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INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	Based on I-ET-3000.00-1500-276-P6B-001 rev. 0
A	Revised in order to verify accordance to law 13.303
B	General Revision
C	Revised to update the information security policy from NP-1 to PUBLIC

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	10/07/2018	30/11/2018	12/08/2019	11/11/2021					
DESIGN	EECE	EECE	EECE/EES	EECE/EES					
EXECUTION	UPLW	BERL	BERL	UT6N					
CHECK	CTT7	UPLW	UT6N	C5DR					
APPROVAL	CXF0	CXF0	UP65	T5B2					

CONTENTS

1. INTRODUCTION

1.1. SCOPE

1.1.1. This specification is based on guidelines requirements by the international standard API RP 17R, ISO 13628-15 and ISO 13628-4. Its purpose is to complement, reaffirm, clarify and modify specific requirements of these codes related to subsea connector systems to be applied to Vertical Diverless Rigid Spool, setting out uniform details of normative requirements, enough to standardize understandings between Petrobras, Contractors and Suppliers, as well as to provide specific data to allow the system to be applied.

1.2. APPLICABILITY

1.2.1. This specification applies to subsea connector systems used in subsea end-connections to rigid pipelines with monobore, Vertical Diverless Rigid Spools.

1.2.2. The basic connector systems components, which are within the scope of this Technical Specification, are:

1. Connector Module (CM)
   a. Outboard hub
   b. Subsea connector
   c. Soft landing system
   d. Pup piece
   e. ROV intervention panel
   f. Back seal test circuit
2. Inboard hub
3. Guide system
4. Seal system
5. Tooling
   a. Connection tool
   b. Pull-in tool
   c. Ring gasket replacement tool
   d. Inboard hub cleaning tool
6. Bases
   a. Transportation skid
   b. Test base
7. Caps
   a. Block cap
   b. Pressure cap
   c. Protection cap
   d. Low pressure cap

NOTE: All definitions are described in item 2.2 herein.

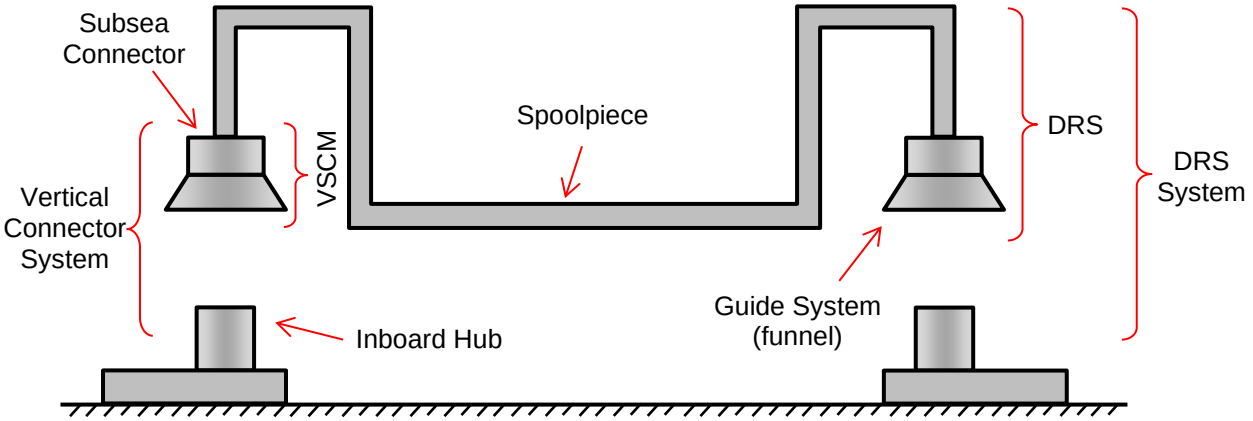

Figure 1: Typical VSCM

2. TERMS AND DEFINITIONS

2.1. VERBAL FORMS

2.1.1. Following verbal forms are used throughout this document:

Shall	Mandatory requirement
Should	Preferred requirement
May	A permissible course of action
Must not	Prohibited requirement

2.2. DEFINITIONS

2.2.1. All terms defined in ISO 13628 parts 1, 4 and 15 apply, in addition to the following:

2.2.2. **Back Seal Test Circuit**
Hydraulic circuit that allows testing the seal integrity without applying pressure to the equipment bore.

2.2.3. **Connector Module (CM)**
It is the main component of the Subsea Connector System, attached to the end of the spoolpiece of the Diverless Rigid Spool. The CM is made up of a subsea connector, soft landing system, ROV panel and parts of the guide system.

This Technical Specification describes one type of Connector Module:

- Vertical Spool Connector Module (VSCM): applicable to vertical diverless rigid spools (Figure 1)

2.2.4. **Diverless**
Any operation performed with remote operated vehicle and/or tool, without assistance of diver.

2.2.5. **Diverless Rigid Spool (DRS)**
Comprises one rigid spoolpiece and two Connector Modules (one module at each end of the spoolpiece). Sometimes the DRS is denominated “spool” in this specification.

2.2.6. **Diverless Rigid Spool Vertical Connection System**
Diverless vertical connection system to tie-in the end of a rigid pipeline to a subsea structure or another rigid pipeline. Comprises one rigid spoolpiece, two Vertical Connector Systems and all other assistance devices required for fabrication and installation of the Diverless Rigid Spool. The Diverless Rigid Spool Vertical Connection System is also denominated Vertical Diverless Rigid Spool System (Vertical DRS System).

2.2.7. **Subsea Connector**
Component responsible for locking the CM to the inboard hub, as well as for energizing the ring gasket.

2.2.8. **Subsea Connector System**
System made up of a Connector Module (CM), inboard hub, sealing and guide systems used to connect rigid or flexible pipelines to subsea structures or to other rigid pipelines, including associated tools, bases and caps, needed for the fabrication, tests and installation of the DRS System.

2.2.9. **Funnel Down**
Component of the guide system shaped as a cone downwards, positioned at vertical Connector Modules.

2.2.10. **Funnel Up**
Component of the guide system shaped as a cone upwards positioned at the subsea structure.

2.2.11. **Guide System**
A system which purpose is to guide the CM during its landing into the inboard hub or landing base, providing the necessary alignment to allow full connection of the connector with the hub.

2.2.12. **Inboard Hub**
Component of the Subsea Connector System, resident at the subsea structure or termination base of a rigid pipeline to which the CM will be connected.

2.2.13. **Material Request (RM)**
Document issued by Petrobras to conduct the procurement of material. The RM stablishes technical requirements and additional instructions which are specific to a Project, including a list of references which shall be considered: Technical specifications, Drawings, Data Sheets, etc.

2.2.14. **Prototype**
Component or equipment piece manufactured on an individual basis in order to perform design qualification tests.

2.2.15. **Qualification**
Testing using a prototype or production unit, if appropriate, in order to verify that the design meets all premises, including product life cycle conditions (testing, installation, operation, intervention and decommission). PVT is also used to refer to qualification in this specification. See also “Validation”.

2.2.16. **ROV Panel**
Interface panel used for operation and intervention via ROV.

2.2.17. **Seal Plate**
Plate where the gaskets are mounted onto, allowing them to be handled concomitantly.

2.2.18. **Ring Gasket Replacement Tool**
Device operated by ROV used to replace the ring gasket.

2.2.19. **Seal System**
System used to stablish a leak tight sealing between the subsea connector and inboard hub. This system may be made up of a seal plate and gaskets.

2.2.20. **Pipelines**
Transport pipelines and production/service injection flowlines, rigid or flexible, installed on the seabed.

2.2.21. **Soft Landing System**
System that allows the final landing of vertical CMs to be smooth, preventing damages to the interfacing sealing elements between the subsea connector and the inboard hub.

2.2.22. **Spoolpiece**
Piping accurately fabricated with sections of rigid linepipes (straight sections and bends).

2.2.23. **Subsea Structure**
System made up of components to be installed underwater for use in subsea oil and gas production or transportation in offshore fields.

2.2.24. **Test Base**
Portable base provided with a hub that allows testing the CM locking mechanisms and the sealing system in the conditions forecasted for the installation (similar structural components and inclination when compared to the inboard hub of the subsea structure).

2.2.25. **Tools**
Any device or equipment piece used to install, lock, unlock, uninstall and test the CM.

2.2.26. **Transportation Skid**
Base used to transport the CM (onshore and offshore), protecting it against possible damages.

2.2.27. **Validation**
Confirmation that the operational requirements for a specific use or application have been fulfilled through the provision of objective evidence

NOTE: Typically, validation is achieved by qualification testing and/or system integration testing.

2.2.28. **Verification**
Confirmation that specified design requirements have been fulfilled, through the provision of objective evidence

NOTE: Typically, verification is achieved by calculations, design reviews, and hydrostatic testing.

2.3. ABBREVIATIONS

2.3.1. All abbreviations defined in ISO 13628 parts 1 and 4 applies, in additions to the following:

CM	Connector Module
CRA	Corrosion-Resistant Alloy
DN	Nominal Diameter
DRS	Diverless Rigid Spool
ET	Technical Specification
FAT	Factory Acceptance Test
LDA	Water Depth (“Lâmina D’Água”)
MDR	Master Document Register
MEG	Mono-Ethylene Glycol
PLSV	Pipe Laying Support Vessel
PSL	Product Specification Level

PVT	Performance Verification Test
RM	Material Request
SIT	System Integration Test
VSCM	Vertical Spool Connector Module

3. REFERENCES

The latest edition of the codes and specs below shall be adopted, unless otherwise stated.

3.1. CODES AND STANDARDS

Ref.	Designation	Title	Ed.	Year
1	API RP 17R	Recommended practice for flowline connectors and jumpers		
2	ISO 13628-4	Petroleum and natural gas industries – Design and operation of subsea production systems – Part 4: Subsea wellhead and tree equipment		
3	ISO 13628-15	Petroleum and natural gas industries – Design and operation of subsea production systems – Part 15: Subsea structures and manifolds		
4	ISO 13628-8	Petroleum and natural gas industries — Design and operation of subsea production systems — Part 8: ROV interfaces on subsea production systems		
5	ISO 13628-9	Petroleum and natural gas industries — Design and operation of subsea production systems — Part 9: Remotely operated tool (ROT) intervention system		
6	ISO 13628-1	Petroleum and natural gas industries — Design and operation of subsea production systems — Part 1: General requirements and recommendations		
7	ISO 10423	Petroleum and natural gas industries — Drilling and production equipment — Wellhead and christmas tree equipment		

3.2. TECHNICAL SPECIFICATIONS

Ref.	Designation	Rev.	Title
8	I-ET-3000.00-1500-24A-PEK-002		Test Requirements for Subsea Connector Systems for Diverless Rigid Spool
9	ET-3000.00-1500-610-PEK-002		Eslingas e Skids para Transporte de Equipamentos Submarinos
10	ET-3000.00-1521-610-PAZ-001		Projeto de Interfaces para Operações com ROV
11	ET-3000.00-1500-940-PEK-001		Projeto de Proteção Catódica para Equipamentos Submarinos

4. SERVICE CONDITIONS

4.1. The design shall comply with ISO 13628-15 and ISO 13628-4, clause Design and Performance Requirements, as well as with the specifications for the following items, which complement the general service conditions and standardize details of the listed requirements.

4.2. The values of the variables of the items described below, which make up the service conditions specified for the application, are defined in the RM or in its referenced documents:

- Design pressures;
- Maximum and minimum design temperatures;
- Composition of fluids carried by the pipelines;
- Environmental data and water depth;
- Control and chemical injection fluids, if applicable;
- Maximum and minimum design hydraulic pressures;
- Minimum design life;
- Maximum spool loads.

5. DESIGN AND FUNCTIONAL REQUIREMENTS

5.1. GENERAL

5.1.1. PSL

5.1.1.1. Pressure containing/controlling components of the connector system shall comply with the PSL specified in the RM. In case it is not specified in the RM, it shall be considered PSL 3G.

5.1.2. Operation

5.1.2.1. The system shall be operated with no diver assistance and no guiding cable (guideline) for installation of the spool.

5.1.2.2. The Vertical Connector System shall be designed considering the use of a heave compensation system during the landing of the DRS at the subsea structures, unless clearly stated in the RM.

5.2. CONNECTOR SYSTEM

5.2.1. CONNECTOR MODULE

5.2.1.1. Interface with Spoolpiece or Subsea Structure Piping

5.2.1.1.1. The type (if flanged or welded) and dimensions of the interface to the spoolpiece and to the structure piping are defined in the RM.

5.2.1.1.2. If the interface is welded, sample rings of the material shall be provided for the purpose of welding qualification. Quantities of rings and dimensions are provided in the RM.

5.2.1.2. Interface for ROV Operations

5.2.1.2.1. General requirements for the design of interface used in ROV operations, including tooling, are defined in the RM. All requirements of reference [10] shall be followed, as well as those from ISO 13628-8.

5.2.1.2.2. All ROV actuation interfaces using either hot stabs or control valves shall allow free access for a workclass ROV.

5.2.1.2.3. The CM shall have a lock/unlock indicator accessible to ROV visualization, as well as an extended/retracted softland indicator. There shall be a clear visual indicator to allow knowing if the alignment condition is proper for the softland retraction. Visual indicators shall be stiff enough to prevent incorrect indications due to deformations. Instrumentation tubing shall not be used as indicator. The design of the visual indicators shall be approved by Petrobras.

5.2.1.2.4. General symbols, signals (turn direction, n° of turns, torque values, etc.) and arrangement of visual indications for operation by ROV shall follow the requirements stated in the RM and reference [10].

5.2.1.2.5. Following symbols for functions and positions shall be used as ROV visual indications:

F	Closed
A	Open
T	Locked
D	Unlocked
PP	Parking place
SL	Soft landing
ST	Back seal test

5.2.1.2.6. A drawing showing the arrangement of the ROV interfaces and visual indications shall be issued for Petrobras evaluation. All instrumentation shall be protected against eventual clashes with the ROV or during deck operations.

5.2.2. Guide System for VSCM

5.2.2.1. This sub-section specifies alignment and geometrical requirements for the guiding system for VSCM. Guidance systems and values other than those defined below may be accepted upon Petrobras analysis during the clarifications phase, prior to the submittal of technical proposals.

5.2.2.2. The use of composite material for the funnel may be proposed by the manufacturer, subject to approval by Petrobras, in order to reduce weight.

5.2.2.3. Coupling

5.2.2.3.1. The DRS shall be landed and coupled vertically. The guide system has to assure primary alignment between the VSCM and the inboard hub. The guiding structure shall be able to align the VSCM with up to 6° initial vertical misalignment relative to the inboard hub.

5.2.2.3.2. Unless otherwise specified in the RM, the Guide Systems may be of the type funnel-up or funnel-down and shall allow the VSCM to be landed, coupled and locked with an initial angular misalignment on the horizontal plane of up to ±15 º.

5.2.2.4. Uncoupling

5.2.2.4.1. The connector system shall be designed to release the connection system, after unlocking, when pulled with a force of maximum 3 times the weight of the VSCM, misaligned by up to 3 degrees to the vertical, without needing the actuation of the soft landing system.

5.2.2.5. Guide System Capture Diameter

5.2.2.5.1. The guide system shall be able to guide the VSCM to full landing, considering possible horizontal movement within a 250 mm radius with regard to the final landing position, as well as considering the loads involved and functional landing and coupling requirements.

5.2.2.6. Guide System Angle

5.2.2.6.1. If using a funnel, it shall be designed to guarantee that the angle formed between the funnel generatrix and the horizontal plane is equal or higher than 40º.

5.2.3. Cathodic Protection

5.2.3.1. Cathodic protection design shall comply with ref. [11].

5.2.4. Painting

5.2.4.1. Painting shall comply with the RM.

5.2.5. Functions

5.2.5.1. The CM and/or its tools shall have the following main functions:

- Connector lock and unlock;
- Contingency unlock (emergency release);
- Soft landing (see 5.2.5.9);
- Back seal test;

5.2.5.2. The CM shall be vertical, have all functions hydraulically actuated and shall be integral, i.e. the hydraulic circuit shall be part of the CM and not of an external tool.

5.2.5.3. Lock

5.2.5.3.1. The CM connector shall remain locked and assure sealing under all load conditions without using external means, including hydraulic pressure, external loads, connection tool or use of springs (see also 5.2.5.4).

5.2.5.4. Secondary Lock

5.2.5.4.1. The use of a secondary lock feature is NOT mandatory, if the connector system design can assure that the connection and the sealing integrity and tightness are maintained under all design conditions during the entire design life, including cyclic loading.

5.2.5.5. Unlock

5.2.5.5.1. While in the unlocked position, the connector and/or its connection tool shall assure that it remains unlocked during the lowering of the DRS without using hydraulic pressure or external loads.

5.2.5.6. Secondary Unlock

5.2.5.6.1. The secondary unlock feature is a function intended to provide another hydraulic unlock function for redundancy, if needed, to disconnect the system. Secondary unlock is required only if the design of the primary unlock function does not allow the disconnection under all working conditions.

5.2.5.7. Contingency Unlock

5.2.5.7.1. An emergency mechanical unlocking method shall be provided as contingency, whose operation shall be performed by ROV. If a tool is needed to perform the contingency unlock operation, it shall be able to be supported by ROV and/or cable, and handled and operated by ROV. If such a tool is anticipated, it shall be part of the scope of supply (quantities to be defined in the RM).

5.2.5.8. Back Seal Test

5.2.5.8.1. The CM shall be provided with hydraulic circuits resident in the CM or, optionally, in the inboard hub to perform the back seal test, after the connector is locked by using the Petrobras standard hot stab operated by ROV.

5.2.5.8.2. Unless otherwise elsewhere stated, the system tightness shall be possible to be monitored by a pressure gage located at the ROV and/or at the CM.

5.2.5.8.3. The seal test system shall take into account the hydrostatic pressure and the ambient water temperature. The seal test chamber shall have the smallest feasible volume, keeping the metal x metal sealing as close as possible from the seal test (elastomeric) sealing.

5.2.5.9. Soft Landing System

5.2.5.9.1. The VSCM shall be provided with a soft landing system (if this function is not provided by a specially designed, ROV operated pull-in or connection tool, see 5.7), so that the final landing is performed, under the influence of the DRS installation loads, without damaging the ring gasket. The integrity of all sealings shall be kept during all operations of the VSCM of its design life.

5.2.5.9.2. The soft landing system shall include an indicator of extension/retraction able to be checked via ROV. The connection system shall possess a clear indicator to verify when the CM is ready to have the solftland retracted.

5.2.5.9.3. This system shall remain extended during DRS landing, keeping the ring gasket away from the inboard hub until final landing.

5.2.5.9.4. The Soft Landing System shall be designed to allow preliminary separation, if needed, between the VSCM and the hub during recovery of the spool, keeping this separation without continuous ROV actuation. Alternatively, this operation may be performed by using the pull-in or connection tool (see 5.7).

5.3. SUBSEA CONNECTOR

5.3.1. The connector design shall allow coupling, locking and sealing between the CM and the hub when submitted to installation loads, in addition to withstanding the design loads and other premises, without deformations such that would affect performance or not meet other requirements of this specification.

5.3.2. The connector shall be of the following type:

- hydraulic connectors with integral hydraulics similar to subsea wellhead connectors;

5.3.3. The latching mechanisms of the connector may be of the following types:

- collet fingers;
- locking dogs;

5.3.4. Load Capacity

5.3.4.1. The capacity of the connector to withstand loads maintaining the sealing integrity shall be higher than the load capacity of the attached spoolpiece for all possible load combinations.

5.3.4.2. The loads to be considered are:

- pressure;
- bending moment
- tension/compression
- shearing; and
- torsion

5.3.5. Connector with Hydraulic Actuation

5.3.5.1. The connector shall possess integral hydraulics, constituted of single toroidal chamber or multiple cylinders actuator, as long as the maximum CM dimensions are met (as specified in the RM or other contractual document).

5.3.5.2. Hydraulic actuation shall be done by using a standard Petrobras hot stab via ROV.

5.3.6. Inner Diameter

5.3.6.1. The inboard hub and CM inner diameters are defined in the RM.

5.3.6.2. In case of different inner diameters along the inboard hub and/or the outboard hub, a minimum 1:5 transition in radius shall be used. Unless otherwise stated in the RM, this transition shall be located, if possible, close to the ring gasket.

5.3.7. Sealing Areas between Connector and Inboard Hub

5.3.7.1. The sealing areas shall be made with CRA. Care shall be taken to avoid the galling effect between the sealing area and the metal ring.

5.3.7.2. The sealing areas shall be protected against impact loads during installation, intervention and recovery.

5.3.7.3. In case of damages to the sealing areas between the subsea structure and the CM, its design shall anticipate the use of a modified ring gasket for contingency sealing.

5.4. RING GASKET

5.4.1. The ring gaskets shall be made or overlaid with CRM. The design, material and hardness selection are responsibility of the supplier and shall consider only the possibility of elastic deformations. The qualification tests shall be performed so as to prove that the hub and connector sealing areas are not damaged, jeopardizing the sealing function.

5.4.2. Only metal-metal ring gaskets are allowed for primary sealing of the seal system.

5.4.3. The ring gaskets shall be protected against impact loads during installation, intervention and recovery.

5.5. TEST BASE

5.5.1. The test base shall be designed to allow hydrostatic testing of the DRS and inclination of the hub up to 6° in relation to the vertical plane in order to simulate the installation condition.

5.5.2. The base ends shall be marked with reflective paint, according to ET-3000.00-1500-610-PEK-002.

5.5.3. The test base shall have the same stiffness as the structure (PLET, PLEM, Wet Christmas Tree, etc.) that it is simulating. It shall be demonstrated by means of calculation.

5.6. TRANSPORTATION SKID

5.6.1. The transportation skid shall be provided with a device to allow CM transportation, so that the CM can always be fixed and protected against impacts.

5.6.2. The skid ends shall be marked with reflective paint, according to ET-3000.00-1500-610-PEK-002.

5.6.3. The test base and all auxiliary tools shall possess transportation skids designed for the entire design life of the CM

5.7. PULL-IN AND CONNECTION TOOLS

5.7.1. These tools are responsible for the final approximation of the connector towards the inboard hub (pull-in tool) and the locking function (connection tool). When non-integral, it shall be retrieved after connection, leaving only passive mechanical hardware subsea. Further references to these tools are given in ISO 13628-9, clause 4.5, Tie-in operations, which shall be considered as recommendations.

5.8. HUB CLEANING TOOL

5.8.1. The hub cleaning tool shall be operated via ROV during cleaning of the installed subsea structure hub sealing area.

5.8.2. It shall be able to clean the sealing area without damaging any component of the system.

5.9. CAPS

5.9.1. Following subsections define and give specific requirements for the caps which normally are part of the scope of supply of the connector system. Quantities of each cap to be supplied shall be defined in the RM.

5.9.2. Blocking Cap

5.9.2.1. The main objective of the blocking cap is the isolation of the internal bores of the subsea structure during the operational phase of the pipeline when the CM is not connected to the structure.

5.9.2.2. The cap shall be designed to withstand the connector design differential pressure and shall have an unlocking and locking system operated by ROV in order to allow it to be removed and reinstalled.

5.9.2.3. The locking and unlocking of the blocking cap connector may be hydraulically or mechanically actuated, according to item 5.3. It shall have same locking requirements as 5.2.5.3.

5.9.2.4. The seal system shall be bi-directional, metal-to-metal.

5.9.2.5. The maximum installation and removal angles shall be in accordance with the guide system (see 5.2.2).

5.9.2.6. The cap shall have a back seal test function, operated by ROV through hot stab (see 5.2.5.8).

5.9.2.7. The cap shall have a guide system and other ancillaries needed for installation and removal via cable, assisted by ROV.

5.9.2.8. The blocking cap shall have a cathodic protection system compatible with the equipment design life.

5.9.2.9. The cap connector shall have a contingency mechanical unlocking method. If a mechanical connector is chosen, a cutting tool may be proposed as contingency mechanical unlocking method; in this case, the cutting procedure specification shall be supplied.

5.9.2.10. The blocking cap shall be provided with a flooding device to equalize inner and outer pressure as well as valves and hot stab ports for MEG injection.

5.9.2.11. The blocking cap shall have an interface for transponder (and/or interface for metrology) in accordance with the transponder specification to be provided by CONTRACTOR.

5.9.3. Protection Cap

5.9.3.1. The protection cap shall cover both sealing and locking areas of the inboard hub against impact loads and assure electric contact with it, in order to avoid calco-magnesian deposits.

5.9.3.2. This cap shall be designed with an unlocking and locking mechanism which allows the cap to be transported with the equipment, locked on its hub.

5.9.3.3. It shall also be installable and retrievable by ROV without need of other items, like a crane or winch cable.

5.9.4. Testing Cap

5.9.4.1. Testing cap allows testing the pipeline and attached subsea structures during the period between the installation of the subsea structure and the DRS or the blocking cap.

5.9.4.2. If not required in the RM, CONTRACTOR shall confirm the need of this cap and further requirements.

5.9.4.3. The testing cap shall have an interface for transponder (and/or interface for metrology) in accordance with the transponder specification to be provided by CONTRACTOR.

5.9.4.4. The seal system may be resilient (soft).

5.9.5. Low Pressure Cap

5.9.5.1. This cap is designed to be locked on the DRS connectors, in order to maintain the fluid used to fill the DRS during installation phase.

5.9.5.2. In order to allow its removal, the cap shall be provided with check valves to equalize inner pressure and outer pressure. The Low Pressure Caps shall be retrievable by ROV at the maximum water depth forecasted for the connectors to be installed. Special attention in their design shall be given to avoid hydraulic locks.

6. TESTING

6.1. Testing requirements for the connector systems are defined in reference [8]. These tests comprehend qualification (PVT), factory acceptance (FAT) and system integration tests (SIT).

7. REPORTS, RECORDS AND DOCUMENTATION

7.1. By using this Technical Specification, as a minimum the following documents shall be issued for Petrobras information and evaluation, or be made available for Petrobras review:

- Design
  - Scope of Supply drawings
  - General Arrangement drawings of each item in the scope of supply
    - ROV interfaces and visual indications arrangement drawing
    - ROV accessibility report
  - Detailed drawings of each component of the scope of supply
  - Design premises
  - Design reports (including a clearance and tolerance studies)
  - Load capacity charts
- PVT
  - Qualification procedures
  - Qualification report (PVT procedure filled with notes and signatures during tests execution)
  - Certificate of Compliance, when qualification of the items shall be certified by an independent third party
- Fabrication

- Inspection and Testing Plan (ITP)
- Databook
- Material certification

- FAT
  - FAT procedures
  - FAT reports
- SIT
  - SIT procedure
  - SIT reports
- Operation and maintenance
  - Operation, inspection, handling, storage, preservation and maintenance manual
    - Subsea cutting procedure for contingency disconnection, in case of clamp connectors
- Installation
    - Installation analysis
    - Retrieval analysis (for decommissioning purposes)
    - Installation procedures and checklists

8. SUMMARY OF INPUT DATA FOR CONNECTOR SYSTEM SPECIFICATION

8.1. Following list presents the information which is needed when using this technical specification and that are planned to be provided in the RM, in the main equipment specification or by CONTRACTOR.

8.2. If any necessary information is not defined in the RM, the main equipment specification or in any other contractual document, PETROBRAS shall be formally consulted before any implementation by CONTRACTOR. CONTRACTOR shall present for PETROBRAS evaluation a range of values that do not violate any requirement found in the contractual documentation.

- Design pressures;
- Maximum and minimum design temperatures;
- Composition of fluids carried by the pipelines;
- Environmental data and water depth;
- Control and chemical injection fluids, if applicable;
- Maximum and minimum design hydraulic pressures;
- Minimum design life;
- Maximum spool loads;
- PSL;
- Inner diameter of the connector and inboard hub;
- Type and dimensions of interface to the spoolpiece and piping;
- Quantities and dimensions of rings for welding qualification;
- Quantities of accessories, tools, caps and spares;
- General requirements for ROV interfaces and visual indications;
- Cathodic protection requirements;
- Coating requirements;
- Additional requirements for material selection and fasteners;
- Guide System and/or funnel (up or down – if not specified, may be any of the two) types;
- Additional guide system alignment requirements;
- Heave compensation requirements for the CM;

- Position of the inner diameter transitions within the inboard and outboard (connector) hub;
- Additional manufacture quality control requirements.

9. MARKING AND TAGGING

9.1. All padeyes shall be painted in red or orange and have their SWL indicated

9.2. All VSCMs shall receive a TAG to differentiate them from each other and have their TAGs stamped. The hubs shall also be marked and differentiated.

9.3. Additional requirements for marking and tagging will be defined at the RM