PETROBRAS	TECHNICAL SPECIFICATION	Nº I-ET-3010.00-5520-800-P4X-004	
	CLIENT:		SHEET 1 of 21
	JOB:		
	AREA:		
SRGE	TITLE: AUTOMATION NETWORK REQUIREMENTS		NP-1
			ESUP

MICROSOFT WORD / V. 365 / I-ET-3010.00-5520-800-P4X-004_A.DOCX

INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL ISSUE
A	REVISED WHERE INDICATED

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	AUG/25/20	AUG/19/22							
DESIGN	ESUP	ESUP							
EXECUTION	U44D	U5D6							
CHECK	U5D6	U44D							
APPROVAL	U49R	CDC1							

SUMMARY

1 INTRODUCTION

1.1 Objective

1.1.1 This specification describes the minimum requirements for the supply of equipment for all automation LAN network devices, to be installed at the UNIT, covering all equipment, material and certification tests.

1.1.2 Package units shall also abide to the requirements presented in this specification.

1.2 Abbreviations

ABNT	*Associação Brasileira de Normas Técnicas*
AC	Alternating Current
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
CAT	Category
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
DIO	Fiber Optic patch panel
EIA	Energy Information Administration
HTTP	HyperText Transfer Protocol
IEC	International Electrotechnical Commission
IGMP	Internet Group Management Protocol
INMETRO	*Instituto Nacional de Metrologia, Normalização e Qualidade Industrial*
IP	Ingress Protection
ISO	International Organization for Standardization
LACP	Link Aggregation Control Protocol
LAN	Local Area Network
LLDP	Link Layer Discovery Protocol
LSZH	Low Smoke Zero Halogen
MRP	Media Redundant Protocol
MSTP	Multiple Spanning Tree Protocol
MTE	*Ministério do Trabalho*
NEXT	Near-End Crosstalk
NTP	Network Time Protocol
OSPF	Open Shortest Path First
OTDR	Optical Time-Domain Reflectometer
PC	Physical Contact
PL	Permanent Link
PIM-SM	Protocol Independent Multicast - Sparse Mode
PIM-SSM	Protocol Independent Multicast - Source-Specific Mode
RADIUS	Remote Authentication Dial In User Service
RFC	Request For Comments
RJ-45	Registered Jack - 45
RSTP	Rapid Spanning Tree Protocol
SC	Square Connector
SNMP	Simple Network Management Protocol
SSH	Secure Shell
STP	Spanning Tree Protocol

TACACS	Terminal Access Controller Access-Control System
UTP	Unscreened Twisted Pair
U/UTP	Unscreened cable with Unscreened Twisted Pair
TIA	Telecommunications Industry Association
VDC	Volts of Direct Current
VLAN	Virtual LAN
VRRP	Virtual Router Redundancy Protocol

2 REFERENCE DOCUMENTS, CODES AND STANDARDS

2.1 **External references**

2.1.1 International Codes, Recommended Practices and Standards

ISO/IEC - INTERNATIONAL ORGANIZATION FOR STANDARDIZATION IEC - INTERNATIONAL ELECTROTECHNICAL COMMISSION / INTERNATIONAL ELECTROTECHNICAL COMMISSION

ISO/IEC 14763-2	Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and Installation
ISO/IEC 14763-3	Information technology – Implementation and operation of customer premises cabling – Part 3: Testing of Optical Fiber Cabling
ISO/IEC 11801-1	Information technology - Generic cabling for customer premises-Part 1: General requirements
ISO/IEC 11801-2	Information technology - Generic cabling for customer premises-Part 2: Office Premises
ISO/IEC 11801-3	Information technology - Generic cabling for customer premises-Part 3: Industrial premises
IEC 60754	Test on gases evolved during combustion of materials from cables
IEC 61034	Measurement of smoke density of cables burning under defined conditions
IEC 60332	Tests on electric and optical fibre cables under fire conditions

EIA/TIA - ENERGY INFORMATION ADMINISTRATION/ TELECOMMUNICATIONS INDUSTRY ASSOCIATION

EIA/ECA-310-E	Cabinets, Racks, Panels, and Associated Equipment
TIA-568.0-E	Generic Telecommunications Cabling for Customer Premises
TIA-568.1-E	Commercial Building Telecommunications Cabling Standard
TIA-568.2-D	Balanced Twisted-Pair Telecommunication Cabling and Components Standard
TIA-568.3-D	Optical Fiber Cabling And Components Standard
TIA-569-E	Commercial Building Standard for Telecommunication Pathways and Spaces
TIA-598-D	Optical Fiber Cable Color Coding
TIA-606-C	Administration Standard for Telecommunications Infrastructure
TIA-607-D	Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA-758-B	Customer-Owned Outside Plant Telecommunications Infrastructure Standard

OTHER STANDARDS

ASTM E662	Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
DEF STAN 07-247	Selection of Materials on the Basis of their Fire Characteristics
MIL-DTL-24643	General Specification for Cables, Electric, Low Smoke Halogen-Free, For Shipboard Use

2.1.2 Brazilian Codes and Standards

ABNT - ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS

NBR 14433	*Conectores de fibra óptica montados em mídias ópticas e adaptadores — Especificação*
NBR 14106	*Cordão óptico - Especificação*
NBR 14565	*Cabeamento estruturado para edifícios comerciais*

INMETRO - *INSTITUTO NACIONAL DE METROLOGIA, NORMALIZAÇÃO E QUALIDADE INDUSTRIAL*

PORTARIA Nº 115 (21/*MARÇO*/2022)	*REQUISITOS DE AVALIAÇÃO DA CONFORMIDADE PARA EQUIPAMENTOS ELÉTRICOS PARA ATMOSFERAS EXPLOSIVAS - CONSOLIDADO*

2.2 **Internal references**

2.2.1 Project Documents

I-ET-3010.00-5520-888-P4X-001	AUTOMATION PANELS
I-ET-3010.00-5140-700-P4X-003	ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS
I-ET-3010.00-5520-861-P4X-002	SUPERVISION AND OPERATION SYSTEM - SOS

2.2.2 Names below and respective document codes may vary according to each project but, in general, the following documents shall be considered along with this technical specification.

- AUTOMATION AND CONTROL SYSTEM FUNCTIONS
- AUTOMATION NETWORK DESCRIPTION
- INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS
- NETWORK INTERCONNECTION DIAGRAM

2.3 **Classification Society**

2.3.1 The DETAIL DESIGN PHASE shall be submitted to approval by Classification Society. The design and installation shall take into account their requirements and comments.

2.3.2 The design, installation and operation shall strictly follow the classification society requirements, along with the specific requirements identified in this document, including also all referenced documents' requirements.

2.4 All MTE – Ministério do Trabalho regulations (NRs) shall be followed. Brazilian regulation (MTE section) and INMETRO regulation superpose all codes and regulations listed in item 2, since they are enforced by Brazilian law.

3 ENVIRONMENTAL AND OPERATION CONDITIONS

3.1 For operational and environmental conditions additional to this section, see INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS.

3.2 All materials used shall be non-hygroscopic, flame retardant and resistant to corrosion caused by marine environmental and hydrocarbon continuous contact.

3.3 Equipment shall be suitable to withstand the dynamic loads imposed by the vessel motions during tow and on location.

3.4 All panels, materials and equipment proper to be used in hazardous areas, shall have conformity certificates complying with "PORTARIA INMETRO Nº 115, de 21/março/2022" and its annexes, and shall be approved by Classification Society. All equipment installed in outdoor areas shall be suitable for Zone 2, Gas Group IIA, T3 IP 56. All equipment installed in non-classified indoor areas shall have ingress protection of IP 20. For further details regarding automation panels, see I-ET-3010.00-5520-888-P4X-001 – AUTOMATION PANELS.

3.5 All electrical and electronic devices, beyond mechanical parts of the equipment, shall be designed and constructed in a tropicalized version. Tropicalization process comprises application of reinforced protective resin and fungus proof coating in all printed circuit boards, use of anti-rust materials and accessories and other implementations according to MANUFACTURERS' experiences and related rules, aiming to provide a robust and reliable construction.

4 POWER REQUIREMENTS FOR ALL EQUIPMENT AND RACKS

4.1 Regarding power supply all Automation equipment and network devices, the available power supplied by the UNIT to be used by the Automation panels and racks is defined in I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS. It is part of the rack SUPPLIER's scope to acquire all internal components complying with the given power supply characteristics; or to provide, where necessary, redundant AC/DC or DC/DC stabilized power supply units for the non-compliant devices (without additional costs to PETROBRAS).

4.2 All equipment and network devices datasheets shall include, for information purposes: nominal power, real power consumption, dissipated power, power factor.

5 STRUCTURED CABLING

5.1 The description below aims to establish the requirements of the automation Network in accordance with the requirements of TIA-568.0-E and ISO 11801 for CAT 6A.

5.2 The structured cabling network shall follow the CAT 6A Certification and the Standards TIA-569-E, TIA-606-C, TIA-607-D, ABNT NBR 14565 and ISO/IEC 11801. Besides that, all physical solution shall be in accordance with the standards TIA-568 in their latest revisions.

5.3 **General criteria regarding all types of Automation Network Cabling**

5.3.1 All cables (UTP/STP CAT 6A and Optical) shall possess the UL Register and Certification via Laboratory of international recognition for parameters that attend the Standards.

5.3.2 All patch cords (Optical or Metallic) shall be purchase tested and certified. PETROBRAS shall not accept patch cords built in the field.

5.3.3 All spare cables and spare patch cords shall also be purchase tested and certified.

5.3.4 Different colors shall be used for each patch cord that belong for each routing domain according to PETROBRAS definition (Figure 5.1).

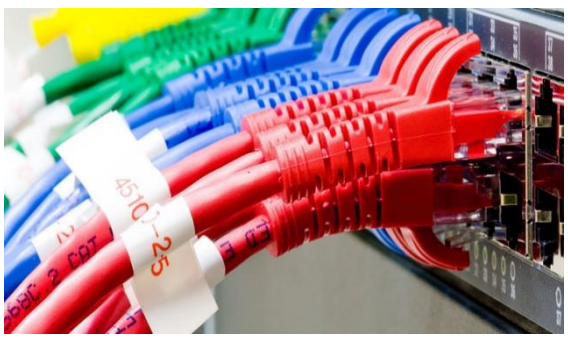

Figure 5.1– Different colors for each routing domain.

5.3.4.1 As a recommendation for SOS, the following colors may be used for the patch cords:

- Data Acquisition LAN Primary: blue
- Data Acquisition LAN Secondary: blue
- SOS LAN primary: white
- SOS LAN secondary: white
- Package LAN primary: black
- Package LAN Secondary: black

5.3.4.2 As a recommendation for CSS/HCSS, the following colors may be used for the patch cords:

- HSDN Primary: red
- HSDN Secondary: red
- Data Acquisition LAN Primary: blue
- Data Acquisition LAN Secondary: blue
- RIO Network Primary: orange
- RIO Network Secondary: orange

5.4 **UTP Cable**

a. Twisted pair cable (UTP) shall comply with the requirements of TIA-568.0-E, TIA-568.2-D and ISO 11801 for Category 6A (CAT6A).
b. The LAN cabling system shall use LSZH (Low Smoke Zero Halogen) UTP CAT 6A cable or other submitted for PETROBRAS approval.
c. All UTP CAT 6A cabling shall be terminated in the CAT 6A Patch Panels with 24 positions (1U high) inside the automation rack.
d. All the UTP cables shall have both ends identified. All the other components of the network shall be identified in the same way: patch panel, fiber optic cables, patch cords and sockets.
e. All connections shall be according to T568A standard.
f. UTP cables shall attend the Standards and composed for 04 (four) pairs of equal, 23 AWG, 100 Ohms, rigid copper drivers with isolation in high density polyethylene, with electric and mechanics characteristics compatible with the established patterns and tested up to 10 GHz. It shall have a cover fire retardant type LSZH.
g. Proper shielded cable (STP) shall be considered whenever electromagnetic interference risks to affect the quality of service. During commissioning, if any type of signal disturbance is detected and affects the service (for instance, monitor twinkle), the system correction shall be performed, and the cable type shall be replaced to proper shielded cable.

5.5 **Optical Cable**

a. Areas outside the accommodation, in the industrial (oil production) area or areas where cable lengths exceed 100 meters shall be cabled with optical fiber according to TIA-568.0-E, TIA-568.3-D, as described below.
b. Optical fiber cable with at least 6 multimode fibers 62.5 x 125 (OM1) with SC optic termination for 1 Gbps links and Optical fiber cable with at least 6 multimode fibers 50 x 125 (OM3) with SC optic termination for 10 Gbps links.
Reminder Note: 10 Gbps optical links are present in the 3 main rings of the Automation Network (SOS SUPERVISORY LAN, CSS DATA ACQUISITION LAN, PACKAGE UNITS

LAN), refer to NETWORK INTERCONNECTION DIAGRAM. All other connections are 1Gbps links (either optical or electrical).

c. Fiber Optic shall be terminated in proper optical patch panel with SC termination and media converter (GigaEthernet RJ-45 electrical to SC optical termination) 19" rack standard inside Automation Panels.
d. Optical cables shall be tight buffered.
e. The optical fibers external jacket shall be flame retardant PVC, LSZH, nonadherent, without rugosity, fully waterproof (longitudinally and radially), with protection against UV (ultraviolet) radiation, petrochemical agents and fungus. The coating shall be uniformly colored, with superficial finishing without roughness.
f. The optical cable shall be made with dielectric material, without metallic components.
g. The optical fibers shall be assembled constituted by fiber optic with primary covering in acrylic and secondary covering in material colored polymer, gathered and covered by dielectric synthetic fibers for mechanical support (resistance to the traction), composing the optical core of the cable. This core shall also have high mechanical rigidity to protect the optical fibers.
h. Their connection capability shall be direct -"breakout" type.
i. The optical cable minimum tensile load rating shall be greater than 2,000 N (short-term)/800 N (log-term) and be able to bear bending with minimum radius less than 10 (ten) times the outside diameter of the cable.
j. Cables shall have UL-listed Riser-rated OFNR, MSHA and Classification Society certifications.
k. Cables shall comply with the following standards:
    - ASTM E662 (Density of Smoke);
    - DEF STAN 07-247 (Toxicity index);
    - MIL-DTL-24643 (acid gas test);
    - TIA-758-B (Water blocked);
    - TIA-568/TIA-598-D (Buffer color codes).
l. There shall be at least 10% of installed spare optical fibers between any two devices where a connection is foreseen. For example, if a connection between two devices takes three fibers, an additional fiber shall be foreseen as spare. Since the optical cable has at least 6 fibers, this would not be an issue in this case. However, for example, if a connection between two devices uses 6 fibers and the optical cable has only 6 fibers, an additional optical cable shall be installed in order to allow for eventual future connections (an optical cable with more fibers could also be used).

5.6 CAT 6A RJ45 Female Connectors

5.6.1 The RJ 45 female connectors shall comply with the requirements of Standard TIA 568.2-D Category 6A and shall be used as access points in the work areas (outlets).

5.7 Patch Cords

5.7.1 Patch cords shall be factory-tested, with RJ45 connectors, unshielded balanced cable (U/UTP), consisting of four conductors in hard copper, nominal diameter of 23 AWG and insulation in high-density polyethylene, according to the standard ABNT NBR 14565.

5.7.2 All patch cords shall be factory tested for Cat.6A of TIA-568.2-D.

5.7.3 Patch cords performance values shall be in the middle of the range of values determined by ANSI / EIA / TIA for NEXT.

5.7.4 To present a halogen-free structure and flame retardant composition with LSZH denomination, complying with the specification of non-propagation of fire, including vertical burning, acidity degree and low gas emission, complying with the following standards: IEC 60754, IEC 61034 and IEC 60332.

5.7.5 Connectors in accordance with the T568A schematic.

5.8 **Racks**

5.8.1 Racks containing LAN network equipment shall follow the requirements defined in document I-ET-3010.00-5520-888-P4X-001 – AUTOMATION PANELS. Besides, racks containing network equipment shall also comply with the following additional requirements:

5.8.1.1 Minimally, 02 (two) fans shall be installed at the top and two fans at the bottom of rear door for air heat exchange. More fans may be required in order to comply with the temperature constraints presented in document INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS.

5.8.1.2 At least, 02 (two) Vertical cable organizers shall be installed per panel

5.8.1.3 Internal lights shall be installed per panel.

5.8.2 A schematic for the internal components of each Server/Switch rack is presented in document AUTOMATION AND CONTROL SYSTEM FUNCTIONS. This schematic is preliminary and shall be updated during detail engineering design with the real components' dimensions. However, as much spacing between the components as possible shall be foreseen, in order to allow air circulation and cooling of the components.

5.8.3 19" racks shall have backside vertical guide in order to support cable rising –Figure 5.2.

Figure 5.2 – Cable termination at terminating hardware (Backside View).

5.9 Cable organizer

5.9.1 It shall be installed one 19 inches closing horizontal cable organizer with 1U between each switch installed inside the automation rack.

5.10 CAT 6A Patch panels

5.10.1 Patch Panel shall be metallic with 19 inches width, according to EIA/ECA-310-E, with 24 RJ-45 female ports and 1U of height.

5.10.2 Patch Panel shall have backside horizontal guide in order to avoid a vertical tension and preserve electrical contact – Figure 5.3.

Figure 5.3 - Patch panel (horizontal guide).

5.11 DIO – Fiber Optic patch panel

5.11.1 All fibers inside the automation racks shall be terminated in fibers optic patch panels - DIO. It shall be 19 inches 1U rack mounted, front articulated drawer type, steel frame.

5.11.2 Equipped with optical cable assembling kit, fusion splice protectors and fiber storage for all fibers.

5.11.3 These patch panels shall have a splice tray compartment to hold the connections between the fiber optic cables and the patch cords (pigtails).

5.11.4 The patch panels shall have capacity for all the fibers of the cable.

5.11.5 All pig tails and adapters shall be terminated in a SC connector.

5.12 Fiber Optic Patch Cord

5.12.1 The connectors shall be compatible with equipment and DIOs.

5.12.2 The polishing of the connectors shall be PC type.

5.12.3 The optical cords shall comply with the ABNT standards NBR 14433 e ABNT NBR 14106.

5.12.4 Patch cords (pigtails) shall be prefabricated and have the same optical fiber specification.

5.12.5 The cable shall have the coating made of polyamide or polypropylene.

5.12.6 The traction element shall be entirely dielectric, and may be made of Kevlar.

5.12.7 The outer jacket shall be flexible, made of a non flammable material.

5.12.8 The cord shall have 6 (six) meters length and one of the ends shall have an SC connector.

5.12.9 The connector shall be caged to the traction element of the patch cord to allow a shot-term 500 N tensile load.

5.12.10 The cord and the connector shall have attenuation lower than 0.1 dB.

5.13 Cable Trays

5.13.1 All UTP/STP and Optical Cables shall be placed in dedicated cable trays throughout pathway in order to provide mechanical protection for all cabling. All cable trays shall be designed to provide sufficient space for scalability, i.e., there shall be, at least, 30% free space.

6 REQUIREMENTS FOR HOOK-UPS AND INSTALLATION

6.1 The point-to-point physical communication channel (optical or metallic data) shall be through a cross-connect interconnection as shown in Figure 6.1.

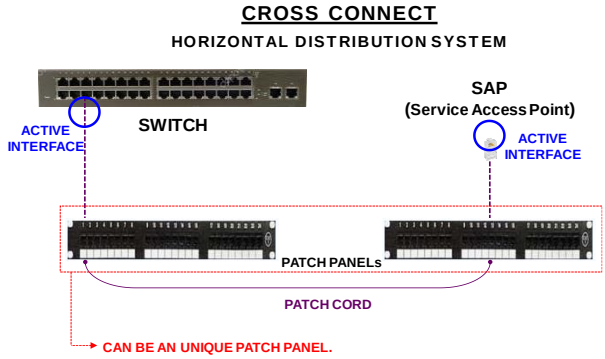

Figure 6.1 – Cross Connect – Interconnection Model.

6.2 The point-to-point physical connection that provides an end-to-end communication channel (optical or electrical data) between active interfaces shall not be performed by a direct connection. All optical/metallic data connection shall be terminate in DIO / Patch Panel passive components as show in Figure 6.1, Figure 6.2 and Figure 6.3.

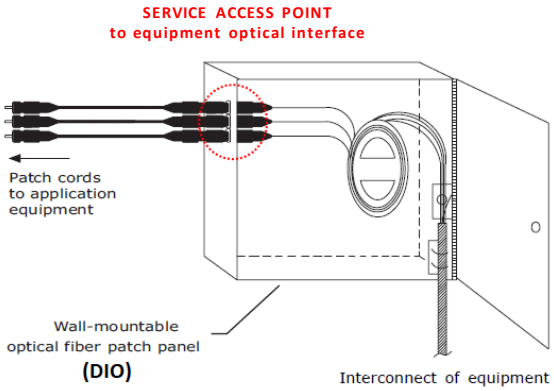

Figure 6.2 – Optical connection from optical equipment interface to DIO.

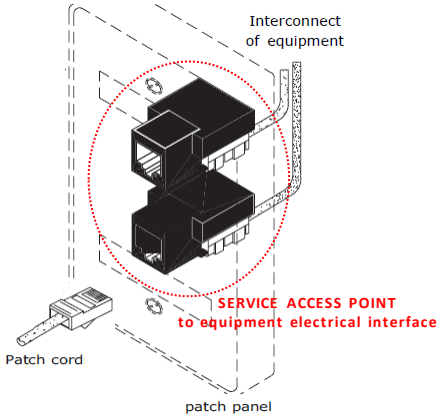

Figure 6.3 – Connection from equipment data interface to patch panel.

6.3 All cable termination (including connections between terminating hardware located in different panels) shall be done at the backside of the terminating hardware (metallic data UTP cable - patch panel or optical cable - DIO) in a female connector in order to provide the service access point to each interface at the front side of the terminating hardware (as shown in Figure 6.5).

6.4 Cable connections between different panels shall be routed incoming and outgoing from/to below of the panels.

6.5 Cable trays curves shall be designed in order to take into account cable's minimum bend radius.

6.6 Automation Structured Cabling System Detailed Project shall consider maximum vertical rise requirement. The maximum vertical rise is the distance over which the cable is vertically self-supporting. This distance is a function of the weight of the cable and its maximum tensile rating.

6.7 Automation Structured Cabling System Detailed Project shall consider maximum length cable requirement.

6.8 Metallic UTP or optical patch cords (jumpers) shall be used to interconnect terminating hardware sockets (Patch Panel/DIO ports) and close the end-to-end communication channel. This method minimizes accidental damage to the backbone or horizontal cable.

Figure 6.4 – Routing patch cord from cable organizer.

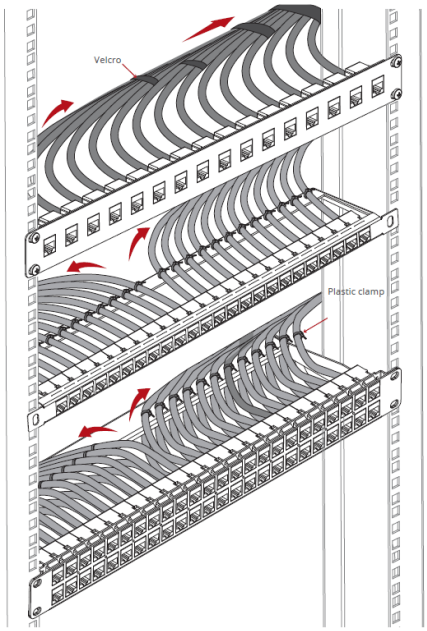

Figure 6.5 – Cable termination at terminating hardware (Front View).

6.9 All metallic components (cable and infrastructure) shall be grounded as IEC 61892 standards.

6.10 CANCELLED

Figure 6.6 – CANCELLED.

6.11 Automation Structured Cabling System Detailed Project shall consider remainder cable below rack under raise floor as showed in Figure 6.7.

Figure 6.7 – Remainder cable (under rack).

6.12 Cable trays deviate shall be designed in order to take into account cable's minimum bend radius Figure 6.8.

Figure 6.8 – Cable trays deviate (respecting minimum bend radius).

6.13 All cabling (UTP/STP and Optical Cables) shall be identified in both extremities, using polyester labels printed mechanically in an indelible way. In the same way all the other components of the network, such as Patch Panels, DIOs, Patch Cords and Sockets, shall be identified.

6.14 DIO assembling shall be mounted as shown in Figure 6.9.

Figure 6.9 – Connection from equipment data interface to patch panel.

6.15 Cable installation shall not exceed the cable's minimum bend radius. Optical fiber cables shall have a minimum bend radius of 10 times the cable's outside diameter when under no load and 20 times the cable's outside diameter when being pulled.

6.16 Patch cords from Patch Panels / DIOs shall be routed behind cable organizer (one cable organizer per Patch Panel / DIO).

6.17 The organization of the cables inside the racks shall use only velcro. On cable trays, the cabling shall be tied with black plastic tie wraps.

6.18 Optical fiber shall only be splicing by fusion method. Optical fiber adapter shall not be acceptable and shall not be used to extend or connect cable segment in order to guarantee the optical link and avoid additional signal attenuation.

7 EQUIPMENT DESCRIPTION - SWITCHES

7.1 SWITCHES

7.1.1 This technical specification describes the following switch sets:

a. L2 Switches

b. L3 Switches

7.2 Technical Characteristics common to all Switches

7.2.1 All Switch sets of this specification have the main purpose of Ethernet frame switching, providing connectivity to the local automation network and shall have the following technical characteristics.

7.2.2 All Switches shall be managed.

7.2.3 Protocols and Functions

7.2.3.1 Spanning Tree Protocol - STP, according to standard 802.1d-2004 (MAC Bridges - Spanning Tree/Rapid Spanning Tree);

7.2.3.2 Rapid Spanning Tree Protocol - RSTP, according to standard 802.1w-2001 (Rapid Spanning Tree), current addition of standard 802.1d-2004;

7.2.3.3 Multiple Spanning Tree Protocol - MSTP, according to standard 802.1s-2002 (Multiple Spanning Tree) current addition of standard 802.1q-2011;

7.2.3.4 VLAN Tagging, according to standard 802.1q-2011 (Virtual Bridged LAN - VLAN/Multiple Spanning Tree);

7.2.3.5 Link Aggregation, according to standard 802.3ad, 802.1ax-2008 with LACP support;

7.2.3.6 Flow Control, according to standard 802.3x-1997 (Flow Control at Gigabit Uplink and Full duplex port);

7.2.3.7 Link Layer Discovery Protocol – LLDP, according to standard 802.1AB (Station and Media Access Control Connectivity Discovery);

7.2.3.8 All switch ports shall have port mirroring capabilities (i.e. the traffic of any number of ports may be copied to a target port);

7.2.3.9 Simple Network Time Protocol – SNTP, according to RFC 4330. All switches shall allow synchronization with SNTP, and they shall distribute SNTP packets to all other devices in the network, so that the devices shall also synchronize;

7.2.4 Management Characteristics

7.2.4.1 SSHv2 Remote Access via SSHv2;

7.2.4.2 Authentication via RADIUS or TACACS+ server;

7.2.4.3 Support IGMPv2 and IGMPv3, as well as the snooping process according to the proposed standards RFC 2236 - Internet Group Management Protocol, version 2 (11/1997) and RFC 3376 - Internet Group Management Protocol, version 3 (10/2002).

7.2.4.4 Syslog, according to RFC 5424 (The Syslog Protocol);

7.2.4.5 Network Time Protocol, according to RFC 1305;

7.2.4.6 If management is supported through a web interface, it shall be via HTTPS.

7.2.4.7 Support SNMPv2 and SNMPv3 protocols. SNMPv3 shall also be available with encryption.

7.3 Technical Characteristics for L2 switches

7.3.1 High Availability Characteristics

7.3.1.1 Media Redundant Protocol (MRP) according to standard IEC 62439-2 or similar.

7.3.2 Support integration with RSTP or MSTP.

7.3.2.1 Support one of these ring coupling protocol: Ring-Coupling (Hirschmann), Dynamic Ring Coupling (Moxa), Standby Coupling (Siemens) or similar.

7.4 Technical Characteristics for L3 switches

That set of equipment shall support all L2 features plus the following characteristics:

L3 Characteristics

7.4.1 Dynamic routing protocol OSPFv2, according to RFC 2328

7.4.2 Virtual Router Redundancy Protocol - VRRP, according to RFC 3768

7.4.3 DHCP Relay Support

7.4.4 Protocol Independent Multicast - Sparse Mode - PIM-SM, according to RFC 7761

7.4.5 Protocol Independent Multicast - Source-Specific Mode - PIM-SSM, conforming to RFC 4607.

8 EQUIPMENT DESCRIPTION - FIREWALLS

8.1 The automation firewalls shall be provided in accordance with the requirements presented in document AUTOMATION NETWORK DESCRIPTION.

8.2 Firewall basic configuration shall be performed. Parameters shall be provided by PETROBRAS during the detailed design project.

8.3 The firmware version required for this equipment to be connected in the PETROBRAS NETWORK will be informed by PETROBRAS during the detailed design project.

9 EQUIPMENT DESCRIPTION – ELECTRO OPTICAL CONVERTERS

9.1 Ideally, switches shall have SC optical fiber ports in the necessary number in order to avoid whenever possible the use of Electro Optical converters. In this case, the optical cables shall be connected directly to the destination automation panel, avoiding the use of EOCP Panels.

9.2 In case this is not possible, the electro optical converters (Ethernet – fiber) media converters shall possess the following characteristics:

9.2.1 Conversion from CAT 6A ethernet (female RJ 45 ports) to the OM1 or OM3 Optical fibers (Female SC Optical termination) and vice versa;

9.2.2 10G Base-T to 10G Base-SR conversion (300 m range) and vice versa;

9.2.3 Support for full duplex and half duplex mode;

9.2.4 All electro optical converters shall be modular. They shall be installed in 19” rack-mountable modular designs (mount chassis). These chassis shall also be supplied and installed in their appropriate Panels.

9.2.5 Dual redundant power supply for each optical converter shall be 24 VDC. The Applicable Power conversion device from the panel power supply (as determined in I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS) to 24 VDC shall be installed in every panel containing electro optical converters.

9.2.6 Redundant networks shall have independent optical converters.

9.2.7 Each converter shall have an alarm signal (voltage free contact) representative of malfunctioning.

9.2.8 Additionally, these LRUs should have:

- Single mode and multimode options (compatibility);
- Hot swappable LRUs;
- Real-time remote diagnostics for all modems in the system.

10 CERTIFICATION NETWORK TESTS

10.1 Structured Cabling Network shall be certified and an evidential report shall be submitted to PETROBRAS.

10.2 Acceptance testing of structured cabling shall be performed at 100% points.

10.3 At least the Permanent Link (PL) certification shall be done according standard ABNT NBR 14565 or ISO / IEC 11801 for the appropriate Category / Class.

10.4 In the case of an external network point using RJ45 connectors, the certification shall use the channel mode according to standard ABNT NBR 14565 or ISO / IEC 11801 for the appropriate Category / Class.

10.5 Metallic Cables (UTP/STP) shall be certified according to Standard ANSI/EIA/TIA requirements TIA-568.2-D CAT 6 /Class A.

10.6 Optic Cabling Network shall be certified according to Standard ANSI/EIA/TIA requirements TIA-568.3-D and an evidential report shall be submitted to PETROBRAS.

10.7 Acceptance tests on optical cables shall be performed on 100% of the fibers.

10.8 The backbone test shall be performed at 850 nm and 1,300 nm windows for multimode fibers according to ISO 14763-3.

10.9 The attenuation shall be measured using light source and power meter.

10.10 Attenuation points using OTDR shall be characterized.

10.11 Measurements shall occur in both directions (A to B and B to A).

10.12 The following items shall be checked during certification tests: termination configuration (T-568A), cable length, propagation delay and delay skew, link budget, Insertion Loss (IL) and Return Loss (RL), Near-End Crosstalk (NEXT), Power Sum NEXT (PS-NEXT), Attenuation to Crosstalk Ratio Near End (ACR-N), Power Sum Attenuation to Crosstalk Ratio Far End (PS-ACRN), Attenuation to Crosstalk Ratio Far End (ACRF), Power Sum Attenuation to Crosstalk Ratio Far End (PS-ACRF), Power Sum Alien Near End Crosstalk (PSA-NEXT) and, finally, Power Sum Attenuation to Alien Crosstalk Ratio Far End (PSA-ACRN).

10.13 Requirements present in TIA-568.3-D shall be fulfilled for multimode optical cabling.

10.14 Performance tests of the complete network are described in document AUTOMATION NETWORK DESCRIPTION.

10.15 In case three (03) seconds have passed without communication between a pair of neighbor switches of the three main Automation Networks rings (SOS Supervisory LAN, CSS Data Acquisition LAN, or Package Units LAN):

- An alarm indicating network failure shall be raised at the SOS system;
- An automatic switchover shall be performed by the MRP protocol to the alternative path of the ring.

10.16 Total downtime of the network shall not exceed five (05) seconds (i.e., 3 seconds to detect the failure + 2 seconds to recover from it), in order not to provoke spurious SOS RTDS's Switchover (see item 10.1 of I-ET-3010.00-5520-861-P4X-002 - SUPERVISION AND OPERATION SYSTEM – SOS).

10.17 Time intervals of items 10.15 and 10.16 shall be configurable and may be changed at any time, without additional costs to PETROBRAS.