PETROBRAS	**TECHNICAL SPECIFICATION**	**Nº** I-ET-3000.00-1510-854-PEK-002	
	CLIENT PETROBRAS		**SHEET** 1 of 18
	JOB		
	AREA –		
SUB	**TITLE** **MONITORING SYSTEM FOR SUBSEA EMERGENCY SHUT-DOWN VALVE (SESDV) – FPU SCOPE**		***PUBLIC***
			SUB/ES/EECE/ECE

REVISION INDEX

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	Original

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	29/07/2022								
DESIGN	ECE								
EXECUTION	BYE8								
CHECK	Y5UJ								
APPROVAL	UR6A								

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1 INTRODUCTION

This document presents the Technical Specification of the FPU (floating production unit) scope for the Subsea Emergency Shut-down Valve (SESDV) Monitoring System.

2 ABBREVIATIONS

AC – Alternating Current;

ABNT – Brazilian Association of Technical Standards;

AFM – Material Supply Authorization;

ANP – National Agency of Petroleum, Natural Gas and Biofuels;

DC – Direct Current;

EC – Electrical connector

ET –Technical Specification;

EFL – Electric Flying Lead

FAT – Factory Acceptance Test;

FPU – Float Production Unit;

GMT – Greenwich Mean Time;

HFL – Hydraulic Flying Lead

ICSS - Integrated Control and Safety System

IEC – International Electrotechnical Commission;

IEEE – Institute of Electrical and Electronics Engineers;

MTTF – Mean Time to Failure;

MQC - Multi-Quick Connect

PBOF – Pressure Balanced Oil Filled;

PVT – Performance Verification Test;

PT – Pressure Transducer;

ROV –Remotely Operated Vehicle;

RM – Material Requisition;

RMS – Root Mean Square;

RTU – Remote Terminal Unit;

SESDV – Subsea Emergency Shut-down Valve;

UEH – Electro-Hydraulic Umbilical;

UEP – Stationary Production Unit;

UTA – Umbilical Termination Assembly;

SDU – Subsea Distribution Unit;

SIT – Site Integration Test;

ZT – Position transducer.

3 REFERENCE DOCUMMENTS, CODES AND STANDARDS

This section lists standards and documents applicable to the design of the control and monitoring system:

3.1 International standards

[1] API 6A - Specification for Wellhead and Christmas Tree Equipment

[2] API 17E – Specification for Subsea Umbilicals

[3] API 17F - Standard for Subsea Production Control Systems

[4] API 17Q - Recommended Practice on Subsea Equipment Qualification

[5] ASME B16.5:2013 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service

[6] ASME B16.5:2013 - Pipe Flanges and Flanged Fittings

[7] DNVGL-RP-B401:2017 - Cathodic Protection Design

[8] IEC 60079 (latest revision) - Series Explosive Atmosphere Standards

[9] IEC 60092 (latest revision) - Electrical installations in ships - ALL PARTS

[10] IEC 60529 (latest revision) - Degrees of Protection Provided by Enclosures (IP Code)

[11] IEC 61892-6 (latest revision) - Mobile and fixed offshore units – Electrical installations – Part 6: Installation

[12] DNV-RP-H103 - Modelling and Analysis of Marine Operations

[13] ISO 13628-6:2006 - (**Note:** The cleaning classification for hydraulic fluids of the old NAS 1638 standard ("Cleanliness Requirements used in Hydraulic Systems") is cited in this specification as a reference best known by the industry. The most current standard is SAE AS 4059 ("Cleanliness Classification for Hydraulic Fluids");

3.2 PETROBRAS documents

[14] I-ET-3000.00-1500-823-PEK-001 Qualification of Wet-Mate Electrical Connectors and Accessories

[15] I-ET-3000.00-1510-800-PEK-002 UMBILICAL TERMINATION ASSEMBLY (UTA) CONTROL SYSTEM – FOR SUBMARINE EXPORT SYSTEMS

[16] I-DE-3000.00-5520-850-PEK-001 - BLOCK DIAGRAM – SUBSEA MONITORING SYSTEMS

4 DEFINITIONS

SESDV CONTRACTOR	The company contracted by PETROBRAS to design, construct and supply the SESDV SYSTEM
FPU CONTRACTOR	The company contracted by PETROBRAS to design, construct and supply the FPU topside infrastructure of SESDV SYSTEM
FPU OPERATOR	PETROBRAS or company contracted by PETROBRAS to operate FPU topside.
SUPPLIER	Company hired by CONTRACTOR, to supply components from SESDV MONITORING SYSTEM.
MAY	It is used when alternatives are equally acceptable
SHOULD	It is used when a provision is not mandatory, but is recommended as a good practice
SHALL	It is used when a provision is mandatory
AVAILABILITY	Probability that the system will remain operating under the conditions specified in the project during its useful life.
EQUIPMENT	Set of components and parts composing an architecture to meet the requirements of this ET.
RECOMMENDED PRACTICE	Best Practice established in Technical Standard, but which admits the possibility of a more adequate alternative to the specific application.
TECHNICAL PROPOSAL	Set of technical premises that the CONTRACTOR undertakes to follow in the design of the Equipment.
SYSTEM	Set of elementary systems, integrated within the premises and operational availability established in the RM to which this ET refers.

5 TECHNICAL CARACTERISTICS

5.1 Design and fabrication

5.1.1 All subsea monitoring components shall be designed in accordance with API 17E and API 17F.

5.1.2 Selection of materials for all subsea structures shall be in accordance with DNVGL-RP-B401:2017 item 5.5 and be designed for the same design life as the SESDV.

5.1.3 All enclosures and equipment to be placed in hazardous areas shall comply and be certificated according to IEC 60079 (latest revision).

5.1.4 All enclosures with a required degree of ingress protection shall comply with IEC 60529 (latest revision).

5.1.5 All electrical cabling specifications and installations shall comply with IEC 60092 (latest revision) and IEC 61892-6 (latest revision).

5.1.6 Electrical and communication analyses shall be performed, including simulations considering the parameters of specified cable types (for deck and umbilical lines). For electrical analysis, the maximum length of the UEH shall be 10 km using TSP conductors with 2.5mm^2 cross section.

5.2 Qualification

5.2.1 All subsea equipment shall be qualified in accordance with API 17Q or ISO 13628-6:2006.

6 GENERAL TECHNICAL REQUIREMENTS

6.1 System overview

6.1.1 Each SESDV foreseen at field project shall receive electrical conductors, coming from the FPU, through a general arrangement using UEH and UTA, as shown in Figure 1.

6.1.2 The monitoring system and actuation can follow two arrangement options:

- One umbilical connects FPU to just one SESDV (Option 1 – Figure 1).
- One umbilical connects FPU to more than one SESDV, through a SDU (Option 2 - Figure 1).

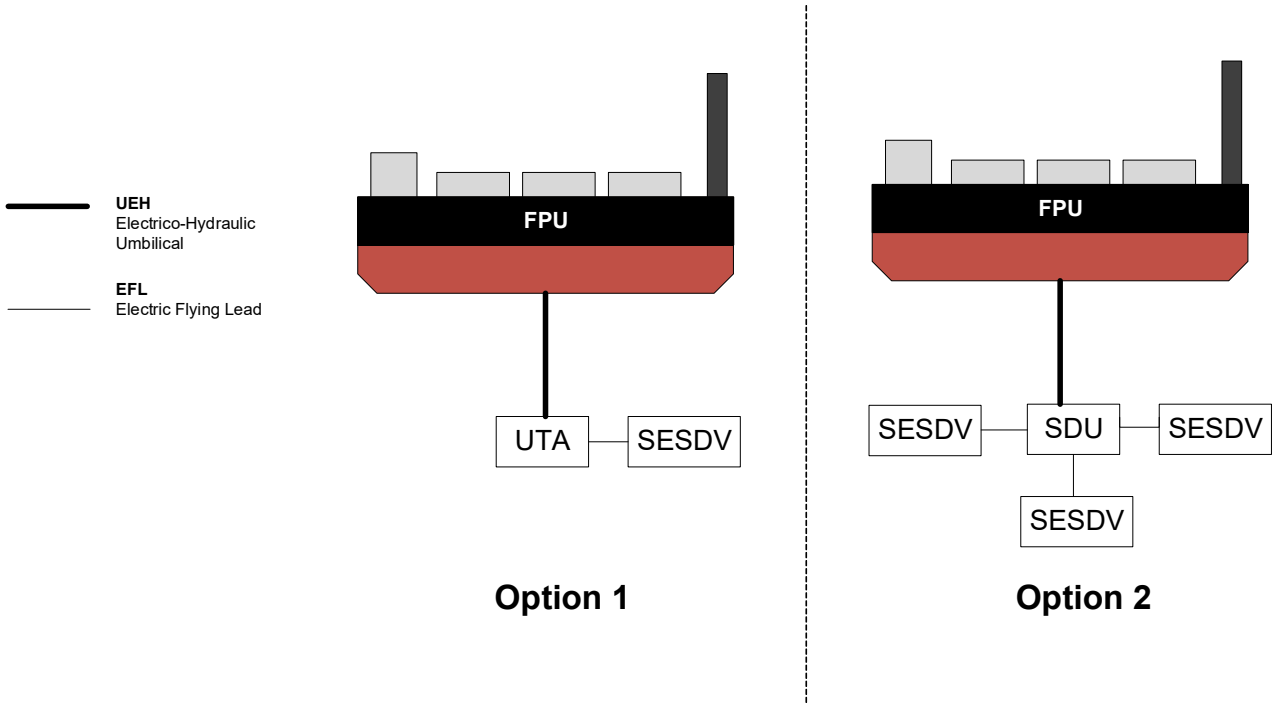


Figure 1 – General schematic of the subsea layout with SESDV Monitoring System (two options)

6.1.3 This technical specification describes FPU provisions for SESDV monitoring system. FPU CONTRACTOR shall provide the required structure for all SESDV foreseen in field project. The base case for this technical specification is Option 1, however if the subsea layout would foresee Option 2, the topside supply (i.e., topside cabling and acquisition channels) shall be dimensioned for the quantity of SESDV foreseen.

6.1.4 Figure 2 presents the general architecture of SESDV Monitoring System

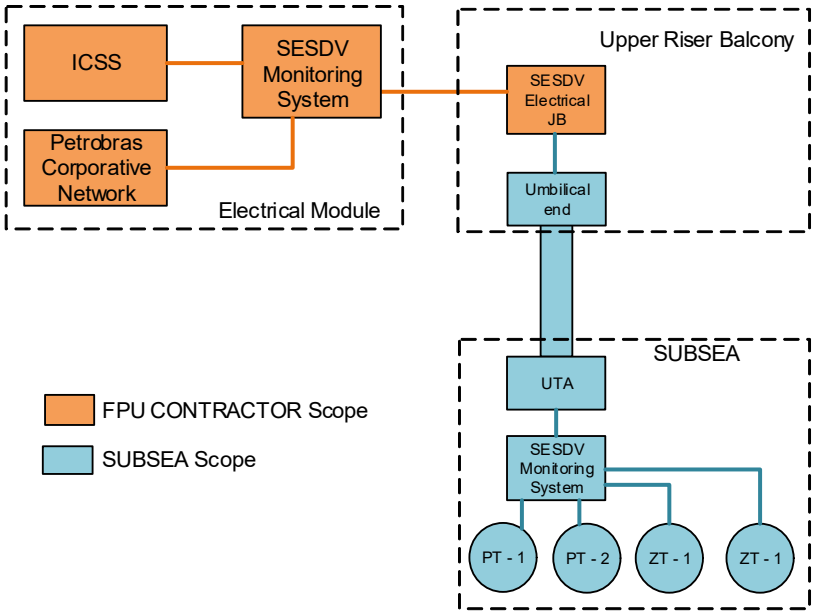


Figure 2 – General Architecture of SESDV Monitoring System

6.1.5 Cabling shall be designed in accordance with international standards.

6.1.6 Connectors/terminations shall be properly protected from exposure before final assembly to junction boxes and other equipment.

6.1.7 All junction boxes/cabinets shall be properly identified with visible tags.

6.1.8 All cabling (at dry area) shall be properly identified with visible tags.

6.1.9 Individual conductors within a bundle (multi-cable) shall be properly identified on both ends, through tags and/or color coding.

6.1.10 Cabling shall conform to the IEC 60502-1 standard.

6.1.11 The SESDV MONITORING SYSTEM shall contain sensors (main and redundant) to monitor:

- Valve position indication (ZT) of the SESDV shutter.
- Pressure (PT) from hydraulic actuation system control line of SESDV system.

6.1.12 From FPU Topside, the electrical cables from the UEH shall be connected to a topside processing system connected with FPU ICSS, for the power supply and data acquisition of the SESDV MONITORING SYSTEM signals.

6.1.13 If there is a conflict of specifications in this documentation and in its references, the most demanding specification shall prevail, unless otherwise expressly directed by PETROBRAS.

6.1.14 For electrical analysis, the maximum length of the UEH shall be 10 km using TSP conductors with 2.5mm^2 cross section.

7 MONITORING SYSTEM TOPSIDE COMPONENTS

7.1 Topside system overview

7.1.1 Topside scope of supply shall comply by:

7.1.1.1 1 (one) SESDV Topside Processing (section 7.2),

7.1.1.2 1 (one) SESDV Electrical JB (section 7.4) for each SESDV umbilical provision slot

7.1.1.3 Topside electrical cabling (section 7.5).

7.2 SESDV Topside Processing

7.2.1 The SESDV Topside Processing system shall:

7.2.1.1 Power Supply subsea sensors.

7.2.1.2 Collect and storage subsea sensors data (in high frequency).

7.2.1.3 Forward subsea sensor data to ICSS.

7.2.2 FPU CONTRACTOR shall supply one cabinet (named as SUBSEA Interface Cabinet from ref [16]) in Electrical Module, where shall be terminated all subsea systems cabling from RRMS.

7.2.3 The SESDV Topside Processing shall be designed for using 15U from SUBSEA Interface Cabinet.

7.2.4 FPU CONTRACTOR shall foresee individual circuit brakers for SESDV Topside Processing. FPU CONTRACTOR shall provide inside cabinet surge protectors connected to FPU grounding system.

7.2.5 The SESDV Topside processing shall be powered by a nominal voltage of 220 V AC (+/- 10%), 50-60Hz, to be supplied through a cable including a protective earth conductor.

7.2.6 SESDV Topside processing shall provide DC power supplies and media converters inside cabinet and prioritize installation using 19-inch multi-slot rack. LAN Network connection (Cat-6 network cable) shall permit remote access by corporative network.

7.2.7 SESDV Topside processing shall have two communication interfaces:

7.2.7.1 On interface connected to Corporative Network (through Petrobras Firewall) to allow remote access,

7.2.7.2 One interface connected to ICSS to forward sensor data.

7.2.8 FPU CONTRACTOR shall provide user interface devices, including keyboard, mouse, and monitor (KVM - 1U rack mounted), for local access to the supervisory system. All user interface devices shall be installed at a comfortable height for human users and with proper consideration for ergonomics.

7.3 ICSS Interface

7.3.1 The forwarding of sensor data to ICSS can use TCP/IP protocol (observed cybersecurity, considering automation network) and final solution shall be presented for PETROBRAS approval.

7.3.2 For each SESDV, FPU CONTRACTOR shall provide two dry contacts from FPU ICSS for each hydraulic function line. The two dry contacts functions for each line shall be SESDVX_OPEN_COMMAND and SESDVX_CLOSE_COMMAND (Where “X” is a sequential number). The FPU ICSS logic shall be closing the dry contact for 60 seconds after the command is executed at the solenoid from SESDV HPU rack

7.3.3 FPU CONTRACTOR shall provide cabling needed for required interface between ICSS and SESDV Topside processing.

7.3.4 FPU CONTRACTOR shall terminate at SAK terminals the dry contacts from FPU ICSS and SESDV electrical conductors from SESDV Electrical JBs.

7.3.5 FPU CONTRACTOR shall also record at FPU ICSS the SESDV position indicator (ZT) and pressure indicator (PT) signals.

7.3.6 The Supervisory screen of SESDV actuation shall indicate the information of each SESDV sensor from monitoring system.

7.4 Software Requirements

7.4.1 The software shall be based on Microsoft Windows solution. The use of a well-established integrated automation solution able to provide all required functionalities is strongly advised.

7.4.2 In the case of power loss, the main processing equipment shall be able to restart automatically without the need for operator intervention.

7.4.3 FPU CONTRACTOR shall inform, during the commissioning, all administrator passwords needed to operate and manage all equipment.

7.4.4 The software shall act as an interface to human operators and external systems of the monitoring system.

7.4.5 Dedicated supervisory screens shall report the value of every monitored variable as they are acquired, along with the status of communication channels of each monitoring unit, including cabinet housekeeping data.

7.4.6 The software shall allow for querying and plotting of historical data for user-selectable intervals.

7.4.7 Data shall be recorded in sets of array files compatible with Microsoft Excel 2003 or newer (*.CSV).

7.4.8 Data shall have included inside GMT timestamp.

7.4.9 A database system for storage of generated all data points (monitored variables and housekeeping) shall be included in a OPC server.

7.4.10 The database shall operate on a circular buffer pattern, whereby older records shall gradually be overwritten by newer samples once the database reaches its capacity. Storage space shall be provided as a dedicated RAID 1 array, sized for at least 24 months of logging at the highest possible data sampling rate.

7.4.11 The software shall record the SESDV position indicator with sample rate of 1Hz.

7.4.12 The software solution shall design a continuous high frequency sample rate (4Hz) circular buffer pattern solution of the acquisition of the pressure transmitter, whereby older records shall gradually be overwritten by newer samples once the buffer reaches its capacity. The buffer window shall be 10 minutes.

7.4.13 When the software receives a SESDV OPEN/CLOSE command (dry contacts), the software will extract a 6 minutes data array starting 1 minute earlier than the received command as illustrated in Figure 3.

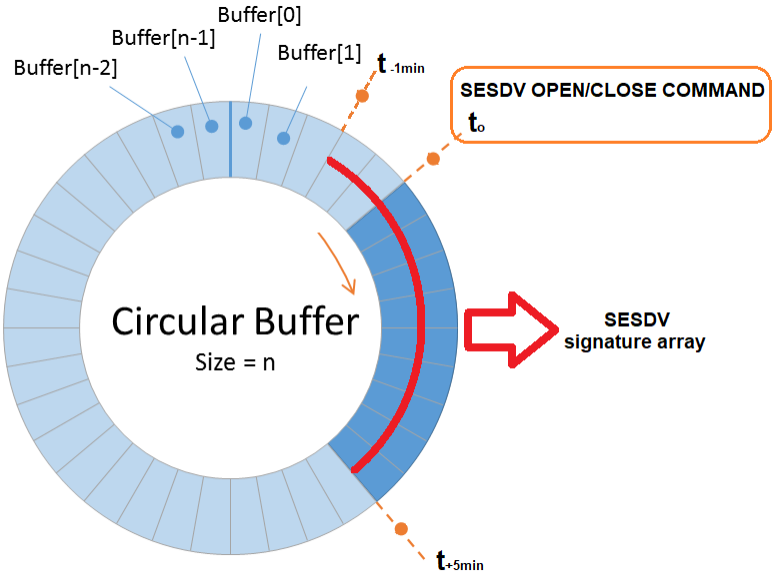


Figure 3 – SESDV signature array circular buffer schematic

7.4.14 Two categories of password protected user accounts shall be implemented, common and privileged. Access to all functionalities of the software shall be restricted exclusively to authenticated users belonging to one of these categories.

7.4.15 Configuration duties, including the management of the various monitoring units and of the user accounts themselves, shall be restricted to privileged users. All view-only functionalities shall be available to all authenticated users.

7.4.16 The software shall keep a log of all accesses, both local and remote, for a minimum of 12 months.

7.4.17 The software shall provide Web Interface (HTTP) access to all screens from within PETROBRAS corporate network. Authenticated users shall be given access to all functionalities just as they are available locally.

7.4.18 The Web Interface shall be fully compatible with the latest versions of the Internet Explorer, Mozilla Firefox and Google Chrome browsers, without the aid of any plugins.

7.4.19 At least 20 concurrent accesses to the software shall be supported by the Web Interface.

7.4.20 The standard Microsoft Windows remote desktop solution shall also be provided to allow remote access to the system from onshore facilities.

7.5 SESDV Electrical JBs

7.5.1 FPU CONTRACTOR shall provide one JB (named SESDV Electrical JB) for each SESDV slots position in FPU.

7.5.2 SESDV Electrical JB shall be installed close to umbilical end of each SESDV.

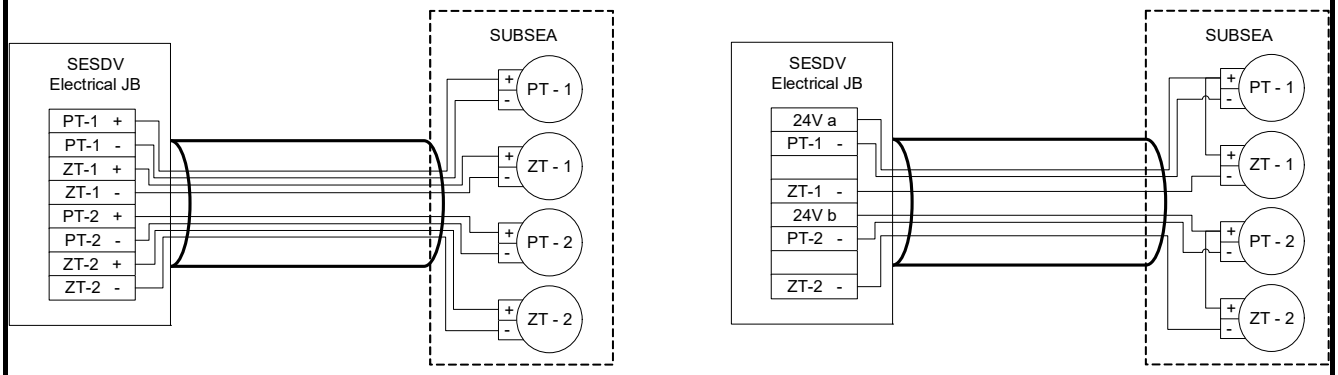
7.5.3 SESDV Electrical JB has the function to arrange SESDV electrical signals of 2 (two) PT sensors (main and redundant), and 2 (two) ZT sensors (main and redundant) of each SESDV.

7.5.3.1 The PT and ZT sensors shall have its entire electrical interface established by 2 (two) wires, which simultaneously perform the electrical supply and the analog communication (passive 4-20mA sensor). Analog communication and power supply shall be in accordance with Appendix D of API 17F (2014).

7.5.4 At SESDV Electrical JB, FPU CONTRACTOR shall consider 4 inlets for SUBSEA side for each SESDV attended. For these inlets plugs (installed) and cable glands (as spare) shall be provided. After umbilical installation the plugs will be replaced by cable glands.

7.5.5 FPU CONTRACTOR shall consider that one umbilical can attend more than one SESDV (See Figure 1).

7.5.6 The connection of four sensors shall demand three (positive sharing) or four (one pair to each sensor) pairs depending on subsea electrical connection. See figure 3.



Option A - 4 Pairs

Option B - 3 Pairs

Figure 4 – SESDV Monitoring System electrical wiring

7.5.7 FPU CONTRACTOR shall provide infrastructure able to support both scenarios of Figure 3.

7.5.8 To arrange SESDV signals, these JBs shall aggregate electrical conductors at SAK terminals according to the UEH configuration (3 pairs or 4 pairs).

7.5.9 Each SESDV Electrical JB shall be installed in places with easy access, in maximum heigh of 2 meters and where is dismiss the use of safety harness for high work.

7.5.10 Each SESDV Electrical JB shall be sealed against dust and powerful water jets (protection degree IP-66).

7.5.11 Each SESDV Electrical JB and cable glandes specification/installation shall be in accordance with its corresponding area classification.

7.6 SESDV topside cabling

7.6.1 FPU CONTRACTOR shall provide cabling for each SESDV functions slots position in FPU.

7.6.2 FPU CONTRACTOR shall provide two multicable (main and spare) with 4 TSP with conductor cross section of 4mm2 for each SESDV foreseen in project. These multicables shall connect SUBSEA Interface Cabinet and the respective SESDV Electrical JB.

8 MONITORING SYSTEM SUBSEA COMPONENTS

8.1 SUBSEA Instrumentation

8.1.1 This section describes the subsea components, to provide FPU CONTRACTOR with subsea system topology.

8.1.2 The electrical system shall have in its composition the submarine instrumentation comprising of:

8.1.2.1 2 (two) PT sensors (main and redundant), resident inside the MONITORING MODULE (ROV retrievable module), with the function of monitor the pressure of the actuation hydraulic line of the SESDV;

8.1.2.2 2 (two) ZT sensors (main and redundant), resident inside the SESDV actuation structure, with the function of monitor the position indication of the SESDV shutter.

8.1.3 The PT and ZT sensors shall have its entire electrical interface established by 2 (two) wires, which simultaneously perform the electrical supply and the analog communication (passive 4-20mA sensor). Analog communication and power supply shall be in accordance with Appendix D of API 17F (2014).

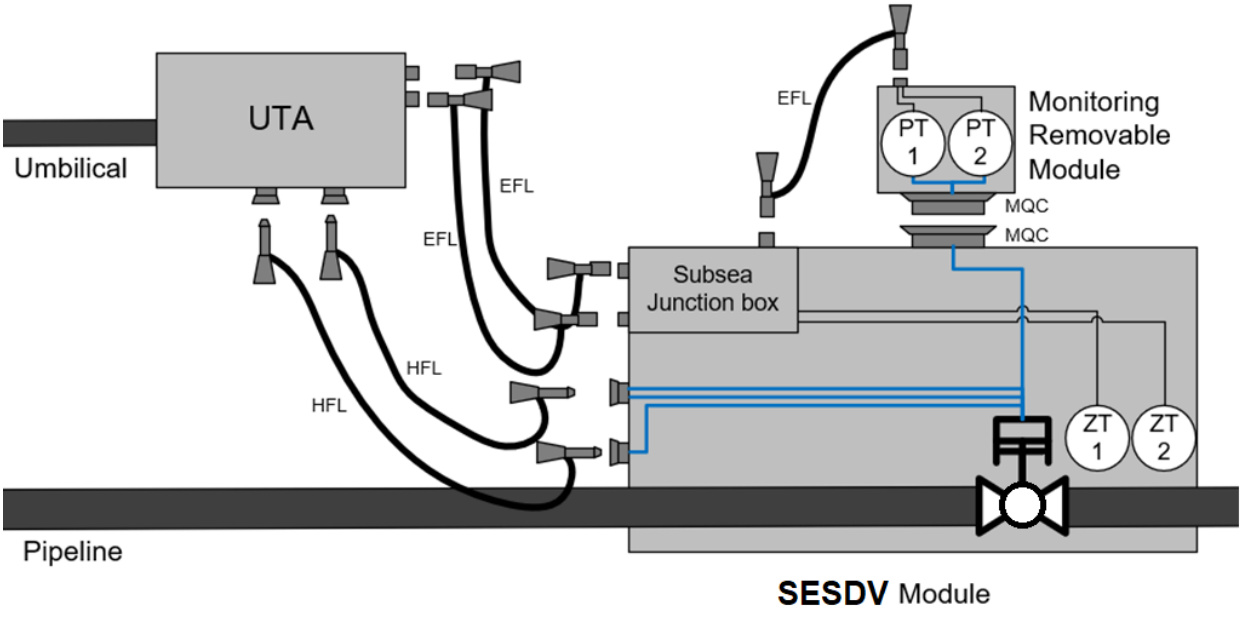


Figure 5 – SESDV MONITORING SYSTEM subsea general schematic

8.1.4 Features of PT sensors:

8.1.4.1 Calibration range: 0 to 7500 psi;

8.1.4.2 Maximum allowable pressure: 10k psi;

8.1.4.3 Break pressure: 15k psi;

8.1.4.4 Stability: ± 0.1 % FS/year;

8.1.4.5 Accuracy: ± 0.2 % FS (“zero / span setting and temperature effects” - TOTAL ERROR BAND);

8.1.4.6 Repeatability: ± 0.06% FS;

8.1.4.7 Resolution: 0.03 % FS;

8.1.4.8 Power supply: 12 to 36 VDC;

8.1.4.9 Output signal: 4 to 20 mA.

8.1.5 Features of ZT sensors:

8.1.5.1 Fully opened position: 4mA;

8.1.5.2 Fully closed position: 20mA;

8.1.5.3 Accuracy: ± 0.6% FS (“zero / span setting and temperature effects” - TOTAL ERROR BAND);

8.1.5.4 Power supply: 12 to 36 VDC;

8.1.5.5 Output signal: 4 to 20 mA.

9 INSTALLATION AND COMMISSIONING REQUIREMENTS

9.1.1 The requirements presented in this section shall be met regarding commissioning activities. Planning of installation and commissioning activities shall be developed and submitted for PETROBRAS approval.

9.1.2 Commissioning is understood, in this context, as the process of placing the system (or parts thereof related to a particular monitored structure) in a fully functional state, without any pending issues.

9.1.3 All equipment shall be tested onshore before deployment at sea. Testing and interventions on equipment shall not be planned or performed during offshore deployment (on deck), save for emergency occasions, in which case approval shall be explicitly given by PETROBRAS.

9.1.4 The fully commissioning of SESDV Monitoring system is in SESDV CONTRACTOR scope, however, FPU CONTRACTOR, shall commission all topside infrastructure in its scope.

9.1.5 In terms of Acceptance Test, the FPU CONTRACTOR shall evidence, at least:

- Cabling and power supply in SUBSEA Interface Cabinet;
- Certification of all network cables related to SESDV Monitoring System;
- Fully testing of each SESDV cabling;
- FPU ICSS dry contacts tests;
- Fully testing of each SESDV topside software functions using simulators.

9.1.6 FPU CONTRACTOR shall provide all infrastructure for SESDV CONTRACTOR, in order to allow it to complete the fully commissioning of SESDV Monitoring system (offshore), including access to installation, power supply and information related the system.

10 TECHNICAL DOCUMENTATION

10.1.1 During de executive design shall be issued to PETROBRAS approval a Technical Proposal of the FPU CONTRACTOR scope, including Datasheets, manuals and certificates for all equipment or cable supplied by FPU CONTRACTOR

10.1.2 The FPU CONTRACTOR technical documentation shall include at least the following:

- One Line diagram
- Piping and Instrumentation Diagram (P&ID)
- Interconnection Diagram
- General arrangement of cabinet installation
- General arrangement of all topside installation, including cable routing, mechanical details and equipment datasheet
- Typical detail of installation at each SESDV slot showing at least junction box, conduits, cable tray (if applicable) connector, and fixation
- Factory Acceptance Test Procedure/Reports
- Acceptance and Performance test (TAP) Procedure/Reports

11 TESTS AND INSPECTIONS

11.1.1 With respect to Topside FATs:

11.1.1.1 The list of FATs of MONITORING SYSTEM, in addition to the FAT procedures themselves, shall be submitted for approval by PETROBRAS during the project detailing phase.

11.1.2 The factory tests program shall demonstrate that all components of MONITORING SYSTEM have been successfully installed and connected and that MONITORING SYSTEM is fully operational including external services (using simulators).

12 SESDV MONITORING SYSTEM SCOPES

12.1 FPU CONTRACTOR responsibilities

12.1.1 Supply, install and interconnect SUBSEA Interface Cabinet for SESDV Monitoring system.

12.1.2 Provide transmission of dry contacts control from FPU ICSS data.

12.1.3 Provide a network connection to the SESDV Monitoring system.

12.1.4 Provide assistance to all activities to be performed by the SESDV CONTRACTOR aboard the FPU, including any crane operation, transportation of loads, heavy mechanical installations and issuance of work permits when needed.

12.1.5 Supply and run all deck and FPU ICSS cabling, including terminations.

12.1.6 Design, supply and install SESDV Electrical JBs & accessories, providing connections between deck cables and SUBSEA Interface Cabinet.

12.1.7 Provide documentation with all information needed for the design of the monitoring system, including but not limited to: cabling information, wiring diagrams, area classification, mechanical, electrical interfaces and diving accessibility report.

12.2 FPU OPERATOR responsibilities

12.2.1 Install umbilical hang off and support umbilical pull in operations.

12.2.2 Install umbilical electrical pigtails with cable glandes in SESDV Electrical JBs.

12.3 UMBILICAL CONTRACTOR responsibilities

12.3.1 Design, supply and install UTA and umbilical line.

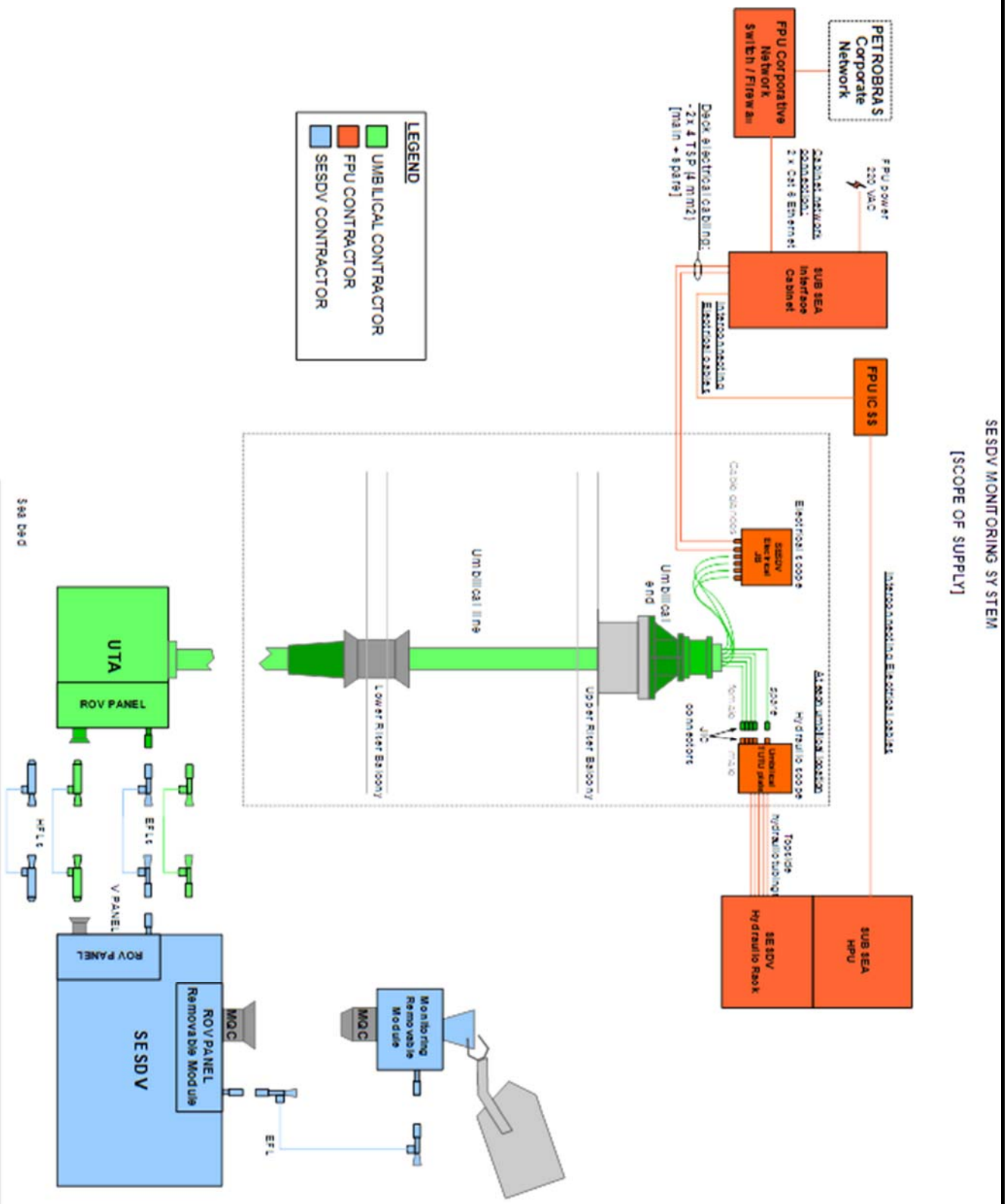
12.4 SESDV CONTRACTOR responsibilities

12.4.1 Design, supply, install and interconnect SUBSEA equipment for SESDV Monitoring system.

12.4.2 Execute any wiring/equipment arrangement at SESDV Electrical JBs and SUBSEA Interface Cabinet for commissioning of SESDV Monitoring system.

12.4.3 Execute the fully commissioning of SESDV Monitoring system (offshore).

12.5 Scopes of Supply



12.6 Scopes of Work