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1 SCOPE AND OBJECTIVE

1.1 This specification establishes the document S-736 – Supplementary Specification to IEC 61800-2 Low-voltage AC Drives attached below as general requirements for specification for Low-Voltage frequency converters, soft-starters, and inverters for offshore units.

Supplementary-Spec
-to-IEC-61800-2-LV-A

1.2 Following IEC 61800-2 and IOGP S-736 item structure, this specification establishes additional technical requirements for design, manufacture and supply of Low-Voltage frequency converters, soft-starters, and inverters for PETROBRAS Offshore Units, including installations in modules and packages.

1.3 This specification shall prevail in case of conflict or lack of information in the document S-736 – Supplementary Specification to IEC 61800-2 Low-voltage AC Drives.

1.4 This specification shall be used for individual Low-Voltage frequency converters, soft-starters, and inverters (BDM) installed inside switchgears and motor control centre, and for complete Low-Voltage power drive systems (CDM/PDS) – floor mounted, or wall mounted.

1.5 All Low-Voltage frequency converters, soft-starters, and inverters shall meet applicable standards, Classification Society rules and NR-10.

1.6 Classification Society requirements shall prevail over requirements of this document.

2 NORMATIVE REFERENCE AND DOCUMENT LIST

2.1 GENERAL

2.1.1 At the design development and for equipment specification, IEC standards shall be used, all on their latest revisions. Exceptionally, where it is clearly justifiable, ANSI, IEEE and others, internationally recognized standards, may be used.

2.1.2 Some standards listed in the following sections are complementary as indicated in this specification text, the compliance to them is conditional or optional.

2.2 CODES, STANDARDS AND RECOMMENDED PRACTICES

2.2.1 INTERNATIONAL ASSOCIATION OF OIL & GAS PRODUCERS

[1] IOGP S-736 Supplementary Specification to IEC 61800-2 Low-Voltage AC Drives

2.2.2 IEC – INTERNATIONAL ELECTROTECHNICAL COMMISSION

[2] IEC 60417 Graphical Symbols for Use on Equipment - Database Snapshot

[3] IEC 60721-3-1 Classification of environmental conditions - Part 3-1 Classification of groups of environmental parameters and their severities – Storage

[4] IEC 60721-3-2 Classification of environmental conditions - Part 3-2: Classification of groups of environmental parameters and their severities – transportation and handling

[5] IEC 60721-3-3 — Classification of environmental conditions – Part 3-3: Classification of groups of environmental parameters and their severities – Stationary use at weather protected locations.

[6] IEC 60721-3-4 — Classification of environmental conditions - Part 3-4: Classification of groups of environmental parameters and their severities – Stationary use at nonweather protected locations

[7] IEC 61188-5-1 — Printed Boards and Printed Boards Assemblies – Design and Use – Part 5-1: Attachment (land/joint) Considerations – Generic Requirements

[8] IEC 61800 — Adjustable speed electrical power drive systems - All parts

[9] IEC 61800-1 — Adjustable speed electrical power drive systems - Part 1: General requirements - Rating specifications for Low-Voltage adjustable speed DC power drive systems

[10] IEC 61800-2 — Adjustable speed electrical power drive systems - Part 2: General requirements – Rating specifications for adjustable speed AC power drive systems

[11] IEC 61800-5-1 — Adjustable speed electrical power drive systems - Part 5-1: Safety requirements – Electrical, thermal and energy

[12] IEC 61892 — Mobile and Fixed Offshore Units - Electrical Installations - All parts

[13] IEC 62326-1 — Printed Boards - Part 1: Generic Specification

[14] IEC 62326-4 — Printed Boards - Part 4: Rigid Multilayer Printed Boards with Interlayer Connections - Sectional Specification

[15] IEC TS 60034-25 — Rotating Electrical Machines - Part 25: Guidance for the Design and Performance of a.c. Motors Specifically Designed for Converter Supply

Note: When all parts are informed, all applicable parts shall be used as reference. If a specific part in mentioned in text, it will be listed following the general code reference.

2.2.3 IEEE – INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERING

[16] IEEE 1580 — Recommended Practice for Marine Cable for Use on Shipboard and Fixed or Floating Facilities

[17] IEEE 519 — IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

2.2.4 LABOUR SECRETARY - MINISTRY OF ECONOMY - REGULATORY STANDARDS FOR OCCUPATIONAL SAFETY AND HEALTH

[18] NR-10 — Segurança em Instalações e Serviços em Eletricidade

[19] NR-12 — Segurança no Trabalho em Máquinas e Equipamentos

2.2.5 ABNT – ASSOCIAÇÃO BRASILEIRA DE NORMALIZAÇÃO TÉCNICA

[20] ABNT NBR 16820 — Sistemas de sinalização de emergência — Projeto, requisitos e métodos de ensaio

2.2.6 IPC- ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

[21] IPC 6012 — Qualification and Performance Specification for Rigid Printed Boards

2.2.7 ASTM - AMERICAN SOCIETY FOR TESTING AND MATERIALS

[22] ASTM F1166 Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities

2.2.8 IMO MODU CODE

[23] IMO MODU CODE Code for the Construction and Equipment of Mobile Offshore Drilling Units

2.3 REFERENCE DOCUMENTS

[24] I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS

[25] I-ET-3010.00-5140-713-P4X-001 - SPECIFICATION FOR TRANSFORMERS FOR OFFSHORE UNITS

[26] I-ET-3010.00-5140-712-P4X-001 - LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS

[27] I-ET-3010.00-1200-300-P4X-001 - NOISE AND VIBRATION CONTROL REQUIREMENTS

[28] I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS

[29] I-ET-3010.00-5140-741-P4X-001 - LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS

[30] I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING

[31] I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEMS OF OFFSHORE UNITS

[32] I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS

[33] I-ET-3010.00-5143-700-P4X-001 - ELECTRICAL SYSTEM PROTECTION CRITERIA

[34] I-DE-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIAGRAM

[35] I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE

[36] I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS

[37] I-ET-3010.00-5400-947-P4X-002 - SAFETY SIGNALLING

[38] I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST

[39] I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS

[40] I-LI-3010.00-5140-700-P4X-001 - ELECTRICAL EQUIPMENT DATA SHEET MODELS

Note: Documents without code in the list are documents with variations according to project characteristics. Verify in project documentation list the reference for codes of these documents.

3 ABBREVIATIONS, TERMS AND DEFINITIONS

3.1 All terms and definitions shall follow IEC 61800-2 and Supplementary Specification IOGP S-736.

3.2 For simplification in this specification Low-Voltage frequency converters, soft-starters, and inverters are here abbreviated as defined in IEC 61800-2 as BDM/CDM/PDS.

3.3 ABBREVIATIONS AND ACRONYMS

A&C	Automation and Control
A.C.	Alternated Current
ANSI	American National Standards Institute
BDM	Basic Drive Module (See IEC 61800-2)
CDC	Control and Distribution Centre (Switchgear Panel)
CDM	Complete Drive Module (See IEC 61800-2)
CT	Current Transformer
DC	Direct Current
ESA	Electrical System Automation
ESD	Emergency Shutdown
ET	Technical Specification
FPSO	Floating, Production, Storage and Offloading Unit
FSO	Floating, Storage and Offloading Unit
HMI	Human-Machine Interface
IEC	International Electrotechnical Commission
IEEE	Institute of Electrotechnical and Electronic Engineers
IR	Intelligent Relay
ISO	International Standardization Organization
MCC	Motor Control Centre
MTTR	Mean Time to Repair
NEMA	National Electrical Manufacturers Association
NR	Norma Regulamentadora (Regulation Standard)
PCC	Point of Common Coupling
PDS	Power Drive System (See IEC 61800-2)
PEE	Power Electronics Equipment
RM	Material Requisition
RTD	Resistance Temperature Detector
SCPD	Short-Circuit Protective Devices
THD	Total Harmonic Distortions
UPS	Uninterruptible Power Supply
VSD	Variable Speed Drive
VSD-FC	Variable Speed Drive – Frequency converter

4 GUIDANCE FOR SPECIFICATION OF BDM/CDM/PDS AND METHODOLOGIES FOR COMPLIANCE

4.1 Applicable standards shall follow complementary IOGP S-736 and the ones indicated in section 2 of this specification.

5 PERFORMANCE AND FUNCTIONALITY CRITERIA

5.1 GENERAL REQUIREMENTS

5.1.1 PETROBRAS complementary requirements are indicated in following items.

a) It shall not be acceptable out-of-date or obsolete equipment or components.

b) Technical support and supply of replacement parts shall be guaranteed for ten (10) years.

c) All deviations to this specification or manufacturer alternative solution shall be informed to PETROBRAS for acknowledge and approval.

5.1.2 PETROBRAS Electrical Structure Construction Requirements are indicated in following items.

a) The metal parts that make up the BDM/CDM/PDS, not intended for conducting, shall have electrical continuity and be connected to the ground bus.

b) For floor mounted or wall mounted BDM/CDM/PDS:

- the ground bus shall be located at the bottom of each section of the equipment, and it shall have a compression connector, suitable for connecting a grounding copper cable, sized, with nominal section as indicated in the I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS. The doors shall have electrical continuity with the metal structure of the BDM/CDM/PDS through flexible copper strip.
- It shall have hinged doors with open position locks.

c) Internal BDM/CDM/PDS auxiliary and control circuits that are installed on the equipment cabinet shall be suitably protected from the main power circuit as required by NR-10.

d) Control circuits, including microprocessor and digital inputs and outputs shall be galvanically isolated from the power circuits.

e) Galvanic insulation of BDM/CDM/PDS control, inlet and output circuits shall be in accordance with IEC 61800-5-1, depending on the type of equipment.

f) All BDM/CDM/PDS shall have galvanic isolators for analogic interfaces with A&C or Package Control Panels.

g) BDM/CDM/PDS apply shall have internal protection against voltage surges and accumulation of electrostatic charges.

5.2 CHARACTERISTICS AND TOPOLOGY

5.2.1 GENERAL

5.2.1.1 PETROBRAS complementary requirements are indicated in following items.

a) To avoid electrolytic corrosion, contacts between different metallic materials shall be prevented.

b) Galvanic isolation shall be implemented where the contact between different metallic materials is necessary.

c) Internal bar insulation and junctions supports shall be of non-hygroscopic and not flammable material.

d) The equipment shall be at the adequate insulation levels.

e) BDM/CDM/PDS shall comply with the requirements of IEC 61800-5-1.

5.2.2 BDM/CDM/PDS CHARACTERISTICS

5.2.2.1 PETROBRAS complementary requirements are indicated in following items.

a) The equipment specified can be mounted:

- inside (BDM)
- or outside an electrical panel (CDM/PDS),

as per supplier/manufacturer requirements.

In case of mounted outside (CDM/PDS), they can be self-supported (or wall mounted), or floor mounted (or cabinet) as their rated power will define.

b) Self-supported CDM/PDS shall comply with requirements defined in I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS.

c) Floor mounted CDM/PDS shall comply with requirements defined in I-ET-3010.00-5140-741-P4X-001 - LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS.

5.2.3 COOLING TOPOLOGY

5.2.3.1 PETROBRAS complementary requirements are indicated in following items.

a) For BDM/CDM/PDS only air-cooling system, heat exchangers system or both systems are allowed.

b) For Self-supported or floor mounted CDM/PDS:

- Air Cooling system shall be either of the options:

  (a) single system, with easy maintenance access and fast replacement.

  (b) fully redundant and independent (when applicable) system, including automatic transfer with alarm in case of failure. Required for CDM/PDS power rated above 375 kW.

- The cooling system scheduled maintenances and spare replacements shall be informed.

5.2.4 BYPASS AND REDUNDANT CONFIGURATIONS

5.2.4.1 PETROBRAS complementary requirements are indicated in following items.

a) BDM/CDM/PDS power and control circuits shall be designed considering that a failure in one component or printed circuit board shall not cascade or induce another failure in other components or printed boards.

b) For Soft-Starters bypass specific requirements see section 8.11.

5.3 RATINGS

5.3.1 INPUT RATINGS

5.3.1.1 PETROBRAS complementary requirements are indicated in following items.

a) System input voltage and frequency are defined in Datasheet and Project Documentation, and they shall follow variations according to IEC 61892 as defined in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

b) BDM/CDM/PDS shall provide protection against the effects of voltage surges and the accumulation of electrostatic loads.

c) For Self-supported and Floor mounted CDM/PDS, when applicable, Internal arc requirements are defined in I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS or in I-ET-3010.00-5140-741-P4X-001 - LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS.

d) The main electrical characteristics shall be:

- Rated input main voltage: in accordance with Project Documentation.
- Rated input auxiliary control voltage: voltage value shall be in accordance with Project Documentation.
- Rated input auxiliary voltage for heating resistors: 1 x 220 Vac, isolated (IT), two phases, from normal panel, if self-supported or floor mounted.
- Input frequency: 60 Hz.
- Rated power: in accordance with load requirements.
- BDM/CDM/PDS (VSD-FC and soft-starters) shall be able to operate at reduced proportional torque and power with momentary input bus voltage variation of ±10%, as defined in IEC 61800-1. This reduced torque and power shall be proportional to the ratio between input voltage and 90%.
- For Harmonic and THD Requirements see items 8.8 and 8.9.

5.3.2 OUTPUT RATINGS

5.3.2.1 PETROBRAS complementary requirements are indicated in following items.

a) The main electrical characteristics shall be:

- Manufacturer shall indicate BDM/CDM/PDS (VSD-FC only) capability to keep rated output power at rated output speed during transient event of input voltage dip of 20% up to 5 s, 300 cycles, as defined in IEC 61800-1. It shall be indicated the allowable frequency of this event.
- Output Frequency Range: In accordance with load requirements.

- Minimum Output Operation Frequency Range: 1 to 75 Hz, unless otherwise defined in Project Documentation.

5.3.3 OPERATING QUADRANTS

5.3.3.1 PETROBRAS complementary requirements are indicated in following items.

a) For operating quadrants, BDM/CDM/PDS shall be 2 quadrants only, non-regenerative, unless otherwise defined in Project Documentation.

b) Active front end, 4 quadrants, may be accepted as a lower harmonic drive, see 8.8.

5.3.4 RATINGS AND FUNCTIONALITY OF THE CONTROL EQUIPMENT

5.3.4.1 PETROBRAS complementary requirements are indicated in following items.

a) For BDM/CDM/PDS, unless otherwise defined in Project Documentation:

- the auxiliary or control voltage needed for internal circuits of the equipment shall be obtained from internal source derived from main input (normal) power source.
- For CDM/PDS Heating resistor circuits: external dedicated source is mandatory.

b) Unless otherwise defined in Project Documentation, power from auxiliary control voltages are not UPS A.C. or UPS D.C. originated.

5.3.5 SPECIAL RATINGS RELATED TO BDM/CDM/PDS OR MOTOR

5.3.5.1 Transformers and reactors, PETROBRAS complementary requirements are indicated in following items.

a) Compliance to I-ET-3010.00-5140-713-P4X-001 - SPECIFICATION FOR TRANSFORMERS FOR OFFSHORE UNITS can be done by test certificate reports and warranty conditions.

b) Manufacturer shall define grounding type (high-value resistance, neutral isolated, etc.) of secondary windings of the input transformer to avoid unwanted: ground system interactions, harmonic flows, and common mode voltages.

c) Earthing/Grounding shall comply with 5.8.2.

5.3.5.2 Motors, PETROBRAS complementary requirements are indicated in following items.

a) PDS shall be designed to drive indicated motor or load according to IEC 61800-2 and Supplementary Specification IOGP S-736.

b) For motors specification see I-ET-3010.00-5140-712-P4X-001 - LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS.

c) The maximum ripple torque shall be in accordance with motor/driven equipment set manufacturer specification for the whole speed variation range and shall not lead to torsional oscillation.

d) Motor type and load characteristics shall be informed in Project Documentation.

5.4 PERFORMANCE

5.4.1 OPERATIONAL

5.4.1.1 PETROBRAS complementary requirements are indicated in following items.

a) BDM/CDM/PDS output voltage and drive performance ‘shall be designed to comply with allowed torque ripple (torque pulsation) in the electrical motor.

b) BDM/CDM/PDS output voltage and drive performance shall be designed to avoid overvoltage at cable and motor’s terminals.

c) If specified in the Project Documentation, automatic reacceleration, BDM/CDM/PDS (VSD-FC only) shall be able to identify the speed of motor rotation and feed it properly, taking the engine to the desired operating condition (motor re-start while still running, coasting).

d) The optimum system configuration shall consider:

- load power over the full speed operation range.
- torque/speed load characteristics over the full speed variation range.
- starting and stoppage’s load requirements.
- dynamic response requirements.
- speed control range.
- overvoltage at cable or motor terminals due to resonance or harmonic presence.
- requirements regarding to power factor as well as to voltage and current distortion factors, individual harmonics, and notches at the Point of Common Coupling (PCC) with the supplying MCC or CDC Switchgear.
- cooling requirements.
- necessity of output filters.

5.4.2 FAULT SUPERVISION

5.4.2.1 PETROBRAS complementary requirements are indicated in following items.

a) Protection functions for BDM/CDM/PDS shall follow IEC 61800-2.

b) For BDM/CDM/PDS (in case of VSD-FCs), it shall provide electronic protection to the motor, which shall be capable of estimating the temperature of its windings based on programmed parameters referring to the motor. This protection shall cause the motor to be turned off when its thermal capacity is exceeded.

5.4.3 MINIMUM STATUS INDICATION REQUIRED

5.4.3.1 Minimum status indication, PETROBRAS complementary requirements are indicated in following items.

a) The BDM/CDM/PDS shall be equipped with a status indication signal for “drive on” (whether) motor rotating or at standstill).

b) The BDM/CDM/PDS shall also be equipped with a status indication signal “drive ready for operation”.

c) Other BDM/CDM/PDS shall follow item 8.10.

5.4.4 I/O DEVICES

5.4.4.1 PETROBRAS complementary requirements are indicated in following items.

a) All BDM/CDM/PDS shall have at least input, and output signals listed in I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.

b) All BDM/CDM/PDS shall include network interfaces and shall follow I-DE-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIAGRAM and I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE regarding architecture and Ethernet communication protocols.

c) For all BDM/CDM/PDS, the network interface shall be used for control and monitoring signals, parameterization, and programming. A file with all configuration parameters shall be provided for the equipment.

d) For all BDM/CDM/PDS, it shall be supplied the memory map for the communication between equipment and Electrical System Automation considering, at least, signals listed in I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST and protocols according to I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.

e) All BDM/CDM/PDS shall have its internal clock synchronized with Electrical System Automation Time Server through the time protocol according to I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.

- All devices with logging or communication capabilities internal to the BDM/CDM/PDS shall have its internal clock synchronized with Electrical System Automation. BIDDER is responsible to provide means of synchronization among internal components which are not connected to Electrical System Automation networks.
- All other internal devices connected to Electrical System Automation networks shall be synchronized with the Electrical System Automation Time Server through the time protocol according to I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.
- All events and alarms shall be logged in the equipment with the time stamp synchronized with the internal clock, which shall be synchronized with the Electrical System Automation Time Server.

5.5 EMC

5.5.1 PETROBRAS complementary requirements are indicated in following items.

a) BDM/CDM/PDS shall comply with requirements of item EMC and RFI REQUIREMENTS as defined in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

5.6 ECODESIGN

5.6.1 ENERGY EFFICIENCY AND POWER LOSSES

5.6.1.1 PETROBRAS complementary requirements are indicated in following items.

a) The efficiency for the BDM/CDM/PDS system including power transformers, cooling auxiliary devices, control and protection devices and accessories shall be:

- 96.0% efficiency at 100% rated load.

- 95.5% efficiency at 75% rated load.
- 95.0% efficiency at 50% rated load.
- 94.0% efficiency at 25% rated load.

b) The minimum power factor at the BDM/CDM/PDS set input with rated voltage and frequency shall be:

- 0.95 lag at 100% rated load.
- 0.95 lag at 75% rated load.
- 0.92 lag at 50% rated load.
- 0.92 lag at 25% rated load.

c) It shall not be allowed power factor correction devices or equipment (capacitor banks or others).

d) The efficiency and power factor presented by the supplier at the proposal shall be verified during the factory and string tests.

Notes: Tests can be verified by valid type test certificates and routine test reports approved by qualified person other than the one performing the test.

5.7 ENVIRONMENTAL CONDITION FOR SERVICE, TRANSPORT AND STORAGE

5.7.1 OPERATION

5.7.1.1 Operational climatic conditions for equipment design shall be considered **Indoor unconditioned** as informed IEC 61800-2 and defined by IEC 60721-3-3.

5.7.1.2 Climatic information for operation shall inform the year version of the reference standard IEC 60721-3-3.

5.7.1.3 PETROBRAS complementary requirements are indicated in following items.

a) BDM/CDM/PDS shall be installed in safe area, on closed room with indicated ambient temperature and humidity indicated in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

b) BDM/CDM/PDS shall be tropicalized as indicated in at I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

c) Environmental definitions are informed at I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

d) Pollution degree shall be class 2, as informed IEC 61800-2, considering offshore units in marine and petrochemical environment, as defined at I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

e) Vibrations, acceleration requirements and other operational information are defined at I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

f) When installed in mobile units and ships (FPSO and FSO), BDM/CDM/PDS shall be suitable to operate normally under motion and inclination limits (static and dynamic) specified by IMO MODU CODE, IEC 61892, and Classification Society.

g) Sonic pressure and sound levels:

- Maximum values are defined at I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS and I-ET-3010.00-1200-300-P4X-001 - NOISE AND VIBRATION CONTROL REQUIREMENTS.

5.7.2 STORAGE AND TRANSPORT OF EQUIPMENT

5.7.2.1 Climatic information for storage and transport of equipment shall inform the year version of the reference standards IEC 60721-3-1 and IEC 60721-3-2.

5.7.2.2 PETROBRAS complementary requirements are indicated in following items.

a) Climatic for storage and transport of equipment conditions shall consider product packing for up to 6 months, as defined in IEC 61800-2, IEC 60721-3-1 and IEC 60721-3-2 however project documentation may define other maximum storage time.

b) Project documentation shall inform of any Unusual climatic conditions for storage and transport. Environmental conditions are defined in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

c) Supplier/manufacturer shall inform PETROBRAS at delivery, all necessary requirements, and auxiliary systems for equipment storage beyond 6 months, if necessary.

d) Each volume shall be properly identified with:

- Storage position.
- PETROBRAS unit, achievement, and business unit.
- Delivery address.
- Material Requisition number.
- Transformer PETROBRAS TAG.
- Manufacturer name and address.
- Weight.
- Contract number.

5.7.3 MECHANICAL CONDITIONS

5.7.3.1 Mechanical conditions for transport of equipment shall inform the year version of the reference standard IEC 60721-3-2.

5.7.3.2 Mechanical conditions for transport, PETROBRAS complementary requirements are indicated in following items.

a) When CDM/PDS is floor mounted type:

- Inclination, shock, humidity, and temperature sensors shall be available and those shall record the maximum values that they were subjected during transportation.
- A record initial values shall be provided at final packing in factory before shipping to site, and, at delivery, at site, upon delivery inspection.
- At delivery, the sensors inspection shall be witnessed by PETROBRAS.

5.7.4 ENVIRONMENTAL SERVICE TESTS (TYPE TEST)

5.7.4.1 Environmental service tests of equipment shall inform the year version of the reference standard IEC 60721-3-2 and IEC 60721-3-4.

5.8 DRIVEN EQUIPMENT INTERFACE

5.8.1 EXPLOSIVE ENVIRONMENT

5.8.1.1 PETROBRAS complementary requirements are indicated in following items.

a) Hazardous areas definitions are informed at I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

Note: Unless otherwise defined in Project Documentation all Low-Voltage drives, BDM/CDM/PDS, shall be installed in safe and internal area.

Certifications for hazardous areas are in the scope of motor manufacturer. See 5.3.5.2.

5.8.2 EARTHING REQUIREMENTS

5.8.2.1 PETROBRAS complementary requirements are indicated in following items.

a) Earthing/Grounding definitions shall be in accordance with project documentation requirements.

b) Earthing/Grounding type shall be suitable to low-voltage system grounding type used and shall allow protective functions defined in I-ET-3010.00-5143-700-P4X-001 - ELECTRICAL SYSTEM PROTECTION CRITERIA.

6 TESTS

6.1 GENERAL

6.1.1 Test reports and certificates shall be delivered as defined in sections 7.2 and 7.3.

7 INFORMATION AND MARKING REQUIREMENTS

7.1 MARKING ON PRODUCT

7.1.1 PETROBRAS complementary requirements are indicated in following items:

7.1.2 NAMEPLATES

a) If self-supported or floor mounted, the CDM/PDS panel nameplates shall be in accordance with IEC 60417 and made with AISI-316 stainless steel.

b) The CDM/PDS panel nameplates shall be outfitted with a main identification plate containing, at least, the following data:

- Manufacturer name or manufacturer brand.
- Supply voltage, number of phases, nominal supply frequency.
- Maximum supply current in continuous operation or power in kVA.
- Maximum supported symmetric short-circuit current and test time.

- Maximum output voltage.
- Nominal output current in continuous operation.
- Momentary current (overload) for 60 seconds.
- Output frequency-controlled range.

c) If self-supported or floor mounted, the CDM/PDS panel shall be outfitted with supplemental identification plate containing, at least, the following data:

- PETRÓLEO BRASILEIRO S.A. – PETROBRAS.
- name of the department of PETROBRAS.
- name of the enterprise (platform).
- TAG number of the Panel.
- number of the RM.
- number of the Order of Purchase of Material (PC) or the number of the contract, in the cases of acquisition built-in in contract of the type of lump sum ("Turnkey ", "Lump Sum", etc.).

Note 1 - The supplemental data nameplate may be included in the main nameplate.

Note 2 - The supplemental data nameplate shall be manufactured in the same material of the main nameplate.

d) If floor mounted:

- The CDM/PDS panel shall have identification frontal plates indicating components of that compartment, i.e.: rectifier, inverter, power cells, cable input, cable output, control, etc.
- The CDM/PDS panel back doors, if any existent, shall have identification plates identical to the plates identifying the front sections.
- The CDM/PDS panels shall have their compartments signalled with literal and graphical labels of instructions, cares, warnings, and alert of dangers according to the requirements for identification plates listed in ASTM F1166 and IEC 60417.

Note: See component markings and labels requirements in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

e) If CDM/PDS input transformer is separated and located in a different cabinet, this cabinet shall contain an additional nameplate containing at least the following information:

- Current.
- input voltage and voltage relation.
- nominal power.
- taps.
- Connection schematics.
- Phase displacement angles.
- Class of insulation.
- Temperature elevation class.
- Environmental supporting ambient conditions and fire conditions, etc.

f) BDM shall follow the same nameplate definitions as required by the panel it is installed.

7.1.3 LABEL REQUIREMENTS

a) All points of wiring for external connection (input and output circuits) shall be functionally identified within the converter on each terminal block or power connection, including power cables, grounding, controls, signals, and alarms.

b) Internally to floor mounted CDM/PDS all equipment and components shall be identified with:

- black acrylic labels, with white letters, containing the codification compatible with design documents (list of materials, diagram, etc.).
- adhesive labels, for small internal components (i.e.: small circuit-breakers, contactors, auxiliary relays) where acrylic labels are not feasible due to constrict sizes and small spaces, adhesive labels are allowed.

c) All CDM/PDS, flour mounted, panel like, panel type, or similar in construction to a panel, regardless of the area where it is installed, shall have the warnings as required by NR-10 and NR-12. These warnings shall follow section A-5 of ABNT NBR 16820 (Cuidado, risco de choque elétrico/Warning, Risk of electrical Shock).

d) Warnings shall follow the standard labels as required in ABNT NBR 16820 for electrical panels risk of shock also informed in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS and I-ET-3010.00-5400-947-P4X-002 - SAFETY SIGNALLING.

e) BDM shall follow the same label definitions as required by the panel it is installed.

7.2 INFORMATION TO BE SUPPLIED WITH THE CDM/PDS

7.2.1 PETROBRAS complementary requirements are indicated in following items:

Note: For BDM the following information shall be made available (when applicable) with the respective required panel documentation.

7.2.2 DOCUMENTS TO PROPOSAL

a) The following documents and information shall be annexed to the proposal for the transformer and all related equipment and accessories:

- Documents list.
- Dimensional drawings including frontal view, upper view, estimated weight, and thermal dissipation.
- Technical catalogues with information about all components.
- Manuals at least with:
    - maintenance tools list,
    - maintenance accessories list,
    - MTTR (mean time to repair),
    - equipment disassembly and assembly detailed procedures,
    - with drawings and weights of each part,
    - lifting drawings,
    - support drawings to receive each disassembled part,

- drawings of activity sequences and lifting heights.

- Spare parts list for two years of operation, including item, part number, quantity, description, MTBF and price for each part.
- Technical assistance prices and representative address.
- Equipment datasheet template issued by PETROBRAS completely filled in with Manufacturer data, including identification of the person responsible for the filling. This Data Sheet shall be submitted to PETROBRAS approval.
- List of applicable standards.
- Painting method.
- Inspection and test schedule, including acceptance criteria for each test.
- Other documents required in project documentation, including certificates.

7.2.3 DOCUMENTS FOR APPROVAL

a) The following documents and information shall be submitted for PETROBRAS approval, after Packager definition, for the transformer and all related equipment and accessories:

- Documents list.
- Dimensional drawings including frontal and upper views, details, location of lifting eyelets and area for incoming cables, fixing base details.
- Weight and volume of each unit for transportation and total weight.
- Thermal dissipation at half load and full load.
- Package and transportation instructions.
- Identification plates.
- Detailed description of the equipment, including all accessories.
- Warranty certificate and declaration of availability of spare parts for 10 (ten) years.

7.2.4 DOCUMENTS AFTER APPROVAL

a) Assembly, Installation, Operation and Maintenance manuals shall be furnished, after documentation approval, containing at least the following information (including all requirement of NR-12):

- Up-to-date datasheet.
- Technical specifications for transformer, all components, and accessories, in accordance with the approved requirements (as built).
- List of standards followed for design, fabrication, and tests.
- Detailed description of equipment and accessories.
- List of risks for operators during operation and maintenance.
- Storage, preservation, and unpacking instructions in Portuguese language.
- Detailed lifting and handling procedures in Portuguese language.
- Installation and assembly instructions in Portuguese language.
- Operation instructions in Portuguese language.

- Maintenance instructions, including list of necessary equipment, accessories, and tools in Portuguese language.
- Spare parts lists.
- “As built” technical catalogue for all components.
- Complete test report, including type, routine, and special tests.
- Components list, including at least, item, description, draw, unit, quantity, and part number.
- Constructive details about baseplate fixation screws such as quantity, size, type, and position in baseplate.

b) Documents provided by Equipment Manufacturer shall be delivered in an electronic format (original version and PDF version), the original documents shall be editable, and the PDF documents shall be searchable.

Note: Documents in English language and in Brazilian Portuguese language shall be provided for all reference manuals.

c) Manuals shall comply with content requirements of NR-12 as defined in I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

7.3 INFORMATION TO BE SUPPLIED OR MADE AVAILABLE

7.3.1 PETROBRAS complementary requirements are indicated in following items:

a) Manufacturer shall provide training for at least 10 (ten) PETROBRAS personnel.

b) Training shall be provided in Brazil, during commissioning period, in Portuguese language.

c) Training plan shall include at least control diagram analysis, storage, transportation, installation, operation, corrective maintenance, preventive maintenance, disassembly, assembly, use of tools and accessories.

7.3.2 SPARE PARTS AND TOOLS

a) Manufacturer shall provide the necessary spare parts for the commissioning and pre-operation periods.

b) Manufacturer shall provide a list of spare parts for all electrical equipment, for at least 2 (two) years of continuous operation, including prices and part number codes.

c) Manufacturer shall provide all unusual tools necessary for maintenance, assembly, or disassembly of the Transformer.

8 COMPLEMENTARY PETROBRAS REQUIREMENTS

8.1 PAINTING

8.1.1 Painting process shall be proper for offshore installations and shall comply with the requirements of I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING.

8.1.2 The finish colour shall be Light Green (MUNSELL notation 5 G 8/4).

8.1.3 Inner components mounting plates, internal faces of doors and safety barriers shall be Safety Orange (MUNSELL notation 2.5 Y R 6/14).

8.1.4 Other colour definitions see I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

8.2 INSTRUMENTS

8.2.1 For floor mounted or wall mounted CDM/PDS, maximum height for installation of push buttons and instruments, Instruments sizes, deflection, type (analogue or digital), position orientation and quantity shall be according to I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEMS OF OFFSHORE UNITS.

8.3 HEATING RESISTORS

8.3.1 As defined in 5.3.1.1d) it shall be provided with 1 (one) heating resistor for each vertical section of the CDM/PDS panels.

8.3.2 The heating resistors shall be powered as defined in section 5.3.4.1.

8.3.3 These resistors shall be protected by thermomagnetic circuit-breakers and be automatically controlled by means of adjustable thermostats with a maximum scale range of 60 ºC.

8.4 PRINTED CIRCUIT BOARDS

8.4.1 For all BDM/CDM/PDS, their printed circuit boards shall be manufactured in accordance with standards IEC 62326-1, IEC 62326-4 and IEC 61188-5-1. Alternative standard IPC 6012 is also acceptable.

8.4.2 Plates, circuits, and their components shall be tropicalized, have treatment specific conformal coating, and meet the requirements defined in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS to work for the expected lifetime according to environmental conditions informed in the same specification.

8.4.3 Printed circuit boards components shall be suitable for operation at temperatures according to environmental conditions informed in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

8.4.4 Printed circuit boards shall have undergone accelerated aging tests ("burn-in tests "), and thermal fatigue cycles ("stress") and have a test report certificate form their manufacturer. See I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS.

8.4.5 Electronic circuits shall be mounted on printed circuit boards, which must be connected to the control system through bolted connectors or the "plug in" type. The process should have resources that prevent loosening of connections.

8.4.6 Plates shall be removable and provided with guides that make it easier their extraction and prevent their wrong assembly.

8.4.7 PCB shall not be connected directly to the main power circuit without a short circuit current protection device (fuses, transducer, etc).

8.5 MAINTENANCE AND RELAIBILITY

8.5.1 The BDM/CDM/PDS shall be designed to allow access and replacement of any power module or control printed circuit board, or the entire equipment, in less than two hours (MTTR ≤ 2h), without the need for special tools.

8.5.2 For floor mounted or wall mounted, the layout of the components, test points and rulers of posts terminals shall be done allowing access for circuit testing, adjustments, repairs, and maintenance through the front of the CDM/PDS, without the need to remove any module printed circuit board or other component.

8.5.3 The BDM/CDM/PDS and its auxiliary systems shall be designed and manufactured to operate continuously serving the primary function in the operation of the motor and be maintenance free for a period of at least 2 years (17520 h) after the commissioning period and in the environmental conditions specified in section 5.7 or in Project Documentation. Manufacturer recommendations for maximum running time without maintenance period are acceptable, if previously approved by PETROBRAS.

8.5.4 BDM/CDM/PDS components shall NOT require preventive or routine maintenance that compromises safety or requires shutdown during the indicated period of 2 years of initial operation (MTBF ≥ 17520 h). Manufacturer recommendations for maintenance interval period are acceptable, if previously approved by PETROBRAS.

8.5.5 The BDM/CDM/PDS and its auxiliary systems shall be designed and manufactured considering a minimum operation life of 20 years (175200 h). In this operational period, it is considered the execution of the maintenance procedures recommended in the maintenance plan supplied by the manufacturer.

Note: Unit lifetime is 30 years. Clauses in 5.1.1 apply.

8.5.6 BDM/CDM/PDS Capacitors shall be specified for a minimum service life of, at least, 5 years unless otherwise defined in Project Documentation. The capacitors lifetime shall consider the temperature within the BDM/CDM/PDS enclosure and the worst voltage and current conditions. Manufacturer recommendations for maintenance interval period are acceptable, if previously approved by PETROBRAS.

8.5.7 It shall be informed in documentation proposal and approval phases, the MTTF defined by technology/topology and MTTR – segregated by mode of failure. In the later phase, the list of failures (with their MTTR) and replaceable parts per failure shall be included.

8.6 CABLES AND ACCESSORIES

8.6.1 The CDM/PDS internal electric cables and accessories shall comply with I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS and it shall be supplied in the package.

8.6.2 BDM/CDM/PDS Manufacturer shall approve the output power cables between converter and driven motor or equipment.

8.6.3 All points of wiring for internal and external connection (input and output circuits) shall be functionally identified within the BDM/CDM/PDS on each terminal block or power connection, including power cables, grounding, controls, signals, and alarms.

8.6.4 Control conductors shall be grouped in terminal blocks exclusively used for this purpose.

8.6.5 Cables and terminal blocks shall be properly identified according to the wiring diagrams.

8.6.6 Input and output power cables terminal lugs shall be pressure, pin or screwed, adequate to cable sizes.

8.6.7 Cable pressure terminals, if used, shall be furnished together with BDM/CDM/PDS, and installed within the converter.

8.6.8 To avoid electromagnetic interference, the control wiring shall be segregated from the force wiring. Also, the A.C. voltages shall be segregated from all D.C, voltage. It shall be done by different channels, adequate distances, or using shielded cables.

8.6.9 All connections of the input and output wiring of the CDM/PDS must be located on the bottom of the converter, unless otherwise indicated in the Project Documentation.

8.6.10 BDM/CDM/PDS electrical cable armature shall have a grounding from the power panel to the BDM/CDM/PDS and from the BDM/CDM/PDS to driven motor or equipment. The shielding/armature of the grounding cables installation shall be in accordance with IEC TS 60034-25.

8.7 DRAWER, FEEDER PANEL AND PERIPHERAL EQUIPMENTS

8.7.1 For information purpose, since this requirement is part of the panel manufacturer scope. BDM/CDM/PDS manufacturer shall acknowledge only and, if required by PETROBRAS, approve panel manufacturer solution.

a) Feeder, transformers and other peripheral equipment system protection requirements shall follow I-ET-3010.00-5143-700-P4X-001 - ELECTRICAL SYSTEM PROTECTION CRITERIA.

b) Panels and feeder panels, Low-Voltage MCC and Low-Voltage switchgear requirements, shall follow I-ET-3010.00-5140-741-P4X-001 - LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS.

c) FEEDER PROTECTION REQUIREMENTS

- The feeder protection shall be approved by BDM/CDM/PDS Manufacturer.
- FEEDER PROTECTION COMMANDS
    - There shall be two outputs for BDM/CDM/PDS shutdown commands:
        - To alarm informing: “BDM/CDM/PDS switching shutdown”,
        - to open main feeder switching device.
- Failures in the driven motor or equipment (except short circuit to ground and between phases) or over temperature, BDM/CDM/PDS shall only alarm and turn off the switching or reduce load. These types of failures should not trip the circuit breaker or open contactor.

d) INPUT TRANSFORMER PROTECTION REQUIREMENTS

- For CDM/PDS input transformer, incorporated or not in CDM/PDS topology, its temperature protection shall be made by BDM/CDM/PDS control.
- CDM/PDS input transformer alarms shall be sent to Electrical System Automation.
- CDM/PDS input transformer Trip signals shall be sent to feeder protection MMR.
- Over-temperature in CDM/PDS transformer, the CDM/PDS shall:
    - First stage: Alarm and reduce the load.
    - Second stage: alarm, turn off the CDM/PDS, and trip feeder.

  It shall be possible to adjust these parameters.

8.8 VOLTAGE AND CURRENT DISTORTION - THD

8.8.1 BDM/CDM/PDS shall be built in such a manner that total harmonic distortions (THD) for voltage and current do not exceed the values recommended in standard IEEE 519, under the worst normal operating conditions.

Note: The IEEE 519 total harmonic distortions (THD) for voltage and current values shall be considered at the indicated PCC:

- the input of the BDM inside drawers of the panels.
- the input side of the CDM/PDS, at the point of the feeder connection.

8.8.2 BDM/CDM/PDS (VSD-FC and soft-starters) minimum number pulses or high frequency switching shall be those that input voltage results in THD are smaller or equal to the values defined IEEE 519 maximum allowable THD for the considered voltage range.

Note: (1) THD shall be calculated considering the characteristic and non-characteristic harmonics, including those due to the DC Link filter necessary to avoid dc current/voltage modulation due to switching of the inverter.

(2) Applicable to soft-starters and inverter only if in continuous operation mode.

8.9 OUTPUT VOLTAGE DISTORTION AND CURRENT FILTERS

8.9.1 A dV/dt filter or sine wave filter shall be provided for BDM/CDM/PDS whenever required by the motor insulation limits, considering the effects of the connection cables.

- This filter shall be sized for motor protection considering BDM/CDM/PDS shall harmonics, cable sizes and characteristics and feeding motor.
- For long cables, with lengths greater than 100 m, output filters are mandatory.
  - These filters shall be used to reduce output voltage harmonic distortion and to avoid overvoltage due to resonance and dV/dt required by the motor insulation limits.
  - Output Filter may not be installed only if:
    - either BDM/CDM/PDS manufacturer has the technology to provide the controlled voltage output with necessary quality assuring a sinusoidal voltage wave form with no need of filters.
    - or transient studies verify that output filter is not necessary.
  - Both, the technology solution, or the studies shall be approved by PETROBRAS.

8.10 BDM/CDM/PDS CONTROL INTERFACE

8.10.1 All BDM/CDM/PDS shall have a local digital HMI (human machine interface) on its front side to allow man/machine interface and user-friendly dialog.

8.10.2 Remote START and STOP controls shall initiate pre-programmed acceleration and deceleration ramps, respectively.

8.10.3 Remote TRIP command shall immediately de-energize the motor.

8.10.4 This HMI panel shall contain at least the following devices for operation and monitoring:

a) selector switch or parameter definable option for selection of mode of operation (LOCAL/REMOTE).

b) START switch.

c) STOP switch.

d) parameter selection switches.

e) parameter and adjustment programming switches.

f) key for increment of functions or control values.

g) key for decrement of functions or control values.

h) signalling LED indicating energized equipment.

i) digital alphanumeric display to allow visualization of the parameters listed in *Table 1*.

Table 1 – Digital display system requirements for LV-PEE HMI.

DISPLAY FUNCTIONS	VSD-FC	SOFT-STARTERS	INVERTERS (D.C.-A.C. CONVERTERS).
Frequency	X	-	X
Speed	X	-	-
Current	X	X	X
Fault diagnosis	X	X	X
Alarms	X	X	X
Self-supervision system messages	X	X	X
Adjustment parameter values	X	X	X

8.10.5 If spare control circuits are foreseen, terminal blocks shall also have spare terminal blocks.

8.10.6 All BDM/CDM/PDS expected to receive ESD or other wet signals from A&C or Package Control Panels shall have interposing relays with enough quantity to convert discrete 24 VDC signal in discrete voltage-free signal. For signals from A&C, see I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.

8.10.7 All BDM/CDM/PDS control shall be microprocessor-based and contain at least the following functions:

a) selectors.

b) alarm functions.

c) network communication with automation system.

d) monitoring and diagnostics.

e) input and output functions.

8.11 LOW-VOLTAGE SOFT-STARTERS SPECIFIC REQUIREMENTS

a) Soft-starters shall have either a programmed temporary delay or a programmed start sequence to allow contactor or circuit breaker to be closed before the soft-starter control functions.

b) For soft-starters connected via network communication with ESA and A&C, the discrete and analogical signals may be changed to network signals.

c) Soft-starters shall permit in its programming and configuration at least the following basic adjustments:

- up and down voltage x time ramps, programmable, capable of being started from the external reference command.
- programming of automatic re-start function, after a trip or undervoltage event.

d) Soft-starters with control only in two phases shall not be accepted.

e) Soft-starters shall have an incorporated bypass contactor.

f) When feeding essential loads Soft-starters shall have also an external bypass contactor, this bypass is in the scope of the panel manufacturer.

8.12 INVERTERS (D.C.-A.C. CONVERTERS) SPECIFIC REQUIREMENTS

a) Inverters shall permit in its programming and configuration at least the following basic adjustments:

- up and down voltage x time ramps, programmable, capable of being started from the external reference command.
- programming of automatic re-start function, after a trip or undervoltage event.

b) For inverters connected via network communication with ESA and A&C, the discrete and analogical signals above may be changed to network signals.

c) If in continuous operation, inverters shall provide electronic protection to its feeding panel or load.

9 ANNEXES - DATASHEET FORMS

9.1 The Datasheets are templates and do not refer to any equipment. The manufacturer shall fill in a Datasheet for each equipment.

9.2 For equipment without Datasheet templates, Manufacturer shall fill in Datasheets according to its own standard and submit to PETROBRAS approval.

9.3 All existing data sheet templates are available at I-LI-3010.00-5140-700-P4X-001 - ELECTRICAL EQUIPMENT DATA SHEET MODELS.