PETROBRAS	**DESCRIPTIVE MEMORANDUM**	No. I-MD-3D10.12-5520-850-PX9-001	
	CLIENT: BUZIOS		SHEET: 1 of 18
	JOB: DESENVOLVIMENTO DA PRODUÇÃO DO CAMPO DE BUZIOS		–
	AREA: BUZIOS 12		NO SCALE / A4
SUB/ES	TITLE: **DESCRIPTIVE MEMORANDUM – SUBSEA MONITORING SYSTEM FOR FPSO BUZIOS 12**		PUBLIC
			SUB/ES/EDA/EAI

INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	Original Issue
A	Revised where marked

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	25/03/2025	12/09/2025							
DESIGN	EAI	EAI							
EXECUTION	BYE8	BYE8							
CHECK	DVHV	DVHV							
APPROVAL	NTHF	NTHF							

CONTENTS

1. INTRODUCTION

1.1. OBJECTIVE

1.1.1. The purpose of this document is to describe the premises, requirements and scope from the monitoring systems. The information presented herein is intended to give to CONTRACTOR correctly design, manufacture, test and install the systems herein presented.

1.1.2. Additional and specific requirements for the components of this scope of supply are found in the references listed in section 4.

1.2. SCOPE

1.2.1. The information contained herein is meant to be used for the FPU CONTRACTOR/SELLER scope encompassing the monitoring system.

1.2.2. Manufacturing requirements for production and injection flowlines and risers are not scope of this document.

2. TERMS AND DEFINITIONS

2.1. VERBAL TENSES

2.1.1. Following meanings shall be considered for the verbal forms used throughout this document:

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

2.2. DEFINITIONS

RISER CONTRACTOR	The company contracted by PETROBRAS to supply the flexible risers including the FBG sensors mounted at the wires inside the spyhole endfitting
FPU CONTRACTOR/SELLER	The company contracted by PETROBRAS to supply the FPU or the topside scope of the FPU
FPU OPERATOR	The company responsible for the FPU topside operations
PETROBRAS	Oil operator for riser integrity management. Any information to be exchanged with PETROBRAS shall be addressed to the subsea engineering group
DRY-MATE [CONNECTOR]	Connector designed for plugging/mating in dry area but is applicable for wet/underwater environments
WET-MATE [CONNECTOR]	Connector designed for plugging/mating subsea area and applicable for wet/underwater environments

2.3. ABBREVIATIONS

AC	Alternating Current
APC	Angle Polished Connector
BSDL	Boca de Sino Diverless (Diverless Bell Mouth)
DAU	Data Acquisition Unit
DC	Direct Current
DMZ	Demilitarized Zone
FAT	Factory Acceptance Test
FBG	Fiber Bragg Grating
FO	Fiber Optic
FPSO	Floating Production, Storage and Offloading
FPU	Floating Production Unit
GPS	Global Positioning System
GTD	General Technical Description
IMU	Inertial Motion Unit
IP	Ingress Protection
JB	Junction Box
MODA	Monitoramento Óptico Direto no Arame (Optical Monitoring Directly on the Wire)
PBOF	Pressure Balanced Oil-Filled
PDU	Power Distribution Unit
SIT	System Integration Test
TSP	Twisted Shielded Pair
TQF	Technical Query Form
TSUDL	Tubo de Suporte Unificado Diverless (Diverless Unified Support Tube)
UPS	Uninterruptible Power Supply
RRMS	Rigid Riser Monitoring System
RSMS	Riser Support Monitoring System
WMC	Wet-mate Connector

3. REFERENCED DOCUMENTATION

3.1. MODA

Item	Document	Title	Revision
[1]	I-ET-3010.00-5529-854-PX9-001	MODA RISER MONITORING SYSTEM – FPU SCOPE (SPREAD MOORING)	0

3.2. RSMS

Item	Document	Title	Revision
[2]	I-ET-3010.00-1300-279-PX9-001	UNIFIED DIVERLESS SUPPORT TUBE (TSUDL) - GENERAL REQUIREMENTS	B
[3]	I-ET-3010.00-1300-279-PX9-002	DIVERLESS BELL MOUTH (BSDL) - GENERAL REQUIREMENTS	B
[4]	I-ET-3010.00-5139-172-PX9-001	PORTABLE UMBILICAL PRESSURIZATION SYSTEM (PUPS)	0

3.3. RRMS

Item	Document	Title	Revision
[5]	I-ET-3010.00-5529-854-PX9-002	RIGID RISER MONITORING SYSTEM (RRMS) – FPU SCOPE	0

4. REFERENCES

Item	Document	Title	Revision
[6]	I-DE-3D10.12-1500-941-P56-001	RISER SUPPORTS ARRANGEMENT CONCEPTUAL DESIGN – FPSO BALCONY	0
[7]	DE-3D10.12-1500-941-PLR-007	ARRANJO SUBMARINO CONCEITUAL (FASE 2) INTERLIGAÇÃO DO PROJETO DE BÚZIOS 12- CENÁRIO HUB13 ALT. C/ GAS TRANSFER, POÇOS SAT., WAG LOOP E DUTOS RÍG. (PO/EG E WAG)	C
[8]	DE-3D10.12-1500-941-PLR-009	DIAGRAMA UNIFILAR DE INTERLIGAÇÃO DO PROJETO DE BÚZIOS 12	A
[9]	I-ET-3010.2K-1200-941-P4X-001	GENERAL TECHNICAL DESCRIPTION - BOT	A
[10]	I-ET-3000.00-1519-29B-PZ9-012	TOPSIDE ARRANGEMENT AND INTERFACES WITH SUBSEA UMBILICAL SYSTEMS	0

4.1. DOCUMENT PRIORITY AND CONFLICTS

4.1.1. The documents referenced in Section 3 are important for the application of this document.

4.1.2. For dated references, only the mentioned edition/revision applies. For undated references, the latest edition of the referenced document (including any amendments), in force when the contract between PETROBRAS and CONTRACTOR was awarded, applies.

4.1.3. In case of conflict between requirements from this Descriptive Memorandum and from any other document, following (decreasing) precedence order shall apply:

1. Project Contract
2. The Material Requisition (RM) document which refers to this document
3. This Descriptive Memorandum
4. Referenced documents

4.1.4. Any questions about the application of the previous orientations shall be formally clarified and registered by issuing a Technical Query to PETROBRAS.

4.1.5. The quantities and functionalities from the slots related in next sections consider the layout presented on document [6], [7], [8] and [9]. Any changes in the Riser Balcony layout may affect the stipulated quantities in the following sections. If any changes occur, the final definition and quantities of the systems shall be confirmed with Petrobras.

5. RISER MONITORING SYSTEMS

5.1. FLEXIBLE RISERS OPTICAL MONITORING SYSTEM (MODA)

5.1.1. The MODA system uses optical sensors based on Fiber Bragg Grating (FBG) technology to measure deformations in the tensile armor wires of the outer layer of flexible risers/jumpers, to identify broken wires in the outer layer and/or detect events related to ruptures of the inner and outer layer wires.

5.1.2. These FBG fiber optic sensors are in the top section of the riser/jumper, inside the Spyhole End Fitting, as illustrated in Figure *1*.

Figure 1: Spyhole end fitting with MODA sensors

5.1.3. The scope of work/supply MODA from FPU CONTRACTOR/SELLER is defined in [1].

5.1.4. The total foreseen for MODA System, comprises 39 risers slots, corresponding to all the flexible risers except the umbilical lines.

5.1.5. FPU CONTRACTOR/SELLER shall provide 3 MODA cabinets dedicated to the MODA System, considering:

- Cabinet A: covering 13 risers with 5 FBG interrogators + 3 servers
- Cabinet B: covering 13 risers with 5 FBG interrogators + 3 servers
- Cabinet C: covering 13 risers with 5 FBG interrogators + 3 servers

5.2. RIGID RISERS MONITORING SYSTEM (RRMS)

5.2.1. The Rigid Riser Monitoring System measures the top inclination angle using an IMU to determine the roll and pitch angles at the top of each riser. Additionally, the system also measures the axial tension and bending moments using FBG sensors.

5.2.2. The scope of work/supply RRMS from FPU CONTRACTOR/SELLER is defined in [5]. Sensor connection overview is illustrated on Figure *2*.

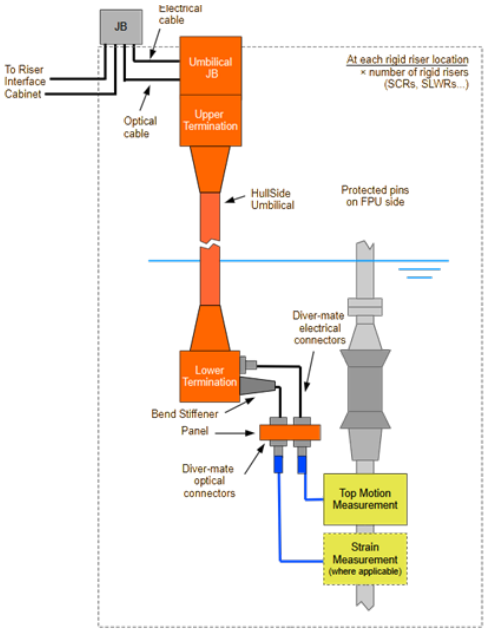

Figure 2: RRMS Sensor Overview

5.2.3. It is FPU CONTRACTOR/SELLER responsibility to provide all the infrastructure for the RRMS system.

5.2.4. The total foreseen for RRMS System, comprises 26 risers slots, corresponding to all the rigid risers.

5.2.5. FPU CONTRACTOR/SELLER shall provide 2 RRMS Cabinet(s) dedicated to the RRMS System, considering:

- Cabinet A: covering 13 risers with 4 FBG interrogators + 1 servers + 13 DSL modems
- Cabinet B: covering 13 risers with 4 FBG interrogators + 1 servers + 13 DSL modems

5.2.6. FPU CONTRACTOR/SELLER shall provide 2 additional DSL Modems to be used for test purposes (test box).

5.3. RISER SUPPORT MONITORING SYSTEM (RSMS)

5.3.1. Riser support is a device designed to support risers in lower balcony from a spread moored FPSO.

5.3.2. RSMS System comprises two types of supports: BSDL, which is applicable for flexible lines and umbilical and TSUDL, which can be used either for flexible lines or rigid lines.

5.3.3. The underwater components of Control and Monitoring System for Riser Supports shall be connected to topside by hullside umbilical lines.

5.3.4. Riser Support System functionality and the electrical termination will be installed in the Riser Interface Cabinet.

5.3.5. UNIFIED DIVERLESS SUPPORT TUBE(TSUDL)

5.3.5.1. The TSUDL, illustrated on Figure *3* is a riser support system for either rigid or flexible risers. The design shall allow pull-in and pull-out operations with minimal diver assistance.

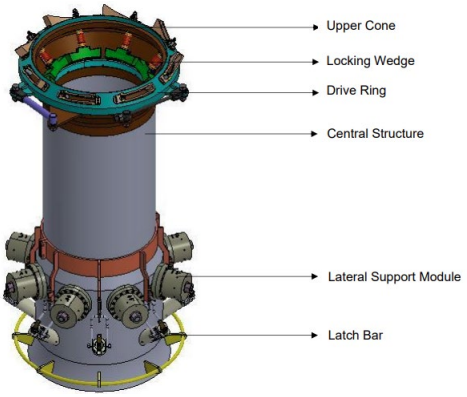

Figure 3: Unified Diverless Support Tube Assembly

5.3.5.2. Control, actuation and monitoring system for TSUDL, comprises:

- Hydraulic actuation with simple action hydraulic actuators installed on the Top Cone, MTLs and latch bars to unlatch the locks and release the riser at pull-out operations.
- Monitoring actuators position with LVDT to identify the complete unlatching of all actuators (applicable to Top Cone).
- Monitoring actuators position with end stroke sensor to identify the complete unlatching of all actuators (applicable to MTL and latch bars).
- Electrochemical potential monitoring to verify an indication of corrosion process.
- All tubing, fittings, electrical and optical cables and connectors.

5.3.5.3. For this project, FPU CONTRACTOR/SELLER shall provide 26 TSUDLs (See the latest revision of [6] to confirm the final amount).

5.3.6. DIVERLESS BELLMOUTH (BSDL)

5.3.6.1. BSDL is a device designed to support flexible line bend stiffener loads and allow diverless pull-in and pull-out operations. Three nominal sizes of BSDL-SI are considered: 32”, for umbilical lines, 46” and/or 48” for flexible production, service, export or gas/water injection lines. *Figure 4* shows BSDL with hydraulic actuator system.

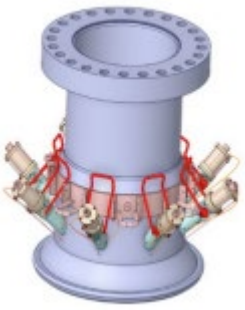

Figure 4: BSDL with Hydraulic Actuator System

5.3.6.2. Control, actuation and monitoring system for BSDL-SI, comprises:

- Hydraulic actuation with simple action hydraulic actuators installed on BSDL round blocks to unlatch the locks and release bend stiffener’s adaptor cap at pull-in and pull-out operations.
- Monitoring actuators position with end stroke sensor to identify the complete unlatching of all actuators.
- Electrochemical potential monitoring to verify an indication of corrosion process.
- All tubing, fittings, electrical and optical cables and connectors.

5.3.6.3. For this project, FPU CONTRACTOR/SELLER shall provide 24 instrumented BSDLs (See the latest revision of [6] to confirm the final amount).

5.4. HULLSIDE UMBILICAL DESIGN

5.4.1. The hullside umbilical is a multipurpose structure that has the function to provide an interconnection between lower and upper riser balcony, through electrical, optical and hydraulic circuits. These circuits shall attend, for this project, the following:

- BSDL actuation system
- BSDL monitoring system
- TSUDL actuation system
- TSUDL monitoring system
- Rigid Riser Monitoring System (RRMS)

5.4.2. FPU CONTRACTOR/SELLER's design shall consider a minimum of 10 hullside umbilicals. The final quantity shall be issued in a TQF for PETROBRAS approval.

5.4.3. FPU CONTRACTOR/SELLER shall provide umbilical type with the following requirements:

- Hydraulic control: 20 x 3/8" thermoplastic hoses (DWP = 7500 psi)
- Low voltage electrical cable: 18 QUADS x 2.5 mm² 0.6/1.0(1.2) kV
- Optical cables: 40 single mode optical fiber cores

5.4.4. FPU CONTRACTOR/SELLER's design shall attend the following requirements for Lower Termination's connectors, covering the maximum scenario of 4 TSUDLs, as shown in *Figure 5*:

- 20 hydraulic pigtails, mounted with medium pressure hydraulic connector, as per ref. [10] (i.e., 4 hydraulic lines for each TSUDL, summing up to 16 lines + 4 spare hydraulic lines);
- 6 wet-mate electrical connectors of 12 ways (i.e., 4 WMC for RRMS + 1 WMC for CANBUS HUB + 1 WMC spare);
- 5 internal optical penetrators + 1 optical wet-mate connector of 8 ways (i.e., 4 WMC for RRMS + 1 WMC spare).

5.4.5. All spare hydraulic connectors shall be supplied with a protective cap.

5.4.6. All spare electrical and optical connectors shall be supplied with a long-term dummy connector, as per specification in [5].

5.4.7. If the arrangement holds BSDLs or a smaller quantity of TSUDL, FPU CONTRACTOR/SELLER shall still meet the minimum quantity of spares mentioned above and the general design, as instructed in the umbilical termination.

5.4.8. Each TSUDL shall have an electrical WMC and optical WMC assembled on a support structure for future offshore mounting the RRMS riser cabling.

5.4.9. For CAN HUB (aka Subsea Junction Box) connection, FPU CONTRACTOR/SELLER shall supply 4-ways wet-mate connectors.

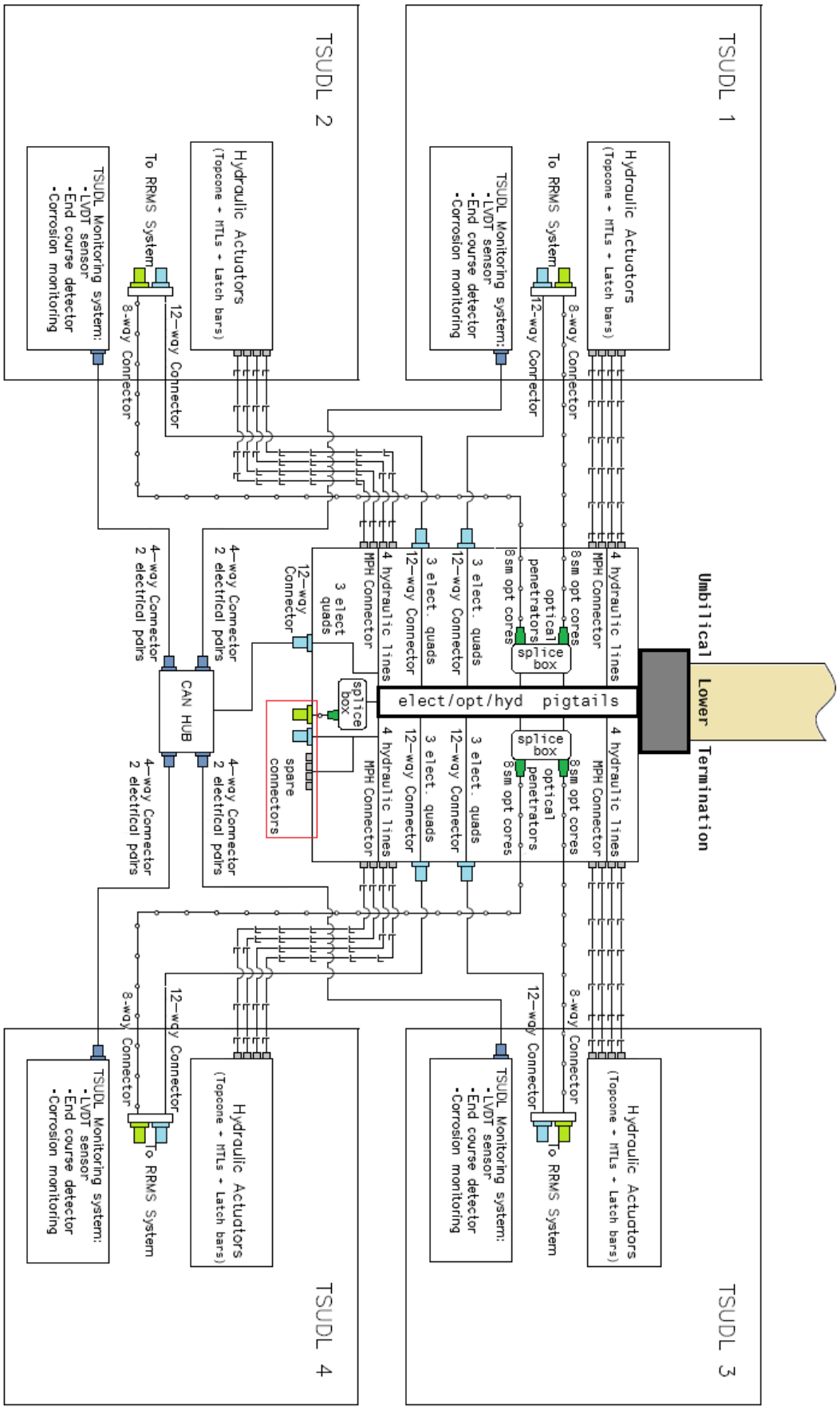

Figure 5: General Schematic of Umbilical Lower Termination covering 4 TSUDLs

5.5. RISER INTERFACE CABINET DESIGN

5.5.1. The Riser Interface Cabinet is a multipurpose cabinet that will be shared among the following monitoring systems:

- MODA (Brazilian acronym for Flexible Riser Monitoring System) - Section 5.1
- RRMS (Rigid Riser Monitoring System) – Section 5.2
- RSMS (Riser Supports Monitoring System) – Section 5.3

5.5.2. It is FPU CONTRACTOR/SELLER responsibility to supply and install Riser Interface Cabinet in Electrical Module.

5.5.3. It is FPU CONTRACTOR/SELLER responsibility to supply, install, test and commission all equipment that will be used in the Riser Interface Cabinet, including auxiliary equipment such as circuit breakers, terminals.

5.5.4. The Riser Interface Cabinet shall be located side by side with the MODA Cabinets and the RRMS Cabinets as illustrated on Figure *6*.

5.5.5. The Riser Interface Cabinet shall have the minimum dimension of 1000mm X 1000 mm X 2000 mm. All cables shall be terminated in proper terminals to provide the correct interface with its corresponding system.

5.5.6. FPU CONTRACTOR/SELLER shall provide bottom cable access between the Riser Interface Cabinet and other monitoring systems cabinets. All cabling and interconnections are FPU CONTRACTOR/SELLER responsibility.

5.5.7. FPU CONTRACTOR/SELLER shall provide GPS & AHRS data from Positioning System (POS) in full & half-duplex RS-485 standards at the Riser Interface Cabinet. The connections shall be as described in Table *1*:

Table 1: Position System (POS) cable configuration

Cable Specification	No. of Runs	From/To	Termination	Intended Function
Signal – 4 TSPs 1.5 mm²	4	Riser Interface Cabinet to FPU Positioning System	Serial Device Server inside Riser Interface Cabinet	FPU Positioning System (POS)

5.5.8. FPU CONTRACTOR/SELLER shall provide GPS & AHRS data from Positioning System (POS). The POS system shall broadcast FPU position to the Riser Interface Cabinet by means of four (4) data connection loops:

a) GPS NMEA 0183 link: GGA, GSA, GSV and ZDA – Channel A
b) GPS NMEA 0183 link: GGA, GSA, GSV and ZDA – Channel B
c) AHRS TSS1 link: FPU attitude in TSS1 protocol
d) AHRS NMEA 0183 link: HDT message

5.5.9. FPU CONTRACTOR/SELLER shall supply and install in the Riser Interface Cabinet a Serial Device Server, capable to retrieve required information from the FPU Positioning System (POS).

5.5.10. The **Serial Device Server** shall have the following minimum requirements:

- Retrieve all the information required from the POS and transmit via IP to other monitoring systems (e.g. RRMS and RSMS)
- Serial Ports capable to retrieve information through RS 232, RS 422 and RS 485
- Ethernet Ports capable to send desired information to other monitoring systems
- Operational Temperature: -40 °C to 75 °C
- Humidity: 5% to 95%
- Rack Mounted or DIN-rail

5.5.11. The **Network Switch(es)** shall have the following minimum requirements:

- Gigabit Ethernet ports to accommodate all FBG interrogators and servers computers from the MODA Cabinet
- Support Spanning Tree Protocols, Virtual Local Area Networks, Link Aggregation, Flow Control, Class of Service, Remote Access, Simple Network Management Protocol, Remote Network Monitoring
- Rack Mounted

- Height: 1U

5.5.12. FPU CONTRACTOR/SELLER shall provide spare space for an additional serial device server for future use. Spare space may be either rack mounted or DIN-rail depending on the one chosen for the project.

5.5.13. FPU CONTRACTOR/SELLER shall submit a TQF containing the detailed model of the proposed Serial Server for PETROBRAS review and approval before making order.

5.5.14. FPU CONTRACTOR/SELLER shall provide in the Riser Interface Cabinet connection to PETROBRAS Corporative Network as detailed in Table *2*.

Table 2: Common topside cabling PETROBRAS Corporative Network

Cable Specification	No. of Runs	From/To	Termination	Intended Function
Shielded CAT-6 Ethernet cable	4	Riser Interface Cabinet to FPU PETROBRAS network switch	Standard RJ-45 female patch panel inside Riser Interface Cabinet.	PETROBRAS corporative network

5.5.15. FPU CONTRACTOR/SELLER shall provide power supply from FPU normal bus. FPU CONTRACTOR/SELLER shall install an UPS in Riser Interface Cabinet to supply power to Riser Interface Cabinet components and RSMS System equipment. FPU CONTRACTOR/SELLER shall calculate estimated power consumption considering a voltage of 220VAC 50/60Hz and 3KW consumption for Riser Interface Cabinet. The UPS shall feed each cabinet for 30 minutes at least, in case of feeding fail.

5.5.16. For each UPS, FPU CONTRACTOR/SELLER shall provide surge protectors connected to FPU grounding system.

5.5.17. **MODA Interface**

5.5.17.1. This section will cover the Riser Interface Cabinet features that are related to the MODA System.

5.5.17.2. FPU CONTRACTOR/SELLER shall provide electrical cables, according to MODA Technical Specification [1], connecting MODA JBs to Riser Interface Cabinet. Electrical cables shall be proper terminated in SAK terminals.

5.5.18. **RRMS Interface**

5.5.18.1. This section will cover the Riser Interface Cabinet features that are related to the RRMS System.

5.5.18.2. FPU CONTRACTOR/SELLER shall provide all deck cable terminations (electrical and optical) according to RRMS Technical Specifications [5], connecting Monitoring Riser JBs to Riser Interface Cabinet.

5.5.18.3. All Deck Cables (electrical and optical) shall be connected on RRMS Cabinet(s) by Riser Interface Cabinet bottom cable access.

5.5.18.4. RRMS Cabinet(s) shall receive information from the FPU Positioning System (POS) as described in Section 5.5.8 through IP address. Connection to RRMS Cabinet(s) shall be done by bottom cable access.

5.5.18.5. RRMS Cabinet(s) shall be interconnected to PETROBRAS Corporative Network as described by 5.5.14. Connection to RRMS Cabinet(s) shall be done by bottom cable access.

5.5.19. **RSMS Interface**

5.5.19.1. This section will cover the Riser Interface Cabinet features that are related to the RSMS System. Riser Interface Cabinet comprises all the Riser Support System (RSMS) functionality.

5.5.19.2. FPU CONTRACTOR/SELLER shall provide all deck cable terminations according to RSMS Technical Specifications, connecting Monitoring Riser JBs to Riser Interface Cabinet.

5.5.19.3. RSMS System shall receive information from the FPU Positioning System (POS) as described in Section 5.5.8 through IP address.

5.5.19.4. RSMS Cabinet(s) shall be interconnected to PETROBRAS Corporative Network as described by 5.5.14.

5.5.19.5. FPU CONTRACTOR/SELLER shall provide power supply to RSMS system from Riser Interface Cabinet UPS as described on 5.5.15.

5.5.19.6. Since RSMS System is entirely designed in the Riser Interface Cabinet, FPU CONTRACTOR/SELLER shall provide all the equipment that will be part of the RSMS system, including also auxiliary equipment for the correct operation of the system.

5.5.19.7. FPU CONTRACTOR/SELLER shall provide and install a dedicated Supervisory System in the Riser Interface Cabinet to communicate with the RTU (Remote Terminal Unit) and act as an interface to human operators and external systems of the monitoring system.

5.5.19.8. Riser Support Supervisory System shall be connected to FPU automation network and shall have a server installed in Riser Interface Cabinet to allow manage all system and register data log of all sensors.

5.5.19.9. Supervisory system shall be able to receive a customized input of FPU Positioning System.

5.5.19.10. The **KVM console switch(es)** shall have the following minimum requirements

- LCD KVM (Keyboard, Video, Mouse) console integrated with KVM switch
- Enough ports to accommodate all server computers (if applicable) of RSMS
- Minimum of 8 inputs
- Rack Mounted
- Height: 1U

5.5.19.11. The **Server Computer(s)** (aka SCADA Master Station) shall have the following minimum requirements:

- Processor clock: 2x Intel Xeon-G 5220 18-Core (2.20GHz 24.75MB L3 Cache) or superior
- RAM memory: 32 GB or better
- 2 hard disk drives (SSD) of at least 1TB each
- 2 hard disk drives (HDD) of at least 4TB each for long term storage
- Support to RAID technology (use RAID-1 at final installation)
- 2 Ethernet ports
- Operational system: Microsoft Windows with licenses
- Software: SCADA Automation software with all licenses and requirements
- Rack Mounted

5.6. MAIN DECK INFRASTRUCTURE

5.6.1. FPU CONTRACTOR/SELLER shall provide all the main deck infrastructure for the proper operation of the control, actuation and monitoring system.

5.6.2. Main deck equipment, such as Junction boxes, RSMS TUTU Plate, Local Panels and others will be fully described on each system technical specification (See references [1], [2], [3], [4], [5]) and summarized on Figure *6*.

6. SCOPE OF SUPPLY

Figure *6* shows the Block Diagram of the aforementioned systems and their scopes. This is a typical design of the project, summarizing the main functions of the system. However, the final block diagram shall follow the project's Technical Specifications and shall be submitted for PETROBRAS approval.

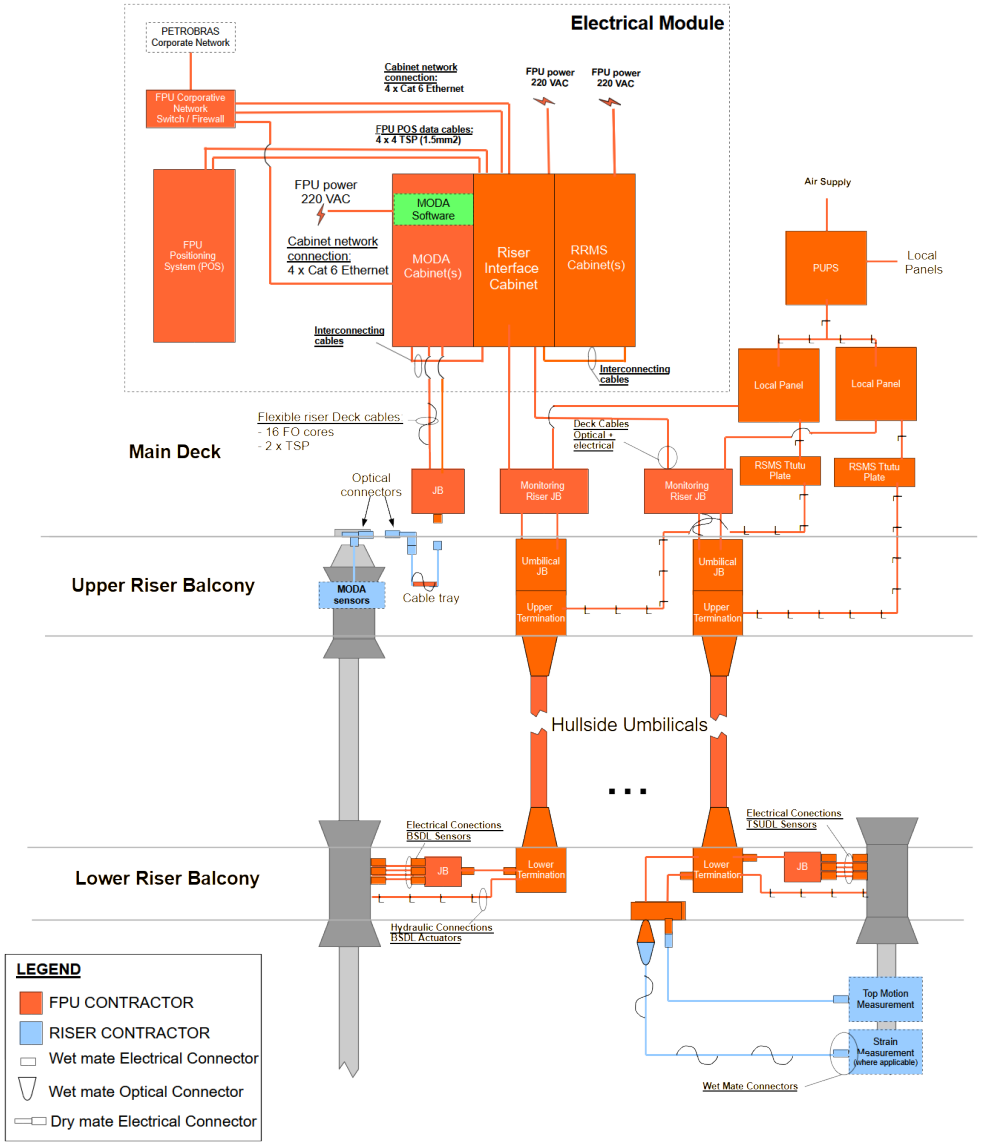

Figure 6: Schematical block diagram

7. PIPING & INSTRUMENTATION DIAGRAM

The images below show the representation of the P&ID drawings for each group of system. Figure 7 shows a general overview of the Control and Monitoring System for the riser supports (RSMS). Figure 8 shows the specific connections for TSDUL and Figure 9 for BSDL. Figure 10 and Figure 11 shows the connections for Upper Balcony (TUTU Plate and Umbilical JB) and Main Deck (Riser JB, PUPS and Local Panel) equipments, respectively. These are a typical P&ID of the project, summarizing the main connections of the system. However, the final P&ID shall follow the project's Technical Specifications and shall be submitted for PETROBRAS approval.

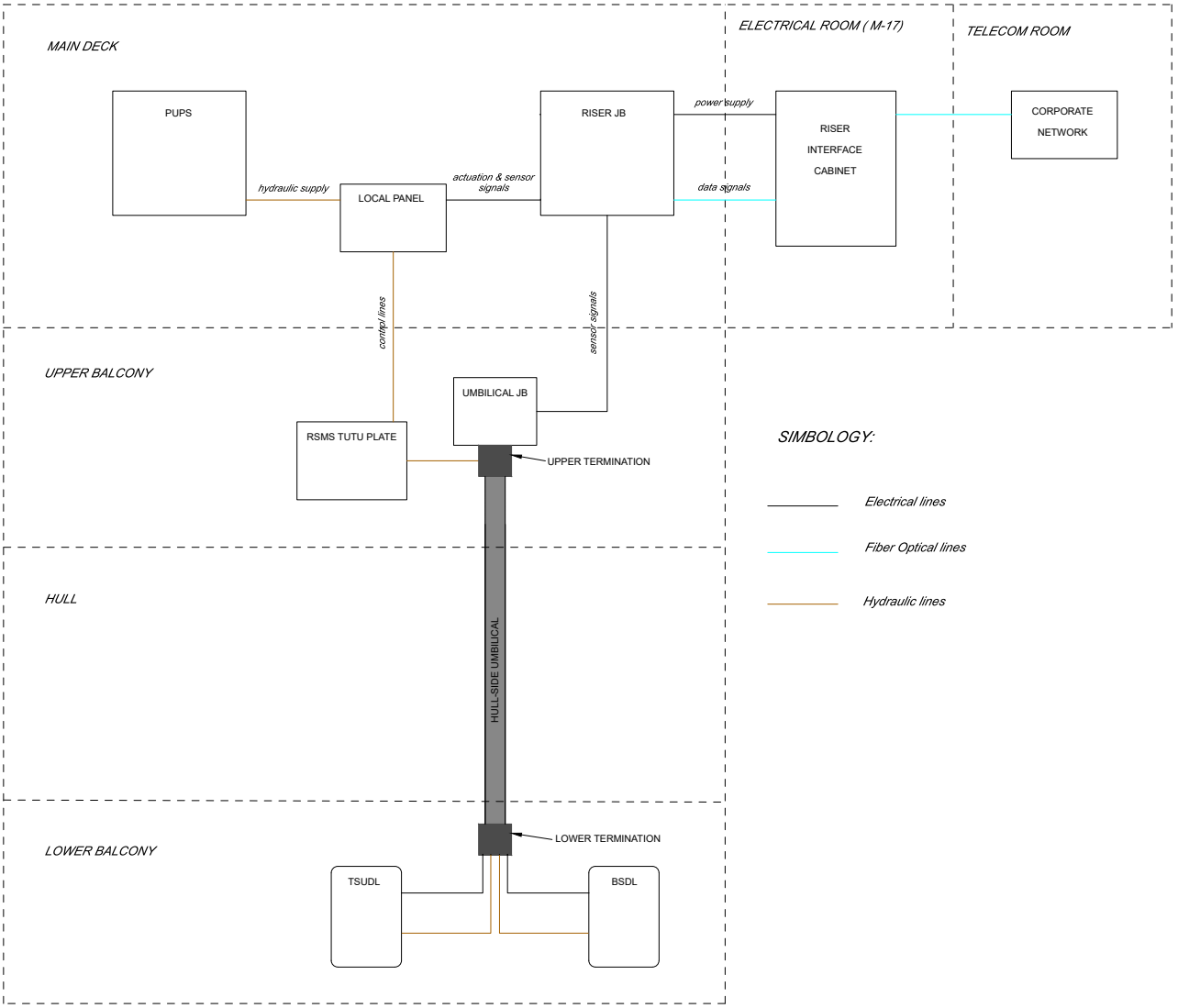

Figure 7: General P&ID

LOWER BALCONY

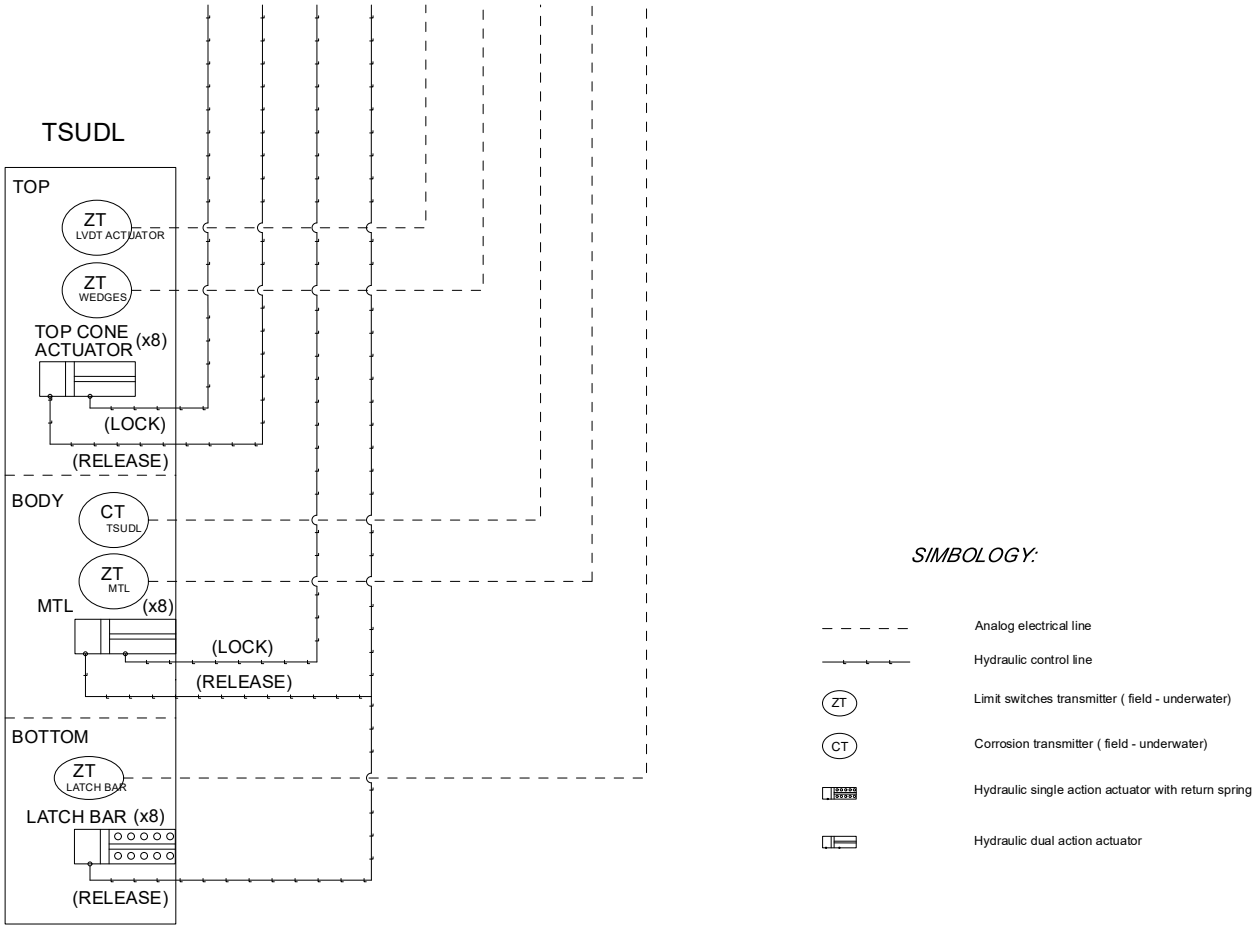

Figure 8: P&ID of TSUDL

LOWER BALCONY

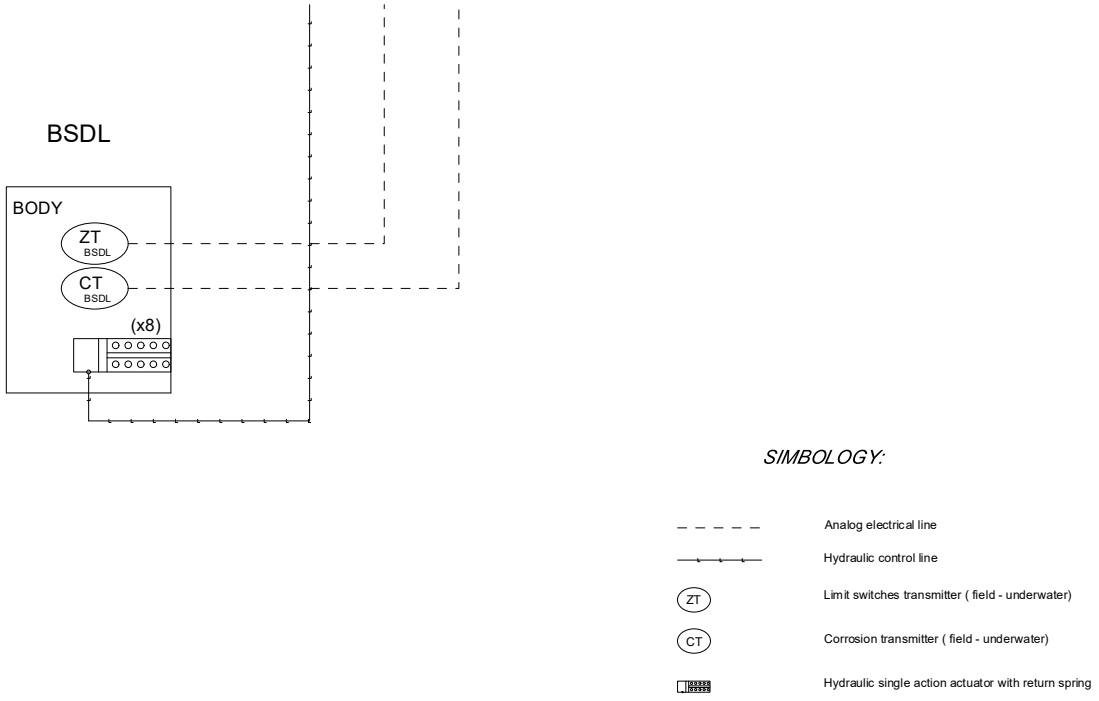

Figure 9: P&ID of BSDL

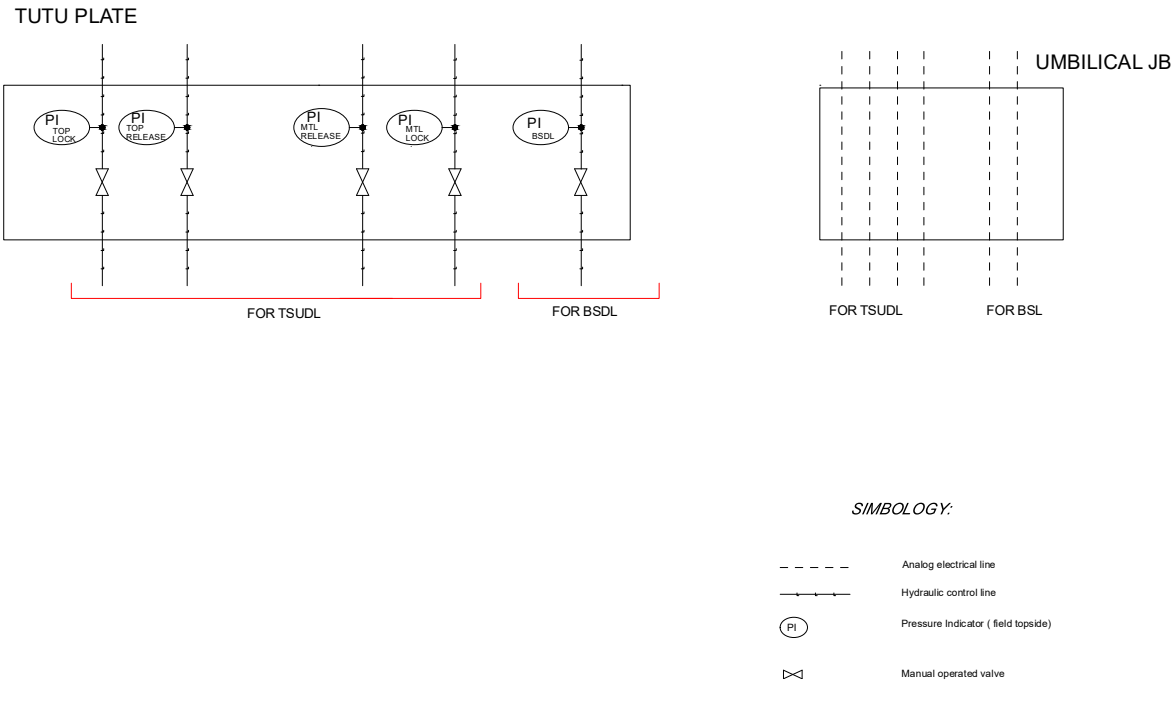

Figure 10: P&ID of TUTU Plate and Umbilical JB

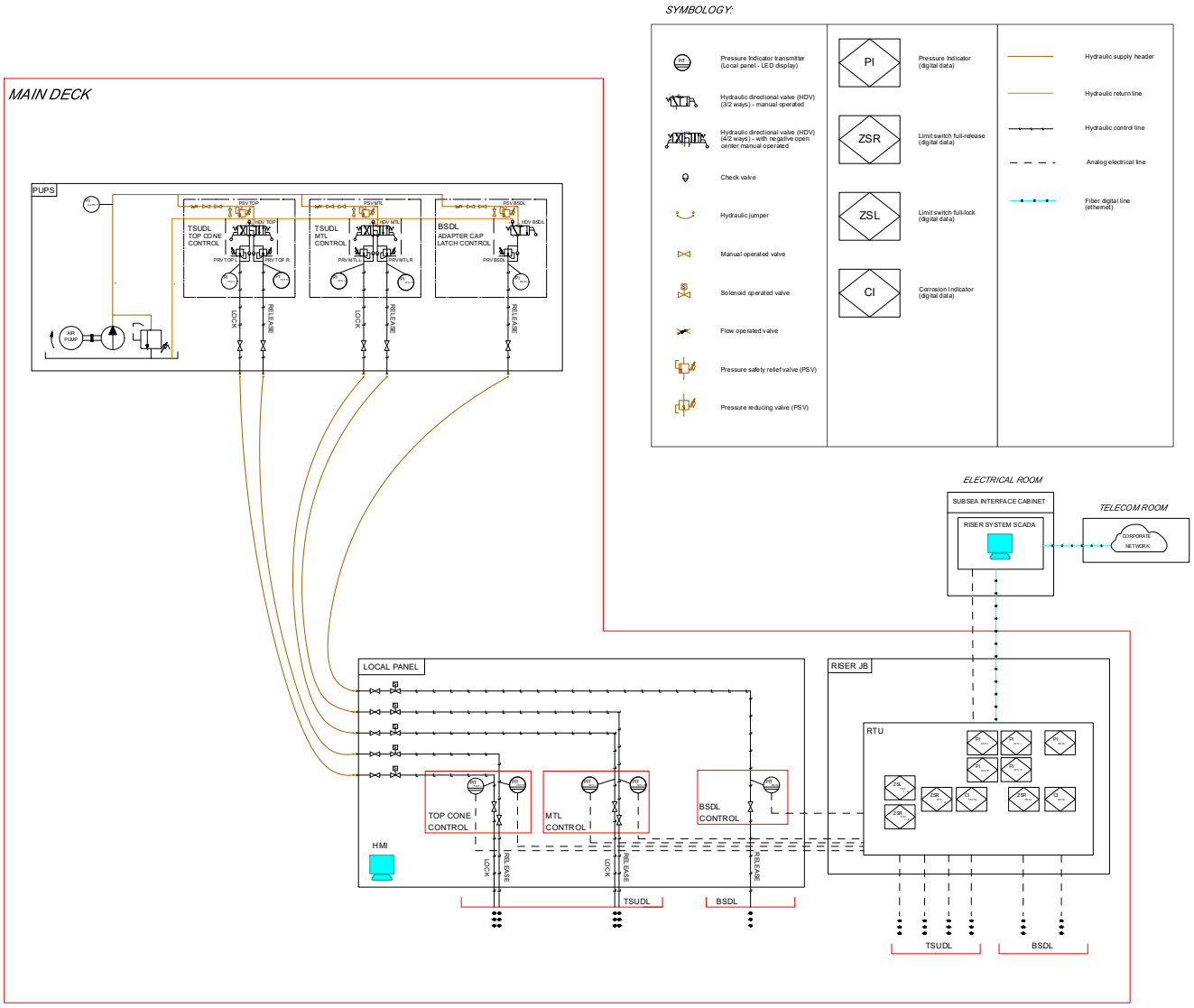

Figure 11: P&ID of PUPS, Local Panel and Riser JB