International Association of Oil & Gas Producers

SPECIFICATION
S-747

December
2021

Supplementary Specification to IEC 61800-2 High-voltage AC Drive Systems

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
0.1	December 2021	Issued for Public Review

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

Disclaimer

Copyright notice

Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

Table of Contents

List of Tables

List of Figures

Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of high-voltage AC drive systems in accordance with IEC 61800-2, Edition 3.0, March 2021, Adjustable speed electrical power drive systems – Part 2: General requirements – Rating specifications for adjustable speed AS power drive systems, for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Specification

This specification is to be applied in conjunction with the supporting procurement data sheet, information requirements specification (IRS) and quality requirements specification (QRS) as follows.

IOGP S-747: Supplementary Specification to IEC 61800-2 High-voltage AC Drive Systems

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to IEC 61800-2, following the IEC 61800-2 clause structure. Clauses from IEC 61800-2 not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to IEC 61800-2 defined in this specification are identified as *Add* (add to clause or add new clause), *Replace* (part of or entire clause) or *Delete*.

IOGP S-747D: Procurement Data Sheet for High-voltage AC Drive Systems

The procurement data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The procurement data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the procurement data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-747L: Information Requirements for High-voltage AC Drive Systems

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

IOGP S-747Q: Quality Requirements for High-voltage AC Drive Systems

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS follows that of IEC 61800-2 and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The procurement data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The supplementary specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser defined requirements (procurement data sheet, QRS, IRS);

d) this specification;

e) IEC 61800-2.

1 Scope

Replace second paragraph with

This specification amends and supplements IEC 61800-2 and associated parts of IEC 61800 referenced in IEC 61800-2 for the design, manufacture and testing of:

- AC drive systems connected to 50 Hz or 60 Hz input voltages;
- AC drive systems with BDMs having both input and output line-to-line voltages above 1 kV AC, i.e. high voltage;
- AC drive systems with a high-voltage BDM integrated into a CDM, with or without an output transformer, in accordance with Table 5.

Delete NOTE

Add new list item to seventh paragraph

- explosion protection safety requirements are covered by IEC 60079 series related to motors located in potentially explosive atmospheres;

Add new list item to seventh paragraph

- AC electrical machines used in PDSs – application guide is covered in IEC TS 60034-25.

Add new subclause

1.1 Additional scope

This specification covers the following essential minimum requirements related to construction, function and transport/handling of BDM/CDM/PDSs:

- Constructional requirements:
  - enclosure – design, accessibility and clearances, compartmentalization/sectionalization, internal arc classification;
  - components – converter, cooling (air and liquid), transformer, capacitor, circuit breaker / contactor / disconnector and earthing switch, motor;
  - busbars, wiring, power/control terminals, cable interface;
  - control supply, panel auxiliaries;
  - earthing.
- Functional requirements:
  - control system, control interface, encoder interface, operator interface, protections and alarms, communication protocol and network interface;
  - reliability and availability;
  - performance including features like voltage dip ride through, kinetic buffering, active volt-ampere reactive (VAR) control and implementing active front end.

- Transport, storage and handling.

Add new subclause

1.2 High-voltage AC drive systems included in scope

This specification will cover BDMs/CDMs located:

- indoors in a non-hazardous area feeding motors located in a non-hazardous area;
- indoors in a non-hazardous area feeding motors located in a hazardous area;
- outdoors in a non-hazardous area and within a weatherproof enclosure;
- onshore or offshore.

Add new subclause

1.3 Scope boundary

This specification covers the PDS including the BDM with either the input, output or both having high voltages, i.e. greater than 1 000 V AC with no upper limit, and is aligned with the scope of IEC 61800-2, but modified in accordance with Figure 23.

Add new subclause

1.4 Exclusions

The following power drive systems are excluded from the scope of this specification:

- rating specifications for AC power drive systems with BDM terminal voltage at input, output or both below 1 000 V AC, i.e. low voltage;
- BDM units with input terminal voltage as high voltage but fed from a low-voltage supply;
- BDM units with output terminal voltage as high voltage but used to drive low-voltage motors;
- AC power drive systems with input transformer at the BDM input as part of the CDM;
- power drive systems for wind turbine applications;
- rating specifications for low-voltage adjustable speed DC power drive systems;
- BDM/CDM with topology – cyclo-converters and matrix converters.

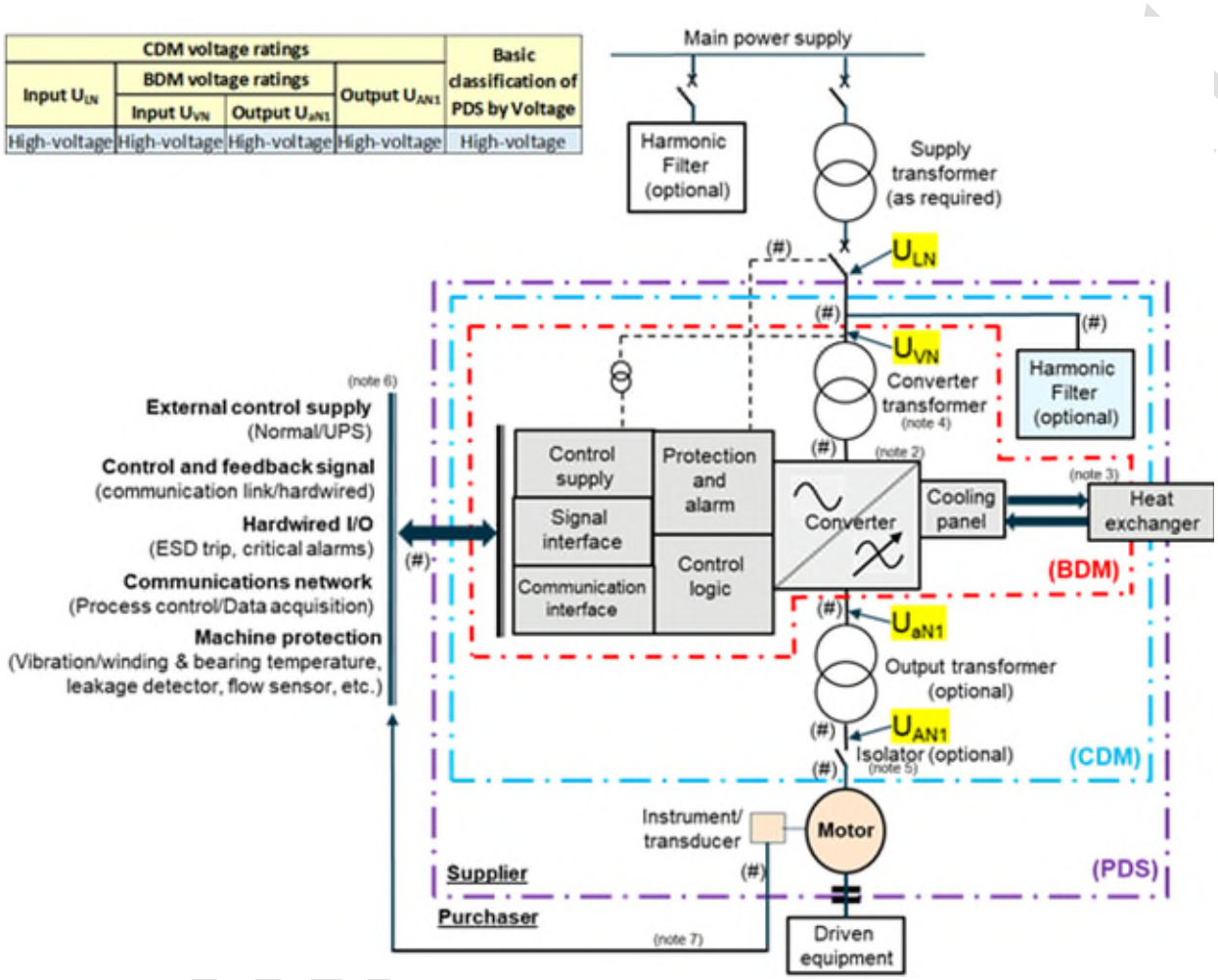
The following components of PDSs are outside the scope of this specification:

- input transformer, if any, upstream of the PDS;
- high-voltage switchgear and associated devices, i.e., upstream switching device, protection and bypass;
- low-voltage switchgear feeders for BDM/CDM auxiliaries, i.e., upstream feeders and protection devices;
- low-voltage AC motor including sensors and mounted accessories, which are not part of the auxiliaries of BDM/CDM and main motor.

The following components which have interface to the PDS are outside the scope of this specification:

- supply transformer, if any, upstream of the PDS;
- switchgear and switching device protection upstream of the PDS;
- switchgear on the bypass path.

Add new Figure 23



NOTE 1 (#) indicates interconnecting cables in purchaser scope typically, except agreed differently.

NOTE 2 Converter may either be air cooled or liquid cooled.

NOTE 3 Heat exchanger (water-water) or cooler (water-air) of liquid cooled converter may either be supplier or purchaser scope.

NOTE 4 Motor cooling arrangement shall be either air-air or water-air.

NOTE 5 Output isolator, if installed should be electrically interlocked with converter. This unit may be either supplier or purchaser scope.

NOTE 6 All interfaces are indicative and may be considered as per project requirements.

NOTE 7 The interface between motor and converter will depend on the type of motor and its associated instrument/transducers.

NOTE 8 The interface between instruments on transformer and SCADA will be considered as per project requirements.

NOTE 9 Synchronous motor will have an excitation system and associated interfaces with motor and converter.

Figure 1 — Scope boundary diagram

2 Normative references

Add to clause

API Standard 541, *Form-wound Squirrel Cage Induction Motors—375 kW (500 Horsepower) and Larger*

API Standard 546, *Brushless Synchronous Machines—500 kVA and Larger*

API Standard 547, *General Purpose Form-wound Squirrel Cage Induction Motors—185 kW (250 hp) through 2240 kW (3000 hp)*

CSA 22.2 No. 274-17, *Adjustable speed drives*

IEC 60092 (all parts except 301, 305, 306, 501, 502 and 503), *Electrical installations in ships*

IEC 60417, *Graphical symbols for use on equipment (available at http://www.graphical-symbols.info/equipment)*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61000-2-4, *Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances*

IEC 61071, *Capacitors for power electronics*

IEC 61378 (all parts), *Converter transformers*

IEC 61892 (all parts), *Mobile and fixed offshore units – Electrical installations*

IEC 62271-100, *High-voltage switchgear and controlgear – Part 100: Alternating-current circuit-breakers*

IEC 62271-102, *High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches*

IEC 62271-106, *High-voltage switchgear and controlgear – Part 106: Alternating current contactors, contactor-based controllers and motor-starters*

IEC 62271-200, *High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC 62443 (all parts), *Industrial communication networks – Network and system security*

IEC 62477-2, *Safety requirements for power electronic converter systems and equipment – Part 2: Power electronic converters from 1 000 V AC or 1 500 V DC up to 36 kV AC or 54 kV DC*

IEC TS 60034-25, *Rotating electrical machines – Part 25: AC electrical machines used in power drive systems – Application guide*

IEEE 18, *IEEE Standard for Shunt Power Capacitors*

IEEE 519, *IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems*

IEEE 841, *IEEE Standard for Petroleum and Chemical Industry—Premium-Efficiency, Severe-Duty, Totally Enclosed Squirrel Cage Induction Motors from 0.75 kW to 370 kW (1 hp to 500 hp)*

IEEE 1276, *IEEE Guide for the Application of High-Temperature Insulation Materials in Liquid-Immersed Distribution, Power, and Regulating Transformers*

IEEE 1566, *IEEE Standard for Performance of Adjustable-Speed AC Drives Rated 375 kW and Larger*

IEEE 1584, *IEEE Guide for Performing Arc-Flash Hazard Calculations*

IEEE C37.04, *IEEE Standard for Ratings and Requirements for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V*

IEEE C37.20.7, *IEEE Guide for Testing Switchgear Rated Up to 52 kV for Internal Arcing Faults*

IEEE C37.22, *American National Standard Preferred Ratings and Related Required Capabilities for Indoor AC Medium-Voltage Switches Used in Metal-Enclosed Switchgear*

IEEE C57.12.00, *IEEE Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers*

IEEE C57.12.01, *IEEE Standard for General Requirements for Dry-Type Distribution and Power Transformers*

IEEE C57.12.90, *IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers*

IEEE C57.12.91, *IEEE Standard Test Code for Dry-Type Distribution and Power Transformers*

IEEE C57.18.10, *IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transformers*

IEEE C57.110, *IEEE Recommended Practice for Establishing Liquid Immersed and Dry-Type Power and Distribution Transformer Capability when Supplying Nonsinusoidal Load Currents*

IOGP S-560, *Supplementary Requirements to IEC 61439-1 & 2 LV Switchgear & Controlgear*

IOGP S-704, *Supplementary Specification to IEC 60034-1 High Voltage Three-phase Cage Induction Motors*

IOGP S-732, *Supplementary Specification to UL 845 Low Voltage Motor Control Centers*

ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

UL 347, *Standard for Safety – Medium-Voltage AC Contactors, Controllers, and Control Centers*

UL 347A, *UL Standard for Safety – Medium Voltage Power Conversion Equipment*

UL 2900-1, *UL Standard for Safety – Software Cybersecurity for Network-Connectable Products, Part 1: General Requirements*

UL 2900-2-2, *UL LLC – Outline of Investigation for Software Cybersecurity for Network-Connectable Products, Part 2-2: Particular Requirements for Industrial Control Systems*

4 Guidance for specification of BDM/CDM/PDS and methodologies for compliance

4.3 Applicable standards

Add new list item

- Explosion protection safety requirements are covered by IEC 60079 series related to motors located in potentially explosive atmospheres.

Add new list item

- AC electrical machines used in PDSs – application guide is covered in IEC TS 60034-25.

5 Performance and functionality criteria

5.2 BDM/CDM/PDS characteristics and topology

5.2.4 Cooling topology

5.2.4.3 Liquid-cooling

Replace first sentence of first paragraph with

Liquid cooling systems shall monitor and control the following:

In first sentence of second paragraph, replace "should" with

shall

5.3 Ratings

5.3.2 Input ratings

5.3.2.2 Input voltage and input frequency

In first paragraph, replace "should" with

shall

5.3.2.3 Input current

In first sentence of first paragraph, replace '"should" with

shall

In second sentence of first paragraph, replace "should" with

shall

In fourth paragraph, replace "If the BDM/CDM/PDS is a category C4 equipment as defined by IEC 61800-3, then harmonic current spectrum should" with

The harmonic current spectrum shall

Delete second sentence of fourth paragraph

5.3.3 Output ratings

5.3.3.1 BDM/CDM continuous operation

Replace first sentence of first paragraph with

BDMs/CDMs shall be continuously rated at the specified site conditions to supply the specified motor duty in terms of:

5.3.3.2 PDS continuous output

In first sentence, replace "should" with

shall

5.3.4 Operating quadrants

5.3.4.1 General

In first sentence, replace "should" with

shall

5.3.6 Special ratings related to BDM/CDM/PDS or motor

5.3.6.2 Transformers and reactors

5.3.6.2.1 General

Replace last sentence of fifth paragraph with

Transformers shall comply with IEC 60076 (all parts) and IEC 61378 (all parts), or ANSI/IEEE C57 (12.00, 12.01, 12.90, 12.91. 18.10 and 110).

5.3.6.2.6 Specific considerations

5.3.6.2.6.4 Shielding between primary and secondary winding

Replace first sentence of first paragraph with

An electrostatic shield shall be provided between the primary and secondary winding to prevent high-voltage transients being transferred to the secondary winding due to capacitive coupling.

In third sentence of first paragraph, replace "should" with

shall

5.4 Performance

5.4.1 Operational

5.4.1.4 Dynamic braking

5.4.1.4.1 Resistive braking

5.4.1.4.1.2 Resistive braking (stop)

In list item a), replace "should" with

shall

In first sentence of list item b), replace "should" with

shall

5.4.1.4.1.3 Resistive braking (slowdown)

In list item a), replace "should" with

shall

In list item b), replace "should" with

shall

5.4.2 Fault supervision

5.4.2.2 BDM/CDM/PDS protection interface

Add to subclause

The BDM/CDM shall detect an internal earth fault in the DC link.

Add to subclause

When an internal earth fault in the DC link is detected, the BDM/CDM shall provide a means of isolating the earth fault.

Table 11 — PDS protection functions

Add rows to Line feeder section

Line feeder	Alarm	Trip	Remark
Earth fault	X	X	

Add rows to Transformer section

Transformer	Alarm	Trip	Remark
Short circuit	X	X	
Earth fault	X	(X)	
Pressure relief valve	X	X	Oil-type only

Add rows to Converter section

Converter	Alarm	Trip	Remark
Short circuit	X	X	Line-Line-Line, Line-Line, Line-Line-Ground
Undervoltage	X		
Underload	X		
Control power trouble	X		
Control unit processor/watchdog failure	X	X	
Cooling system changeover failure	X	(X)	
Short time converter output current limit protection	X		

Add rows to Motor section

Motor	Alarm	Trip	Remark
Short circuit	X	X	
Phase loss	X	X	
Motor stall/jam	X	(X)	
Earth fault in stator winding	X	(X)	
Loss of field	X	X	Synchronous motor only
Exciter current short circuit	X	X	Synchronous motor only
Exciter earth fault	X	X	Synchronous motor only
Overtemperature exciter stator winding	X	X	Synchronous motor only

Add table NOTE 3

NOTE 3 The protection functions listed in this table are achieved via an external protective device or by BDM itself. No external device/component/circuit is required unless the BDM is not able to achieve a particular protection function.

5.4.3 Minimum status indication required

Replace subclause with

The BDM/CDM/PDS shall be equipped with status indication for:

- mains circuit breaker off;
- mains circuit breaker on;
- drive ready;
- drive run;
- drive trip;
- drive common alarm;
- output isolator off (if applicable);
- output isolator on (if applicable).

5.4.4 I/O devices

5.4.4.1 General

In first paragraph, replace "should" with

shall

5.5 General safety

Replace first sentence with

The general safety evaluation of the BDM/CDM/PDS shall be performed in accordance with IEC 61800-5-1 or IEEE 1566.

5.6 Functional safety

Replace fourth paragraph with

The functional safety of the BDM/CDM/PDS shall be in accordance with IEC 61800-5-2.

5.7 EMC

Replace third paragraph with

EM compatibility of the BDM/CDM/PDS shall be in accordance with IEC 61800-3.

Replace fourth paragraph with

EM immunity, associated with the functional safety of the BDM/CDM/PDS shall be in accordance with IEC 61800-5-2.

5.9 Environmental condition for service, transport and storage

5.9.1 General

Replace first sentence with

Service conditions for operation shall be selected in accordance with IEC 60721 series.

5.9.2 Operation

5.9.2.1 Climatic conditions

5.9.2.1.1 General

Replace first paragraph with

The BDM/CDM/PDS shall comply with the values provided in Table 12 for environmental service condition.

5.10 Types of load duty profiles

Add to first paragraph

The output current ratings of the BDM/CDM shall comply with motor rated full load current operating in continuous running duty, duty type S1, in accordance with IEC 60034-1.

6 Test

6.5 Standard tests for BDM/CDM/PDS

6.5.1 General

Replace subclause with

Testing of the BDM/CDM/PDS and identified PDS components shall be performed in accordance with Table 22.

Add new Table 22

Table 22 — Standard tests for BDM/CDM/PDS

Test description [a, b]	Test to be performed on	Testing location	Test parameters/measurements	Remarks
Routine tests				
Visual inspection	BDM	Manufacturer's facility	Dimensions, mass, degree of protection, individual marking, accessibility, tag and rating plate, lifting arrangements, indication and HMI functionalities, earthing and padlocking, etc.	
Insulation	BDM	Manufacturer's facility	Insulation values of components and devices	
Light load / full current test using a reactor	BDM	Manufacturer's facility	Current values, converter temperature rise, time duration till the temperature stabilizes	Time duration may vary based on the drive topology and converter type
Functional tests				
Start-up sequence and operation	BDM	Manufacturer's facility	Interlocks (door limit switches, etc.), controls, ramp up/down, schematics, remote access, alarms, trips (overload, overvoltage, earth fault), skip frequency bands, E-stop, communication network, etc.	
DC link undervoltage	BDM	Manufacturer's facility	Drive trip below minimum DC link voltage	
Disturbance ride-through and restart	BDM	Manufacturer's facility	Ride-through and restart function	
Speed control function	BDM	Manufacturer's facility	Maximum and minimum speed operation, ramp up / ramp down function, behaviour on loss of speed set point signal (analog/communication link), set point vs, output speed accuracy and linearity, etc.	
Automatic restart/re-acceleration and flying restart capability following a trip at full speed	BDM/CDM/PDS	During string test (location as per purchase order)	Automatic restart and catch on fly/flying restart function	Test if required for intended application

Table 22 *(continued)*

Test description [a, b]	Test to be performed on	Testing location	Test parameters/measurements	Remarks
Functional tests *(continued)*				
Heat run tests at rated load	CDM/motor	Respective manufacturer's facility	Transformer temperature rise, Motor temperature rise, Bearing temperatures, Shaft vibrations, etc.	
Load characteristic (load envelope)	PDS	During string test (location as per purchase order)	Voltage, current and power at terminals of converter transformer input, converter input and motor input, current unbalance, test of current/torque limiting functions, torque capability, power factor, output voltage waveform, output current waveform, etc.	Test optional per application/rating
Harmonic distortion (current)	PDS	Field test	Harmonics values up to 40th harmonics in current on the line side and motor side	Test optional
Functionality of all auxiliary devices (cooling system)	BDM (auxiliaries)	Respective manufacturer's facility	Auto start / auto changeover of standby auxiliaries, Replacement of filter and de-ioniser resin bottle in operation, leak detection, water conductivity, static pressure, differential pressure, low flow, water temperature, simulation of warning/alarms from cooling unit	
Bearing insulation	Motor	Motor manufacturer's facility	Shaft voltage, bearing insulation (ohmic value)	
Audible noise	Individual PDS components	Respective manufacturer's facility	Noise (dBA) at 1 m distance	
Torque pulsation	PDS	During string test (location as per purchase order)	Air gap torque pulsations calculated using speed and/or current measurements	Test optional

NOTE The performance tests may be carried out on at least one HV AC drive system of a group of identical systems rated 4 MW and above, within the same purchase order.

[a] The tests in this table shall be conducted for validation of performance and functionality in accordance with the applicable tests specified in Table 6.

[b] When a required test is not listed in Table 6, the test procedures with the relevant acceptance criteria shall be provided by the responsible party, as described in 4.2.

7 Information and marking requirements

7.1 General

Add to subclause

Name plates shall be 316L stainless steel.

Add to subclause

Name plates shall be affixed with 316L stainless steel rivets or screws.

7.2 Marking on product

In first paragraph, replace "should" with

shall

In second paragraph, replace "should" with

shall

In third paragraph, replace "should" with

shall

Add to subclause

Vertical section and door-mounted instruments shall be identified with permanently engraved laminated nameplates.

Add to subclause

Internal components, PC boards, devices, protection relays, instruments and terminal blocks shall be identified, in accordance with the wiring diagrams, by permanent labels fixed on the non-removable part of the component or on the structure of the enclosure.

7.3 Information to be supplied with the PDS or BDM/CDM

In first paragraph, replace "should" with

shall

In second paragraph, replace "should" with

shall

In third paragraph, replace "should" with

shall

7.4 Information to be supplied or made available

In first paragraph, replace "should" with

shall

In second paragraph, replace "should" with

shall

7.5 Safety and warning

7.5.1 Safety and warning labels

In first paragraph, replace "should" with

shall

Add to subclause

Caution, danger and warning labels with instructions and graphical symbols shall be in accordance with IEC 60417 or ISO 7010.

Add to subclause

Caution, danger and warning labels shall display information in English and in the specified language.

Add to subclause

Transport and anchoring hardware that needs to be removed when the equipment is installed shall be identified with caution labels or tags.

7.5.2 Additional safety considerations of a PDS

In third paragraph, replace "should" with

shall

Add new clause

8 Constructional requirements

8.1 General

8.1.1

BDMs shall comply with the emissions and immunity limits in accordance with IEC 61800-3.

8.1.2

Safety aspects shall be in accordance with IEC 62477-2 or UL 347A or CSA 22.2 NO 274.

8.2 Enclosure

8.2.1 Design

8.2.1.1

When a high voltage compartment door is not closed and secured, door interlocks shall prohibit the energizing of PDS components.

8.2.1.2

When the PDS is energized, high voltage compartment doors shall be prevented from opening.

8.2.1.3

Unless the high voltage supply is withdrawn with power components in the compartment electrically isolated and discharged or electrically isolated and earthed, the doors of the high voltage compartment shall not open.

8.2.1.4

Door interlocks shall not be provided for control or cooling compartments that require access for service or maintenance during operation.

8.2.1.5

Compartments without door interlocks shall have no exposed live parts with voltages equal to or greater than 50 V.

8.2.1.6

When the door is open, the low voltage compartments with live parts, accessible during operation, shall provide a degree of protection of at least IP20 in accordance with IEC 60529.

8.2.1.7

When the cover and door are closed, the low voltage compartment shall provide a degree of protection of at least IP21 in accordance with IEC 60529.

8.2.1.8

The stray magnetic field of the BDM/CDM components shall not cause vibrations in the enclosure.

8.2.1.9

Devices that may cause a trip due to vibration or impact shall not be mounted on the enclosure door.

8.2.1.10

Undrilled removable gland plates or multi-cable transits shall be used for cable entry.

8.2.1.11

Gland plates shall be non-magnetic.

8.2.1.12

Bolted covers on the side or rear of enclosures shall be removable from the outside.

8.2.1.13

Unpainted hardware of the enclosure shall be of non-corrosive material or coated with a non-corrosive material.

8.2.2 Accessibility and clearances

8.2.2.1

The internal layout within the enclosure shall permit servicing or replacement of components and modules from the front.

8.2.2.2

The arrangement of the components within the enclosure shall permit installation of the enclosure against a wall without need for access from the rear.

8.2.2.3

Hinged doors of compartments with power components, isolating switches and breakers shall have a facility for padlocking.

8.2.2.4

Hinged doors of enclosures shall open at least 90°.

8.2.2.5

Hinged doors shall have a door stay to secure the door in open position.

8.2.3 Compartmentalization/sectionalization

8.2.3.1

Enclosures shall have the vertical sections segregated in accordance with the voltage levels and the need for access during operation.

8.2.3.2

Components and auxiliaries that need open-door access during operation shall not be mounted inside high-voltage compartments.

8.2.3.3

The arrangement of compartments shall minimize the interconnecting cables between the compartments.

8.2.4 Internal arc classification

8.2.4.1

An arc-resistant enclosure for high voltage compartments, based on the maximum three-phase short circuit current from the power system source, shall be provided in accordance with IEC 62271-200 or IEEE C37.20.7.

8.2.4.2

The incident power level of an electric arc shall be calculated in accordance with IEEE 1584.

8.2.4.3

The arc flash energy calculations for a fault in the electrical network shall include the current contribution from the motors in the network.

8.2.4.4

The accessibility type shall be 2b, in accordance with IEC 62477-2:2018, Table AA.1.

8.2.4.5

The internal arc classification of the enclosure shall be AFLTB for enclosures placed against a wall and AFLRTB for other installations.

8.2.4.6

The rated arc fault current of the enclosure shall be no less than the cumulative contribution of fault currents from all branches of the system.

8.2.4.7

The rated arc fault current withstand duration of the enclosure shall be no less than 0.5 s.

8.2.4.8

The internal arc classification rating plate information shall be in accordance with IEC 62477-2.

8.2.4.9

When required in accordance with IEC 62477-2, associated protection or special conditions shall be documented.

8.3 Components

8.3.1 General

8.3.1.1

Components weighing more than 25 kg shall be provided with lifting or pulling lugs.

8.3.1.2

Main circuit switches, MCBs, MCCBs and contactors shall be in accordance with IOGP S-560 or IOGP S-732.

8.3.2 Converter

8.3.2.1

The converter power device or cell arrangement shall permit replacement of the power module or the control printed circuit board in less than 1 h.

8.3.2.2

The fault withstand duration of the rectifier section of the converter shall be greater than the mains breaker release time.

8.3.2.3

The converter control system shall identify and isolate a faulty module.

8.3.2.4

When the control system isolates a faulty converter module, the converter shall continue to operate uninterrupted.

8.3.3 Cooling

8.3.3.1 General

8.3.3.1.1

Cooling fans shall be redundant.

8.3.3.1.2

Cooling circuit pumps shall be redundant.

8.3.3.1.3

When an operational cooling fan or pump fails, transfer of operation to the standby cooling fan or pump shall be initiated automatically.

8.3.3.1.4

When automatic transfer is initiated due to a fault of a working fan or pump, the control system shall generate an alarm.

8.3.3.1.5

The control system shall have a feature for periodic transfer of operation between working and standby cooling fans and pumps.

8.3.3.1.6

Periodic transfer of operation between the working and standby units shall be initiated on elapse of the user-defined run-time interval.

8.3.3.1.7

The run-time interval for periodic transfer shall be configurable in the control system individually for each cooling fan and pump.

8.3.3.1.8

The control system shall permit manual transfer of operation between working and standby cooling fans and pumps.

8.3.3.1.9

The BDM/CDM/PDS shall continue to operate uninterrupted during the transfer of operation between the working and standby units.

8.3.3.1.10

The control system shall initiate an alarm on failure of periodic transfer of operation between the working and standby units.

8.3.3.1.11

The cooling system shall be designed for the heat losses of the BDM/CDM at rated output for the specified ambient temperature.

8.3.3.1.12

A fault in the cooling system shall prevent the start of the BDM/CDM.

8.3.3.2 Air cooling

8.3.3.2.1

Air-cooling fans shall be equipped with a monitoring facility.

8.3.3.2.2

Failure of an air-cooling fan shall generate an alarm without shutting down the BDM/CDM.

8.3.3.3 Liquid cooling

8.3.3.3.1

Low-voltage three-phase motors for liquid cooling pumps and fans shall conform to IEC 60034 or IEEE 841.

8.3.3.3.2

Check valves shall not be used for isolation purposes in the liquid cooling circuit.

8.3.3.3.3

Piping and tubing in the liquid cooling circuit shall have a service life of at least 20 years

8.3.3.3.4

External pipe connections shall be provided with mating flanges, gaskets and fixing hardware.

8.3.3.3.5

When the cooling medium is sea water, heat exchangers and valves shall be designed for an open ventilated area or outdoor installation.

8.3.3.3.6

The liquid cooling system shall be provided with instruments for protection and measurement of conductivity, pressure, temperature, liquid level and leakage.

8.3.3.3.7

The liquid cooling system shall permit replacement of consumables while the BDM/CDM is in operation.

8.3.3.3.8

The liquid cooling system shall allow liquid sampling, topping up, changing of de-ionizer, filter replacement, water polishing, etc. while continuing the liquid flow in the BDM.

8.3.3.3.9

The liquid cooling system shall permit maintenance of the standby fan and pump while the BDM/CDM is in operation.

8.3.3.3.10

With the mains supply disconnected and isolated, the power semi-conductor devices shall be replaceable without draining the cooling medium from the liquid cooled converter.

8.3.3.3.11

Dew formation within the liquid cooled drive system shall be prevented.

8.3.3.3.12

BDM/CDM compartments with cooling medium pipes shall have a means of containing leaks.

8.3.3.3.13

The liquid cooling system shall monitor the reservoir or make-up tank for evaporation or leakage of the cooling medium.

8.3.4 Transformers

8.3.4.1

Transformers shall comply with one or more of the following standards

- IEC 61378-1;
- IEC 60076-1, 2, 3, 5, 7, 10, 11, 12 and 14;
- IEEE C57.12.00, 12.01, 12.90, 12.91, 18.10 and 110;
- IEEE 1276.

8.3.4.2

Transformers shall have resistance temperature detectors, two per winding and one on the core.

8.3.4.3

The resistance temperature detectors on the windings and core of the transformer shall be located to detect the hottest temperature.

8.3.4.4

When pre-magnetization is required, the pre-magnetization transformer and disconnectors shall be installed in the same compartment as the converter transformer.

8.3.4.5

Power connection terminals of the transformer shall be tinned copper.

8.3.5 Capacitors

8.3.5.1

Capacitors shall be tested in accordance with IEC 61071 or IEEE 18.

8.3.5.2

Electrolytic capacitors shall not be used in the power section of the converter, input or output filters, DC link or snubber circuits.

8.3.5.3

The line filter capacitors shall have a continuous operation voltage rating of 110 % of the network rated voltage.

8.3.5.4

DC link capacitors shall have a continuous operation voltage rating of 125 % of the maximum DC link voltage.

8.3.5.5

Power capacitors shall have a service life of at least 15 years.

8.3.5.6

The service life of power capacitors shall take account of the temperature inside the enclosure, the peak voltage stress, ripple currents and harmonic currents.

8.3.6 Circuit breakers

Circuit breakers shall be designed and tested in accordance with IEC 62271-100 or IEEE C37.04.

8.3.7 Contactors

Contactors shall be designed and tested in accordance with IEC 62271-106 or UL 347.

8.3.8 Disconnectors and earthing switches

Disconnectors and earthing switches shall be designed and tested in accordance with IEC 62271-102 or IEEE C37.22.

8.3.9 Filters

When a harmonic filter is installed, earth fault detection and voltage measurement shall be performed using a voltage transformer.

8.3.10 Motors

Motors shall comply with IOGP S-704 or API Standard 541 or API Standard 547 or API Standard 546.

8.4 Busbars, wiring and terminals

8.4.1 Busbars

Copper busbar joints and termination ends shall be tin-plated.

8.4.2 Wiring

8.4.2.1

The insulation material of internal wires shall be low halogen, flame retardant and have a low smoke index.

8.4.2.2

Wiring ends on terminals shall be labelled with wire marker ferrules in accordance with the wiring diagram.

8.4.2.3

Wiring for external connections shall be routed to individual terminals on a front accessible terminal block.

8.4.3 Power and control terminals

8.4.3.1

Control terminals shall have a single wire termination.

8.4.3.2

Control terminals shall be labelled in accordance with wiring diagram.

8.4.3.3

Auxiliary power terminals with a voltage greater than 50 V, accessible with the compartment door open shall be shrouded to provide a degree of protection of at least IP20.

8.4.4 Cable interface

The separation distance between the gland plate or multi-cable transit and the power terminals within the enclosure shall permit installation of the specified power cables without mechanical stress on the terminals.

8.5 Control supply and panel auxiliaries

8.5.1 Control supply

8.5.1.1

The BDM shall have redundant AC to DC control power units with each unit fed from an independent external AC control power supply.

8.5.1.2

The output of the AC to DC control power units shall be connected in parallel via blocking diodes prior to further distribution within BDM/CDM.

8.5.1.3

Protection devices on the input side of the AC to DC control power units shall be provided within the BDM.

8.5.2 Panel auxiliaries

BDM/CDM compartments shall have LED lamps for internal illumination controlled by door limit switches.

8.6 Earthing

8.6.1

The electrical safety of HV AC drive systems shall be in accordance with IEC 61800-5-1 or IEEE 1566.

8.6.2

A main protective earth of copper material shall be provided in all compartments.

NOTE The main protective earth is normally a tinned copper bar.

8.6.3

The main protective earth shall be interconnected between compartments and extended outside the enclosure at both ends for external connections.

8.6.4

The extension of the main protective earth at both ends of the enclosure shall permit connection of earthing cables with cross section area of at least 120 mm² (4/0 AWG).

8.6.5

Metal parts of the BDM/CDM shall have electrical continuity and connection to the main protective earth.

8.6.6

Covers, hinged doors, gland plates and multi-cable transits shall have electrical continuity with the metal structure of the enclosure.

8.6.7

High-voltage BDM/CDM components shall have provision for earthing with a 20 mm (0.79 in) earthing ball stud or a fixed earthing switch.

8.6.8

When provision of an earthing ball stud or fixed earthing switch is not feasible, a portable earthing device shall be supplied.

Add new clause

9 Functional requirements

9.1 General

9.1.1

Control circuits, signal inputs and signal outputs shall be galvanically isolated from the power circuits in accordance with IEC 61800-5-1 or IEEE 1566.

9.1.2

The compatibility level for total harmonic distortion shall be in accordance with IEC 61000-2-4:2002, Table 5, electromagnetic environment Class 1 and IEEE 519:2014, Table 1.

NOTE 1 Planning level, if defined in national standards or guidelines, is acceptable provided that the planning level is not higher than the compatibility level.

NOTE 2 Where compliance to electromagnetic environment Class 1 value is not practical, Class 2 may be allowed provided the generation and distribution equipment are designed to operate at such higher limits.

9.1.3

The compatibility level for individual harmonic distortion shall be in accordance with the most stringent voltage distortion limit under electromagnetic environment Class 1 among IEC 61000-2-4:2002, Table 2, IEC 61000-2-4:2002, Table 3, IEC 61000-2-4:2002, Table 4 and IEEE 519:2014, Table 1 for the specified voltage.

NOTE 1 Planning level, if defined in national standards or guidelines, is acceptable provided that the planning level is not higher than the compatibility level.

NOTE 2 Where compliance to electromagnetic environment Class 1 value is not practical, Class 2 may be allowed provided the generation and distribution equipment are designed to operate at such higher limits.

9.1.4

For onshore installations, the performance of the BDM/CDM/PDS shall be in accordance with IEC 61800-2 or IEEE 1566.

9.1.5

For offshore installations, the performance, testing and installation of the BDM/CDM/PDS shall be in accordance with IEC 61800-2 or IEEE 1566, and:

- IEC 61892 (all parts) for mobile and fixed units; or
- IEC 60092 (all parts except 301, 305, 306, 501, 502 and 503) for electrical installations in ships.

9.1.6

When the requirements in accordance with the International Maritime Organization (IMO), International Association of Classification Societies Ltd. (IACS) or other applicable classification societies contradicts or conflicts with the requirements of IEC or IEEE standards, the more stringent shall be applied.

9.2 Control and interface

9.2.1 Control system

9.2.1.1

The converter control system shall diagnose faults, capture transient waveforms and, monitor and record events.

9.2.1.2

The converter control system shall have capability to record disturbance and fault information triggered by a fault condition.

9.2.1.3

The duration of recording the disturbance and fault information shall be a configurable time window from -500 ms to +2000 ms from the instance of the trigger.

9.2.2 Control interface

9.2.2.1

Signals exchanged amongst PDS components and between PDS components and interfacing equipment shall be in accordance with Table 23.

9.2.2.2

When a synchronous motor is the driver, signals exchanged between the PDS and the excitation panel shall be in accordance with Table 24.

9.2.2.3

The control, power and auxiliary power interfaces between the PDS and external power supplies shall be in accordance with Table 25.

9.2.3 Active VAr control

9.2.3.1

Active infeed converters shall provide reactive power support to the grid power, both leading and lagging, if specified.

NOTE 1 Reactive power support is also known as "Active VAr Control".

NOTE 2 Active VAr control is not possible with LCI drives as the line side power factor is determined by the load.

NOTE 3 An active infeed converter must document its ability with a complete PQ diagram for voltages in the range of 0.9 pu to 1.1 pu.

9.2.3.2

When the grid power experiences a sudden voltage dip or overvoltage, the reactive power from the active infeed converter shall support the grid voltage.

9.2.4 Operator interface

9.2.4.1

The HMI shall accept operational input commands, set points and parametrization.

9.2.4.2

The HMI shall have a screen for displaying operating status, operating parameter values, alarms, events and fault diagnostics.

9.2.4.3

The HMI shall display information on the cause of a trip, with parameters prior to and subsequent to the trip.

9.2.4.4

The HMI shall have a facility to connect and synchronize with the central time server.

Add new Table 23

Table 23 — PDS interface signals

From	To	Interface type	Interface signal description [a]	Wiring
Converter	Input switchgear - circuit breaker or contactor	Command	Close, open/trip	Hardwired
		Interlock	Emergency stop (on converter) push button contacts wired to closing and tripping circuits of circuit breaker or contactor coil	
		Status feedback	-	
		Measurement/control feedback	-	
Input switchgear - circuit breaker or contactor	Converter	Command	-	Hardwired
		Interlock	-	
		Status feedback	Circuit breaker close (in service), circuit breaker open (in service), circuit breaker ready to close, contactor on, contactor off	
		Measurement/control feedback	-	
PCS (process control system) or UCP (unit control panel) or equipment PLC [b]	Converter	Command	Start (optional), stop, speed setpoint, local/remote selection (optional)	Hardwired / via communication link
		Interlock	-	
		Status feedback	-	
		Measurement/control feedback	-	
Converter	PCS (process control system) or UCP (unit control panel) or equipment PLC	Command	-	Hardwired / via communication link
		Interlock	-	
		Status feedback	Ready to power up, ready to start (rotation), running, common alarm, common fault, local/remote mode selected (optional), external trip	
		Measurement/control feedback	Current, speed, output power (kW/HP), motor running hours	
ESD/SAS/SIS (emergency shutdown system/ safety automation system / safety integrated system)	Input switchgear - circuit breaker or contactor	Command	Trip [c]	Hardwired
		Interlock	-	
		Status feedback	-	
		Measurement/control feedback	-	
ESD/SAS/SIS (emergency shutdown system/ safety automation system / safety integrated system)	Converter	Command	Trip [d]	Hardwired
		Interlock	-	
		Status feedback	-	
		Measurement/control feedback	-	

Table 23 *(continued)*

From	To	Interface type	Interface signal description [a]	Wiring
Converter	ESD/SAS/SIS (emergency shutdown system/ safety automation system / safety integrated system)	Command	-	-
		Interlock	-	
		Status feedback	-	
		Measurement/control feedback	-	
CDM components, as applicable (transformer, reactor, output isolator, harmonic filter, cooling unit) [e]	Converter	Command	-	Hardwired
		Interlock	Cover/door interlock (for high voltage compartments)	
		Status feedback	Transformer/reactor cooling fan fault, output isolator close/open, cooling medium low flow (optional), cooling medium high temperature, cooling medium low level, cooling medium fan trip, cooling medium pump trip, conductivity (high and high-high)	
		Measurement/control feedback	Transformer/reactor winding temperature RTD (optional), transformer/reactor oil temperature RTD (optional), transformer/reactor oil level (optional), transformer/reactor core temperature (optional), Buchholz relay – gas/surge (optional), sudden pressure relay (optional), current (short circuit/earth fault - optional).	
Standalone LCS (local control station in field, if applicable) / driven equipment UCP (unit control panel) [f]	Converter	Command	Start (optional), stop, speed increase/decrease (optional), local/remote selection (optional)	Hardwired
		Interlock	-	
		Status feedback	-	
		Measurement/control feedback	-	
Converter	Standalone LCS (local control station in field, if applicable) / driven equipment UCP (unit control panel)	Command	-	Hardwired
		Interlock	-	
		Status feedback (only to LCP/UCP)	Ready to start (optional), run, common fault, local/remote mode selected (optional)	
		Measurement/control feedback	motor current (optional), motor speed (optional)	

Table 23 *(continued)*

From	To	Interface type	Interface signal description [a]	Wiring
Motor (interface signals depend on the type of motor selected and project requirement) [g]	Converter/SAS/SIS (safety automation system / safety integrated system)[h]	Command	-	Hardwired
		Interlock	Purge cycle complete, loss of purge (low-low)	
		Status feedback	exchanger cooling fan fault (air-air cooled), cooling water flow low (optional), cooling water leakage detected (air-water cooled), motor pressurization low (optional), differential pressure high (optional)	
		Measurement/control feedback	Motor winding temperature (thermistor/RTD), cooler inlet air temperature, cooler outlet air temperature, motor speed via. encoder/pulse tach generator/shaft speed pickup (optional) **In the absence of a separate MMS (machine monitoring system), the following interface signals are connected directly:** motor bearing temperature RTD, motor vibration and key phase sensor.	
Motor	MMS (machine monitoring system) (optional) [i]	Command	-	Hardwired
		Interlock	-	
		Status feedback	-	
		Measurement/control feedback	Motor bearing temperature RTD, motor vibration and key phase sensor	
MMS (machine monitoring system) (optional)	Converter/SAS/SIS (safety automation system / safety integrated system)	Command	Trip	Hardwired
		Interlock	-	
		Status feedback	-	
		Measurement/control feedback	-	

[a] There are multiple methods to implement the control philosophy and alternative methods of controls are also acceptable. Interface signals may be added/deleted based on project control philosophy. However, in absence of any defined control philosophy, these interface signals typically used in most projects constitute the essential minimum considering provision of footnotes e to i.

[b] Equipment PLC may be installed separately or within the driven equipment UCP (unit control panel).

[c] This trip command is to disconnect mains supply during emergency.

[d] This trip command is to initiate early trip of converter during emergency.

[e] The CDM components may vary depending on the topology and so will the interface signals.

[f] Provision of LCS (local control station) or UCP (unit control panel) in field and its interface signals will be based on project control philosophy.

[g] The choice of motor type will be based on project philosophy, ATEX requirements and the interface signals will vary in accordance with the motor type.

[h] Motor interface signals wiring to converter, SAS or SIS system will be based on project control philosophy.

[i] Where separate machine monitoring system is not envisaged, the interface signals will be wired to converter, SAS or SIS system based on the project control philosophy.

Add new Table 24

Table 24 — Synchronous motor interface signals

From	To	Interface type	Description	Wiring
Excitation panel	Converter	Command	-	Hardwired
		Interlock	Exciter healthy	
		Status feedback	Excitation on/off	
		Measurement/control feedback	-	
Converter	Excitation panel	Command	Excitation start, excitation stop, excitation raise, excitation lower, excitation current (4-20 mA) signal (optional),	Hardwired
		Interlock	Emergency stop push button	
		Status feedback	-	
		Measurement/control feedback	-	
Synchronous motor	Converter	Command	-	Hardwired
		Interlock	-	
		Status feedback	-	
		Measurement/control feedback	Speed encoder (optional)	
NOTE Apply this table with Table 23 for complete interface signals of a PDS having a synchronous motor as driver.				

Add new Table 25

Table 25 — Control, power and auxiliary supply interface signals

From	To	Interface type	Description	Wiring
PDB / UPS DB	Converter	Control source (single phase or DC)	Drive control supply (external)	Hardwired
PDB	Converter	Power source (three phase)	Pre-charge/pre-magnetization circuit, cooling fan circuit, cooling pump	Hardwired
PDB	Converter	Auxiliary source (single phase)	Panel space heater, motor space heater, panel illumination circuit	Hardwired
PDB	Exciter panel	Power source (three phase supply for synchronous motor)	Excitation supply source (for synchronous motor)	Hardwired
PDB	Exciter panel	Auxiliary source (single phase)	Panel space heater, motor space heater, panel illumination circuit	Hardwired

9.2.4.5

Alarms, events and fault information shall be time stamped and stored chronologically in the non-volatile memory of the HMI.

9.2.4.6

When the storage capacity is full, the non-volatile memory shall be automatically overwritten on a "first-in, first-out" basis.

9.2.4.7

The non-volatile memory shall be manually erasable.

9.2.4.8

The HMI shall have trend buffers for variables that allow one-shot or multi-shot trending.

9.2.4.9

Failure of the HMI shall not compromise the operation of the BDM/CDM/PDS.

9.2.4.10

The HMI shall have password protected multiple levels of access:

- for viewing, by the operator;
- for settings, by trained operating personnel;
- for service, by the manufacturer's personnel.

9.2.4.11

The HMI shall use plain language text for error messages without the need to look up error codes or decipher the meaning of error messages.

9.2.4.12

When the HMI and BDM are installed in the same field zone as an IEC 62443 network without a layer 3 firewall in between the HMI and BDM processor unit, the HMI shall have a non-windows operating system.

9.2.5 Protection and alarms

9.2.5.1

The alarm and protection functions shall be displayed on the HMI with a first failure feature.

9.2.5.2

When specified, the BDM/CDM/PDS shall permit continued operation with a single earth fault.

9.2.6 Communication protocol and network interface

9.2.6.1

The BDM shall have communication hardware compliant with the interface media and protocol as specified for remote monitoring and automation system interface.

9.2.6.2

The cyber security requirements for the communication network shall be in accordance with IEC 62443 (all parts) or UL 2900-1 and UL 2900-2-2.

9.3 Reliability and availability

9.3.1

The BDM/CDM/PDS shall provide a minimum operation life of 20 years for the specified environmental conditions in accordance with the scheduled maintenance activities recommended by the manufacturer.

9.3.2

The PDS shall operate continuously for 6 years without need for intermediate stop to perform preventive or routine maintenance.

9.3.3

The BDM including auxiliaries shall have an availability of minimum 99,9 %.

9.3.4

Failure of a component or sub-component within the BDM/CDM/PDS shall not trigger a cascade failure involving other components.

9.4 Performance

9.4.1

The BDM/CDM/PDS shall withstand thermal and dynamic stresses and transient mechanical torques resulting from a short circuit.

9.4.2

The converter control system shall provide speed regulation within ±1 % of maximum frequency in Volt/Hertz control.

9.4.3

The converter control system shall provide speed regulation within ±0,2 % of maximum frequency in an open loop vector control.

9.4.4

The converter control system shall provide speed regulation within ±0,02 % of maximum frequency in a closed loop vector control.

9.4.5

When an input voltage on one or more phases dips to 65 % of the nominal voltage for a duration of no longer than 500 ms, the BDM shall initiate the kinetic buffering feature and sustain the control power through the duration of the voltage dip.

9.4.6

When the input voltage is restored from a voltage dip to at least 90 % of the nominal voltage, the BDM shall perform a flying restart and re-accelerate to the given set point.

9.4.7

When the input voltage is restored from a voltage dip to at least 90 % of the nominal voltage, BDM auxiliary drives if tripped, shall restart and prevent a trip of the BDM/CDM/PDS.

9.4.8

The BDM/CDM/PDS shall have an automatic restart feature with a programmable re-start delay.

NOTE A sustained start command and a healthy control supply are essential to operate this feature, when enabled.

9.4.9

The converter control system shall have at least two skip frequency band which can be configured individually between the operating speed range to rapidly run through the critical speeds.

9.4.10

The BDM/CDM output voltage and performance shall be compatible with the permissible torque ripple or pulsation for the driven equipment train.

9.4.11

The insulation of the BDM/CDM shall be designed to overvoltage category III in accordance with IEC 61800-5-1.

Add new clause

10 Transport, storage and handling

10.1

When specified, an impact indicator and a data logger with date-time stamping for recording shock, tilt, temperature, humidity and pressure shall be installed on each shipping section prior to shipping.

10.2

Transport and anchoring hardware shall be installed to prevent damage due to tilt or inclination of shipping sections when manoeuvring during transportation and installation.

10.3

Transport and anchoring hardware shall be identified in the instruction manual for removal post-installation.

10.4

When specified, the packaging shall permit safe connection of an external power supply to the internal space heaters of the enclosure during storage.

Registered Office
City Tower
Level 14
40 Basinghall Street
London EC2V 5DE
United Kingdom

T +44 (0)20 3763 9700
reception@iogp.org

Brussels Office
Avenue de Tervuren 188A
B-1150 Brussels
Belgium

T +32 (0)2 790 7762
reception-europe@iogp.org

Houston Office
15377 Memorial Drive
Suite 250
Houston, TX 77079
USA

T +1 (713) 261 0411
reception-americas@iogp.org

www.iogp.org