, shipment and operation, and shall withstand all moments and forces due to the vessel motion.

Lifting facilities shall enable lifting of the equipment with crane as a single point lift for transportation and installation. The design and manufacture of the lifting lugs shall be certified. The arrangement of equipment, piping and superstructure shall be such that the centre of gravity coincides approximately with the geometrical centre of the skid. When lifting the skids, complete with all equipment mounted, beam deflection shall not exceed 1/400 L.

The skid shall resist all sling forces, including both horizontal and vertical components of the applied sling angle (sling angles shall be within between 50 and 90° with the horizontal plane).

Lifting beams, spreader bars, slings, shackles etc. are within PACKAGER’s scope of supply.

Drip trays with drain connections shall be provided underneath equipment where significant spillage is likely to occur.

The skid shall be welded to the supporting structures.

The floor shall be made of plate material with a raised on-slip tread.

Welds underneath skid beams shall be ground flush.

Skid shall have 2 diagonally opposed earthing bosses.

Welding shall be carried out with procedures and operators qualified in accordance with ASME section IX. Welding shall not be performed before qualified welding procedure etc. is approved. Intermittent fillet welds are not permitted.

5.2.8 Maintenance and Mechanical Handling

Withdrawal spaces and clearances shall be provided for all removable vessel/pipe internals (e.g. filters/membranes). Suitable lifting facilities shall be in place to allow filter cleaning/replacement.

PACKAGER/MANUFACTURER shall ensure by means of a mechanical handling survey, that the maintenance envelopes required by the full displacement of the loaded lifting beam hoists are kept clear, and are not impinged upon or traversed across by pipes, cables or any other fixed items.

All required maintenance lifting beams, complete with the necessary hoisting and lifting gear, shall be provided to enable safe and easy maintenance. Lifting beams shall overhang by at least 1.2 m into agreed laydown areas.
The deflection of the maintenance crane/hoisting beams shall not exceed 1/500 of the span length.

All beams and lifting gear shall be subject to load testing, witnessed by PETROBRAS representative and CS.

5.2.9 Piping

5.2.9.1 General

All interconnecting piping shall comply with the requirements of ASME B31.3.

All skid piping within the limits of supply shall be fabricated and terminated at the baseplate edge by means of valves and/or flanges and blind flanges according to ASME B16.5.

The flanges shall be flush with the transverse ends of the skid having a uniform B.O.P. (Bottom of Pipe) at as low as practical an elevation. This shall be shown on PACKAGER/MANUFACTURER’s P&ID’s and General Arrangement drawings. All tubing for the off-skid interfaces shall be terminated at the skid by means of compression fitting valves.

All piping shall be rigidly supported for service and shipment; supports on the module plates shall not be accepted without under-deck stiffening. Supporting and installation shall enable piping removal without disturbing structural members.

Fabricated branch weld connections (fittings, couplings etc.) shall be directly joined to the header with full penetration welds, where applicable.

After completion of fabrication etc., all fabricated pipe spools shall be internally and externally cleaned to remove all loose scale, weld spatter, sand and other foreign materials.

PACKAGER/MANUFACTURER shall check and approve all piping with respect to stresses, vibration and layout. Anchor points shall be provided at skid edge.

5.2.9.2 Drainage

All drain lines shall be routed through the deck to a common drain header, terminated at one flange 300 mm below the pancake level at the skid edge, for connection to PETROBRAS overboard drain system.

Drain pipes shall have continuous slope, with no low point traps, toward the end point. Connections into the drain header shall be entering from the top.

All drain lines shall be rigid and provided with means to prevent vacuum conditions in the line.

5.2.9.3 Valves

Valves shall preferably be positioned with their stem pointing upwards and located in such way that the hand wheel or stem will not obstruct walkways. Where hand operated valves are not easily operable, gear operated valves shall be used.

5.3 ELECTRICAL

Electrical equipment and material shall comply with I-ET-3010.00-5140-700-P4X-001 SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

Electric motors shall comply with I-ET-3010.00-5140-712-P4X-001 LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS.
Electrical installations inside the package and the voltages to be supplied for electrical loads (motors, heaters, control panels etc.) shall comply with I-ET-3010.00-5140-700-P4X-003 ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS and I-DE-3010.00-5140-700-P4X-003 – GROUNDING INSTALLATION TYPICAL DETAILS.

The electrical interfaces of the package shall comply with I-DE-3010.00-5140-797-P4X-001-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIAGRAM and I-ET-3010.00-5140-797-P4X-001-ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.

The application of electrical equipment, instruments and accessories on hazardous areas shall follow the requirements of IEC series 60079, 61892-6 and 61892-7, as well as have their conformity certificates according to INMETRO Portaria 179, May 18th 2010 and INMETRO Portaria 89, Feb 23rd 2012 and approved by Classification Society.

Electrical equipment and accessories installed in external safe or hazardous areas, which shall be kept operating during emergency shutdown ESD-3P or ESD-3T shall be certified for installation in hazardous areas Zone 1 Group IIA temperature T3 (IEC 61892-7).

Equipment, accessories, piping and structures shall be grounded according to IEC 61892-6 and 60092-502. For installations in hazardous area, the grounding requirements of IEC 61892-7 shall also be met.

5.4 INSTRUMENTATION

Pumps shall be fitted with all instrumentation required for safe and reliable unattended operation.

Tanks shall be provided with local level indicators, level transmitters and other instruments required for operation and monitoring, in accordance with the respective process data sheets, P&IDs and I-ET-3010.1M-1200-800-P4X-005 – FIELD INSTRUMENTATION.

Level, temperature, pressure and any other instrument cabling shall be led to the package limits in order to make the signals available for connection with the FPSO automation and monitoring systems.

For Package type classification of the Chemical Injection Units, refer to I-MD-3010.1M-5520-800-P4X-001 - AUTOMATION AND CONTROL SYSTEM FUNCTIONS - TOPSIDES. For package requirements, refer to I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGED UNITS. Units start, stop, control, automation and safety shall be designed an implemented in accordance with the respective package classification, as described in detail in the document referred above.

Instruments shall not be mounted on the skid frame.

Control and safeguarding instrumentation shall be segregated according to reference documents.

All instruments shall be provided with process isolation valves, vent and drain valves as applicable.

5.5 PAINTING

Paint system for external coating shall be according to I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING.

Color code shall comply with DR-ENGP-I-1.15 – COLOR CODING
5.6 SAFETY

5.6.1 Piping

The use of couplings in pipes with flammable liquids between FPSO decks and Process Plant shall be minimized to reduce the risk of pool fire. The use of couplings in gas lines shall be minimized.

SDVs shall be installed in locations where they are not affected by fire originating in other areas.

6 NAMEPLATES, TAGGING AND SAFETY SIGNS

PACKAGER/ MANUFACTURER shall attach corrosion resistant SS 316 nameplates on each item of equipment in an accessible location, fastened with corrosion resistant pins, in Portuguese.

Nameplates for tanks shall be according to I-ET-3010.00-1200-510-P4X-001 METALLIC TANKS DESIGN FOR TOPSIDE.

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

- Service;
- Tag number;
- Manufacturer and year of build;
- Manufacturer’s serial number;
- Main data for design, operation and testing (Power, Pressure, Volume, Temperature, Rotation, Flow rate), where applicable;
- Driver power rating and speed, where applicable;
- Design code;
- Empty, operation and test weight.
- Specific requirements;

Tagging of all mechanical, electrical and piping items, shall be according to I-ET-3000.00-1200-940-P4X-001 - TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN. The main items shall have individual tag numbers as dictated by PETROBRAS.

All safety signs shall be in Portuguese.

7 CERTIFICATION REQUIREMENTS

7.1 GENERAL

PACKAGER/ MANUFACTURER shall be responsible for all required certification of the equipment.

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.

For pressure containing parts of equipment and main components, PACKAGER/ MANUFACTURER shall attest material properties and chemical composition by means of appropriate certificates.
7.2 **CLASS CERTIFICATION**
For Tanks and Pumps, a CS Certificate of compliance with Rules requirements shall be supplied.

**8  INSPECTION, TESTING AND COMMISSIONING**

**8.1 GENERAL**
PACKAGER shall submit an inspection and testing program of all supplied equipment to Purchaser’s approval, prior to work start in accordance with document schedule.

Unless otherwise stated, all inspections and tests shall be performed at the workshop of PACKAGER/ MANUFACTURER in the presence of PETROBRAS representative and CS surveyor as applicable.

Inspections and tests are an integral part of the order which will not be considered complete until such inspections and tests have been carried out in full. Purchaser shall issue an Inspection Release Certificate (IRC) after completion of these inspections and tests only.

**8.2 INSPECTION**
PACKAGER shall submit an ITP with the bid.

PETROBRAS shall identify all the required witnessed inspections on a marked up copy of the ITP.

PETROBRAS reserve the right to inspect the package equipment anytime during fabrication to ensure that material and workmanship are in accordance with this specification.

PACKAGER shall ensure that all the witnessed inspection requirements by CS are met and due notice is given. The notification period for such inspections shall be mutually agreed upon during the kick-off meeting.

PACKAGER/ MANUFACTURER shall provide notice in advance to the surveyor to witness the specified tests at least 2 (two) weeks for Brazilian PACKAGERS/ MANUFACTURERS/ Sub-Suppliers and 3 (three) weeks for foreign PACKAGERS/ MANUFACTURERS/ Sub-Suppliers.

**8.3 HYDROSTATIC TESTING**
All applicable equipment shall be hydrostatically tested in the presence of PETROBRAS surveyors, including:

- All tanks;
- All fabricated retaining pipework to ASME B31.3.
- All pumps as per relevant API codes.

All piping systems shall be drained of water and dried after hydrostatic testing.

**8.4 NDT EXAMINATION**
Final NDT examinations, for acceptance purposes, shall be carried out after completion of any post weld heat treatment (when applicable) and before painting, hydrostatic testing etc.
8.5 **ELECTRICAL**
Testing shall be witnessed by PETROBRAS surveyors and shall include a Megger test for cables and electric motors, and all tests in accordance with the reference standards and documents.

8.6 **INSTRUMENTATION**
Testing shall be witnessed by PETROBRAS surveyors and shall include at least:
- Hydrostatic test (valves)
- Running test (actuators)
- Review of calibration certificate (PSVs).

8.7 **EQUIPMENT INSPECTION**
Unless waived by PETROBRAS, the following inspections and checks shall be witnessed by PETROBRAS surveyors:
- Verification of materials of construction of the package units (vessels, tanks, pumps, etc.) for conformity with the requirements of the specification;
- Verification that piping, fittings and valves conform to specification of materials and fabrication;
- Radiographic, dye penetrant, magnetic particles, ultrasonic inspection of welds on the pressure retaining parts of the equipment;
- Approval of the relief valve settings and witness of their testing after setting;
- Review of ITR’s;
- A visual check of the assemblies package noting:
  - That the thickness of pressure retaining parts meets or exceeds the quoted design thickness;
  - Any repairs;
  - Dry-film thickness quoted;
  - General appearance, materials, workmanship and surface finish standard are acceptable;
  - Dimensional check: Alignment to be demonstrated.

8.8 **FACTORY ACCEPTANCE TESTS (FAT)**
The following tests shall be included in PACKAGER/ MANUFACTURER scope:
- Pumps running tests;
- Hydrotest of all tanks and piping;
- Electrical continuity checks on all wiring and earthing;
- Functional checks on all instruments and valves.

PACKAGER/ MANUFACTURER shall prepare an FAT for the package and submit it to PETROBRAS approval.

FAT will be witnessed by PETROBRAS representatives. PACKAGER shall advise PETROBRAS of the test schedule at least two (2) weeks for Brazilian Manufacturer/Sub-Suppliers and 3 (three) weeks for foreign Manufacturer/Sub-Suppliers before the scheduled test dates. PACKAGER shall invite CLASS surveyor for FAT.
Acceptance of the FAT will not be considered as the final acceptance test of the package unit.

8.9 ASSEMBLY ASSISTANCE AND COMMISSIONING REQUIREMENTS

PACKAGER is responsible for assembly supervision of the equipment, including assembly of components to be delivered loose (for example, some tanks’ internals etc.).

PACKAGER shall be responsible for pre-commissioning and commissioning supervision of the equipment supplied. Final acceptance will be on satisfactory completion of commissioning tests as specified by the Purchaser.

9 MATERIALS

9.1 GENERAL

The repair and defects in pressure-containing castings by peening or burning-in or by impregnation with other compounds is not allowed.

Repair by welding or by plugging shall be undertaken only when permitted by the material specification and shall only be applied with the procedures specified.

After weld repair, castings shall be heat treated, if specified in the material specification. A major weld repair shall always be followed by heat treatment.

Details of all major weld repairs and the heat treatment shall be recorded and reported to PETROBRAS.

The use of asbestos or materials containing asbestos is prohibited.

9.2 MATERIAL CERTIFICATION

In order to ensure that the materials of construction are in accordance with data sheets, all certificates shall contain the following information:

- Name of manufacturer
- Purchase order number and issue date
- Identification number of certificate and issue date
- Material specification(s)
- Material charge, batch or heat number
- Mechanical properties recorded from test results
- NDT methods and results
- Heat treatment procedure

10 PREPARATION FOR SHIPMENT

10.1 MARKING

All items supplied according to this specification shall be marked for identification against a certificate or relevant test documentation. Marking shall be such that it will not damage or impair the component. Items that cannot be identified shall be rejected. Rejected items may be re-certified by carrying out all relevant testing, with prior approval of PETROBRAS.

As a minimum, the following identification shall be provided:

- Project Number
• Manufacturer’s name
• Purchase Order Number
• Shipping Weight
• Item Number
• CS surveyor’s stamp

10.2 PACKING
The equipment shall be supplied tested, flushed, preserved and protected from corrosion.
The equipment preparation shall be suitable for 24 months outdoor storage from the time of shipment.
Packaging design shall be submitted to PETROBRAS for approval. Equipment shall be packed in accordance with the packaging requirements of the country which the equipment is being shipped to.
PACKAGER shall provide the procedures for unpacking, handling and installation, as well as repacking and long-term storage requirements.
PACKAGER shall specify any limitations applicable to the transportation and installation phase.

11 PACKAGER/ MANUFACTURER RESPONSIBILITY
PACKAGER shall assume sole contractual and total engineering responsibility for the package equipment. PACKAGER responsibility shall include, but is not limited to:
• Technical responsibility for the entire scope of supply.
• Resolving all engineering questions and/ or problems relating to design and manufacturing.
• All coordination with manufacturers and collection of all details, drawings, calculations, and data to achieve optimum design and full submission of the documents requested in the specification.
• Providing details as requested of any sub-vendors relating to design and manufacturing.
• To submit to the certifying authority the documentation as described in the latest edition of their rules for equipment on offshore facilities.
• Installation at site by others (however, presence of supervision will be required).
• Pre-Commissioning, Commissioning & Training Operations.

Any exclusion and/or alternative to what is specified in this Technical Specification, including the use of the PACKAGER/MANUFACTURER’s standard and exclusive technology, shall be presented in a Deviation List, subject to PETROBRAS acceptance during the clarification phase, preceding the proposal presentation. Otherwise the requirements herein will be considered as “Agreed”, and so required.
The Deviation List mentioned above shall contain, at least, for each requirement that the PACKAGER/ MANUFACTURER intends to change:
• The document description, code and section that contains the requirement;
• The PACKAGER/MANUFACTURER proposal;
• The reason for deviation, and the costs, schedule and technical benefits/impacts of the change;
# 12 WEIGHT CONTROL

PACKAGER shall fill in the following attachment.

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## NOTES

**General:**
- Vendor shall fill in all blank spaces in the weight control data sheet (fields and check boxes). All missing information will be considered as not applicable or not according to vendor’s proposal.
- Vendor shall fill in data sheets for main and auxiliary equipment, furnished separately or on different skids. If necessary, manufacturer shall produce additional copies of the weight control data sheet.

**Weight data:**
- Accuracy of weight figures shall be ± 10% in the proposal phase. After placing of the purchase order, the accuracy shall be refined to ± 3%.

**Dimensional data:**
- Manufacturer shall indicate equipment orientation.
- Any variation in center of gravity from dry to operating mode shall be noted.
- Manufacturer shall indicate with dashed lines on sketch and respective dimensions on the information table all maintenance areas required for assembly and disassembly of equipment.
- Accuracy of dimensions shall be ± 10% in the proposal phase. After placing of the purchase order, the accuracy shall be refined to ± 3%.