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REDLINE

Version 3.0 to Version 2.0

Supplementary Specification
to IEC 61439-1 and IEC 61439-2
for Low-voltage Switchgear and
Controlgear

Redline Version

Revision history

| VERSION | DATE | PURPOSE |
|---------|---------------|----------------|
| 3.0 | December 2022 | Third Edition |
| 2.0 | November 2016 | Second Edition |
| 1.0 | June 2016 | First Edition |

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).

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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).

This third edition cancels and replaces the second edition published in November 2016.

Due to technical writing requirements leading to extensive changes, this third edition should be treated as a new document.

ABOUT THE REDLINE VERSION

This Redline version aims at comparing Version 3.0 to Version 2.0 but may not capture all changes.

The Redline version is not a specification document. It is a mark-up copy provided for information only. The user must refer to the official published version.

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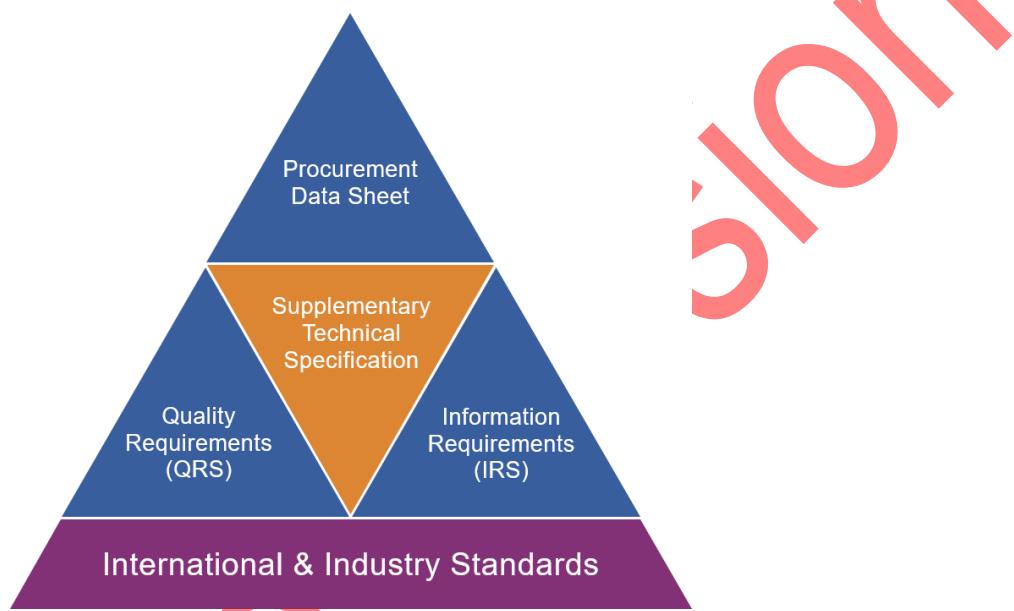
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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of low voltage switchgear and control gear assemblies in accordance with IEC 61439-1, Edition 3, May 2020 and IEC 61439-2, Edition 3.0, July 2020, Corrigendum 1, 2021 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 presumes that a compilation of documents will for Procurement Documents
Supplementary Technical Specification

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

IOGP S-560: Supplementary Specification to IEC 61439-1 and IEC 61439-2 for Low-voltage Switchgear and Controlgear

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to IEC 61439-1 and IEC 61439-2, following the IEC 61439-1 and IEC 61439-2 clause structure. Clauses from IEC 61439-1 and IEC 61439-2 not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to IEC 61439-1 or IEC 61439-2 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-560D: Procurement Data Sheet for Low-voltage Switchgear and Controlgear (IEC)

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 PSC-Assemblies, which will consist of part, or all of the following: the equipment.

IOGP S-560, Supplementary 560L: Information Requirements to IEC 61439 – LV for Low-voltage Switchgear and Controlgear Assemblies. (IEC)

- LV PSC Assembly Requisition (Purchase Order), with required documentation, quality assurance and inspection attachments.
- LV PSC Assembly Data Sheet(s) for common and individual assembly. The IRS defines the information requirements (supersedes IEC 61439-2 Annex BB (informative), User information template).
- LV PSC Assembly Circuit Schedule, or data file containing this, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information (one per Assembly).
- User Diagram(s), such as single-line diagrams, schematic diagrams, wiring diagrams, logic diagrams.

Supporting documents requirements will be based on the following:

- IOGP S-560D, Data sheets for IEC 61439 – LV Switchgear and Controlgear Assemblies.
- IOGP S-560L, Supplier Deliverable Requirements List (SDRL) for IEC 61439 – LV Switchgear and Controlgear Assemblies.

IOGP IOGP S-560Q, Purchase Order: Quality Requirements (POQR) for IEC 61439 – LV Low-voltage Switchgear and Controlgear Assemblies. (IEC)

The following requirements are not detailed within this Specification and will be identified in the Requisition, or as an attachment to the Requisition:

- Health, safety and environmental management requirements.
- Packing, preservation, marking and shipping requirements (in addition to the standard requirement in clause 6.2.2).
- Spare parts.

Unless defined otherwise in the Requisition, the 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 61439-1 and IEC 61439-2, 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 codes and standards documents shall be:

- a. Local statutory codes and regulations.
- b. International statutory regulations.
- c. Data Sheets.
- d. User documents.
- e. This IOGP Specification.
- f. Referenced international codes.

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order);
- c) purchaser defined requirements (procurement data sheet, IRS, QRS);
- d) this specification;
- e) IEC 61439-1 and IEC 61439-2.

Redline Version

1 Scope

1.1 General

*Additiona*This specification covers fully withdrawable switchgear and controlgear of cubicle and multi-cubicle type assemblies for indoor installation. This specification also applies to fixed and withdrawable cubicle type assemblies and combinations thereof.

Add to subclause:

This Specificationspecification does not cover:

- low-voltage switchgear and controlgear assemblies installed outdoors;
- detailed user requirements for electrical control and management systems;
- explosion protected "Ex" switchgear for use in potentially explosive atmospheres;
- pillar type or construction site distribution equipment (addressed by IEC 61439-4 and IEC 61439-5);
- standalone lighting and small power distribution boards with rated current not exceeding 250 A (addressed by IEC 61439-3).

Add new subclause

1.1

This specification details the requirements for the design, materials, fabrication, inspection and testing of low-voltage power switchgear and controlgear assemblies (PSC Assemblies).This Specification amends and supplements IEC 61439-1Edition 2.0 : 2014;2020 and IEC 61439-2Edition 2.0 : 2014;2020, referring sequentially to the same clause numbers.

Add new subclause

1.2

Clauses of IEC 61439-1 and IEC 61439-2 that are not addressed within this Specification shall specification remain fully applicable as written. Where there is no direct corresponding IEC 61439-1 or IEC 61439-2 clause, a new reference clause number has been added in this Specification. PSC Assemblies shall be tested to the extent defined in this Specification and in the Data Sheets to meet the arc containment requirements of the User in accordance with IEC TR 61641.

This Specification addresses fully withdrawable switchgear and controlgear of (multi) cubicle type assemblies for indoor installation, it shall also apply, where specified in the requisition documents to fixed and withdrawable cubicle type assemblies and combinations thereof.

1.2 In scope requirements

Additional subclause:

The requirements detailed in this Specification are intended to:

- a. Establish minimum default selections from the options given in IEC 61439-1 and IEC 61439-2;
- b. Specify additional and functional requirements where IEC 61439-1 and IEC 61439-2 are insufficiently detailed;
- c. Specify provisions or options to encourage indoor installed PSC Assembly rationalization within the petrochemical, refining, oil and gas industry.

Areas of conflict or inconsistency between these documents shall be brought to the attention of User for resolution. In the event of a conflict between this Specification and a relevant law or regulation, the relevant law or regulation shall be followed. If this Specification creates a higher obligation, it shall be followed as long as this also achieves full compliance with the law or regulation.

NOTE Requirements for Regional Trade Certification (eg CE marking) shall be identified in the Requisition documentation.

1.3 Out of scope requirements

Additional subclause:

This Specification does not cover:

- a. Requirements for integration with the Electrical Control & Management Systems (ECMS);
- b. Requirements for integration of any switchgear condition monitoring systems;
- c. Explosion protected 'Ex' equipment, (addressed by IEC 60079 series);
- d. 'Pillar' type or construction site distribution equipment, (addressed by IEC 61439 parts 4 and 5);
- e. Lighting and small power distribution boards rated less than 250 A specification.

2 Normative references

This clause of Part 1 and Part 2 is applicable except as follows.

Addition:

Add to start of clause

The following documents/publications are referenced/referred to in this document. For dated references, only the version cited shall be applied. For undated references, procurement data sheet (IOGP S-560D) or the latest version IRS (IOGP S-560L) in such a way that some or all of the referenced document (including any amendments) shall be applied their content constitutes requirements of this specification.

ANSI/IEEE C37.2 Standard for Electrical Power System Device Function Numbers, Acronyms, and Contact Designations.

Add to clause

BS EN 61439-1 2. Low-voltage switchgear and controlgear assemblies Part 1: General rules.

BS EN 61439-2 Low-voltage Power switchgear and controlgear assemblies Part 2: Power switchgear and controlgear assemblies.

IEC 60034-11, Rotating electrical machines – Part 11: Thermal protection

IEC 60051 (All parts)—, Direct acting indicating analogue electrical-measuring instruments and their accessories

IEC 60112 Method for the determination of the proof and the comparative tracking indices of solid insulating materials.

IEC 60079-14:2013, Explosive atmospheres – Part 14: Electrical installations design, selection and erection

IEC 60092-101:2018, Electrical installations in ships – Part 101: Definitions and general requirements

IEC 60269-1 — 2, Low-voltage fuses — Part 1: General requirements.

IEC 60269-2 Low-voltage fuses — Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) — Examples of standardized systems of fuses A to J-K

IEC 60664-1, Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests

IEC 60684 (All parts) Flexible insulating sleeving

IEC 60688, Electrical measuring transducers for converting a.c. AC and DC electrical quantities to analogue or digital signals

IEC 60947-2, Low-voltage switchgear and controlgear – Part 2: Circuit-breakers

IEC 60947-4-1, Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters

IEC 60947-4-2, Low-voltage switchgear and controlgear – Part 4-2: Contactors and motor-starters – Semiconductor motor controllers, starters and soft-starters

IEC 60947-5-1, Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices

IEC 60947-5-5, Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function

IEC 60947-7-1, Low-voltage switchgear and controlgear – Part 7-1: Ancillary equipment – Terminal blocks for copper conductors

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

IEC 61511-1, Functional safety — Safety instrumented systems for the process industry sector — Part 1: Framework, definitions, system, hardware and application programming requirements

IEC TR 61641 Enclosed low voltage switchgear and controlgear assemblies — Guide for testing under conditions of arcing due to internal fault.

IEC 61850 (All parts) Communication networks and systems in substations.

IEC 61869-1 Instrument transformers — Part 1: General requirements.

IEC 61869-2, Instrument transformers – Part 2: Additional requirements for current transformers.

IEC 61869-3, *Instrument transformers – Part 3: Additional requirements for inductive voltage transformers.*

~~IEC 61869-4, *Instrument transformers – Part 4: Additional requirements for combined transformers.*~~

IEC 61892-3, *Mobile and fixed offshore units – Electrical installations – Part 3: Equipment*

IEC 62052-11, *Electricity metering equipment (AC) – General requirements, tests and test conditions – Part 11: Metering equipment*

~~IEC 62061, *Safety of machinery – Functional safety of safety-related protection provided by enclosures for electrical, electronic equipment against external mechanical impacts (IK code)*~~

IEC 62402, Obsolescence management

~~IEC TR 61641:2014, *Enclosed low-voltage switchgear and programmable electronic control gear assemblies – Guide for testing under conditions of arcing due to internal fault.*~~

~~IEC TS 63107, *Integration of internal arc-fault mitigation systems in power switchgear and controlgear assemblies (PSC-assemblies) according to IEC 61439-2*~~

~~ISO 13489-1, *Safety of machinery – Safety-related parts of control systems.*~~

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

3 Terms and definitions

This clause of Part 1 and Part 2 is applicable except as follows.

3.10 Manufacturer/user

3.10.2 ASSEMBLY manufacturer

Addition:

For the purpose of this Specification, ASSEMBLY manufacturer to be read as Manufacturer.

Additional definitions:

3.1 General terms

Add new term 3.1.16

3.2.12 Bus section 1.16

A number of sections normally connected together in service by a physically continuous main busbar.

3.2.13 Busbus coupler

A functional unit which that contains a mechanical switching and/or isolating device, which electrically connects together two bus sections.

3.10.4 Circuit Schedule

Developed by User summarising details of specific requirements for each load and designation and its required features and functions.

3.10.5 Data Sheet

Developed by User summarizing the characteristics, performance and constructional requirements for the design and selection of the equipment.

3.10.8 Supplier Deliverable Requirements Listing (SDRL)

Indication of information required, review type, place of review and documents for inclusion as part of requisition.

3.10.9 Technical Authority

Individual or entity responsible for defining the technical requirements of the PSC Assemblies. The Technical Authority may be the User, or an agent, engineer or consultant authorized to act for, and on behalf of the User. For consistency, the term Technical Authority shall be used.

3.10.10 User Diagrams / Documents

Developed by User, defines the functional requirements for a given type/scheme of circuit, protection, control, metering etc., such as single line diagrams, schematic diagrams, wiring diagrams. Used during the development and design stage of a project.

3.10.11 Functional logic

Control logic embedded in IEDs (eg protection relays) that is developed by the Manufacturer to implement the requirements of the User Diagrams and associated protection relay settings.

3.10.12 Purchase Order Quality Requirements (POQR)

Project based requirements issued by User as part of requisition detailing specific quality requirements / responsibilities by Manufacturer.

Add new term 3.1.17

3.1.17

bus section

line-up of sections connected together in service by a physically continuous main busbar

Add new term 3.1.18

3.1.18

insulatum terra

IT

(latin) electrical system earthing method with no connection or high impedance connection to earth

Add new term 3.1.19

3.1.19

secondary selective

substation configuration where two (or more) switchboard bus sections are connected together via a bus coupler(s) and when loss of supply on an incoming circuit occurs, service to the switchboard is maintained where the bus coupler(s) is normally closed and if the bus coupler(s) is normally open, service is restored through manual or automatic closure of the bus coupler device

4 Symbols and abbreviations

This clause of Part 1 and Part 2 is applicable except as follows.

Additional abbreviations:

Add to clause

AC alternating current

ACB = Air circuit breaker

ASD = Adjustable Speed Drive adjustable speed drive

ATS : Automatic Transfer System

CE : European Conformity

CT : Current Transformer

DC direct current

DMZ demilitarized zone

ECMS = Electrical Control electrical control and Management System

EU : European Union

FAT : Factory Acceptance Test

HMI : Human Machine Interface

HRC: High Rupturing Capacity

IED : Intelligent Electronic Devices

IK : Code Indication of degree of mechanical impact protection provided by an enclosure against external harmful impacts

I/O : Input / Output

$I_{p\text{arc}}$: Permissible short circuit current under arcng conditions as defined in IEC TR 61641

$I_{ps\text{arc}}$: Permissible short circuit current under self extinguishing arcng conditions as defined in IEC TR 61641

IT : Insulated Terramanagement system earthing

ITP : Inspection and Test Plan

FAT factory acceptance test

HMI human machine interface

HRC high rupturing capacity

IED intelligent electronic device

I/O input/output

IT insulatum terra

LED : Light Emitting Diode light emitting diode
MCB : Miniature Circuit Breaker miniature circuit breaker
MCCB : Molded Case Circuit Breaker moulded case circuit breaker
MTS : Manual Transfer System
POQR : Purchase Order Quality Requirements
RCBO : Residual Current Circuit Breaker with Overcurrent Protection
SAT : Site Acceptance Test
SDRL : Supplier Deliverable Requirements Listing
SIL : Safety Integrity Level
THD : Total Harmonic Distortion (IEC 61000-2-2)
TN : Terra Neutral PMS power management system earthing
PSC : power switchgear and controlgear
PSS : power semiconductor system
RCBO : residual current circuit breaker with overcurrent protection
RCD : residual current device
SIL : safety instrumented level
THD : total harmonic distortion

5 Interface characteristics

This clause of Part 1 and Part 2 is applicable except as follows.

5.1 General

Addition:

Unless defined otherwise in the Data Sheets, the PSC Assembly and ancillary components shall be suitable for operation without damaging effect, with power supply system variations of:

- a. AC/DC nominal supply voltage: $\pm 10\%$;
- b. Frequency: $\pm 5\%$;
- c. Temporary over voltages (transient) in accordance with IEC 61439-2, Annex BB.

5.2 Voltage ratings

5.2.41 Rated impulse withstand voltage ($U_{imp} U_n$) (of the ASSEMBLY assembly)

Addition:

Add to subclause

The PSC-~~Assemblies~~assembly and ancillary components shall be ~~verification~~rated for nominal supply voltage variations of $\pm 10\%$.

Add to subclause

PSC-assemblies shall be rated to operate as a minimum in a class 2 power system supply environment with voltage harmonic content of up to 8 % THD in accordance with IEC 61000-2-4.

5.2.4

Add to subclause

PSC-assemblies shall be type tested within accordance with IEC 60664-1 to provide a minimum coordinated insulation values in accordance with overvoltage category III as stated in IEC 61439-1, Annex Table G unless defined otherwise in the Data Sheets.¹

5.3 Current ratings

Addition:

Each PSC Assembly shall have current ratings not less than those defined in the Data Sheets at the specified upper limit ambient air temperature.

5.3.1 Rated current of ~~the ASSEMBLY~~an assembly (I_{nA})

Addition:

Rated current Add to subclause

The rated current of a PSC-assembly main busbars and main circuits shall not depend on forced ventilation and.

NOTE This does not preclude the use of forced cooling on individual outgoing circuits with high thermal influence such as functional units containing integral adjustable (variable) speed drive modules.

Add to subclause

Busbar connections within bus coupler sections and the bus coupler switching device shall have a rated current not less than that of the main busbars.

5.3.3 Group rated current of a main circuit (I_{ng})

Replace second paragraph with

Where the group rated current (I_{ng}) of a main circuit is less than the rated current (I_{nc}) of this circuit, the group rated current of the functional unit in its designated compartment position shall be continuous ratings after de-rating for the specified service conditions. The main busbars shall be rated for the nominal current over the entire length of the PSC Assembly and shall not be rated lower than the incoming supply functional units marked on the functional unit.

Replace NOTE 2 with

NOTE 2 For a functional unit with a given I_{ng} , the specific arrangement of assembly or section of an assembly can also be stated in terms of power at the given I_{ng} .

5.4 Rated diversity factor (RDF) (IEC 61439-2)

Replacement of text:

A diversity factor of Add new subclause

5.4.101 Values of assumed loading

5.4.101.1, 0 shall be applied to main (horizontal) busbars. For ~~For~~

~~For~~ temperature rise tests ~~or and~~ temperature rise calculations, ~~a diversity~~ an assumed loading factor of 1,0 shall be applied for ~~each section containing only one functional unit~~. The Circuit Schedule shall identify the ~~assumed loading of the functional units~~. This shall be used in conjunction with IEC 61439-2, Table 101 to provide RDF for each section, and shall be subject to agreement between User and Manufacturer. The initial RDF to be applied may be defined in the Data Sheets. ~~sections containing a single functional unit~~.

5.4.101.2

Spare equipped functional units ~~and unequipped spaces for future functional units~~ shall be considered as being ~~loaded to 90% of their rated current and potentially rated current respectively~~ shall have an assumed loading factor in accordance with Table 101.

5.4.101.3

Unequipped spaces shall have an assumed loading factor in accordance with Table 101 for representative circuits that occupy the space.

5.5 Rated frequency (f_n)

Replace second sentence of second paragraph with

The PSC-assembly and ancillary components shall be rated for nominal supply frequency variations of $\pm 5\%$.

6 Information

This clause of Part 1 and Part 2 is applicable except as follows.

6.1 PSC-ASSEMBLY Assembly designation marking (IEC 61439-2)

Addition:

The PSC Assembly nameplate (designation label) shall be fixed at approximately eye level on the front of the assembly with non-corrodible screws or rivets and shall contain the following additional information:

- e) Rated voltage,
- f) Rated frequency,
- g) Rated current of main busbar system,

Rated Add new list item h)

h) rated peak and withstand current;

Add new list item i)

i) short-time withstand current and withstand:

Add new list item j)

j) short-time withstand duration;

DegreeAdd new list item k)

k) degree of protection (IP rating);

FormAdd new list item l)

l) form of internal separation;

InternalAdd new list item m)

m) internal arc resistance fault rating (permissible current and duration);

h. Where applicable, other markings (e.g. CE).

Additionally, on theAdd new list item n)

n) arcing class.

Add to subclause

The main nameplate or on an adjacent label:

m. Assembly shall include the assembly identification (tag) number,

n. User's purchase order number;

Year and year of assembly manufacture.

6.2 Documentation

6.2.1 Information relating to the ASSEMBLY assembly

Addition:

The Manufacturer shall deliver all the documents as defined in the SDRL, in accordance with the agreed terms, media format requirements, quantities and schedule.

The language used for all provided information shall be English, unless defined otherwise in the requisition or Data Sheets.

Add to subclause

All documents (excluding Manufacturer standard manufacturers catalogues and manuals) shall show state the Assembly identification number, User's purchase order number and Manufacturer's reference number. Installation instructions, operations instructions and maintenance instructions can be contained in Manufacturer standard catalogues and manuals, as long as they contain all data and information required in their final form and are relevant to the assemblies supplied and that the materials included in the supply are clearly identifiable within the documents.

6.2.2 Instructions for handling, installation, operation and maintenance

Addition:

Add to subclause

When a secondary selective electrical interlock or mechanical interlock system is fitted, nameplates containing operational instructions shall be fixed on the front of the PSC-assembly near the point of operation.

Add to subclause

Assemblies supplied in multiple transport units shall have these units clearly marked be identified to facilitate reassembly at site.

For PSC-Assemblies having operational Add to subclause

Operational removable or withdrawable parts with mass higher weighing more than 25 kg (such as circuit breakers), each withdrawable unit that shall be clearly marked. A load certified hoist to facilitate removal of these parts shall be provided or where other methods for manual handling are proposed by the Manufacturer, these shall be subject to agreement with the User with labels confirming the actual weight.

6.3 Device and ~~+/-~~ component identification

Addition:

The language used on all devices, labels, plates and notices shall be English, unless alternative or additional language(s) are defined as required in the Data Sheets. Labels shall have Add to subclause

Informative labels shall have black characters on a white background.

Add to subclause

Text only warning labels shall have white characters on a red background.

EachAdd to subclause

The functional unit shall have a front of panel circuit designation label and an identical label repeated labels at the front of panel and main/auxiliary cable termination locations and terminations.

Add to subclause

The functional unit shall contain the following information:

Functionala) functional unit compartment location (section and tier) number.

Tagb) tag number of connected equipment.

Servicec) service description of connected equipment.

Circuit rating ord) motor kW or feeder current rating.

Circuit designation labels shall be secured with non-corrodible screws or other readily replaceable fixing system. The tag number, service description and rating shall be as defined in the Circuit Schedule.

6.3.101 Synoptic diagram

Additional subclause:

If defined as required in the Data Sheets, a durable mimic one line (synoptic) diagram shall be provided on the front of the assembly, indicating the busbars, incomers, bus couplers and main feeders.

Add to subclause

Nameplates and identification tags shall be attached to the PSC-assembly with stainless steel 316 threaded fasteners.

7 Service conditions

This clause of Part 1 is applicable except as follows.

7.1 Normal service conditions

Addition:

PSC Assemblies shall be suitable for installation in an indoor location unless defined otherwise in the Data Sheets.

7.1.1.1 Ambient air temperature for indoor installations

Addition:

Ambient air temperatures as described in IEC 61439-1 shall be applied unless defined otherwise in the Data Sheets. All components shall have the User-specified ratings after de rating factors (if any) for the specified service conditions.

7.1.3 Pollution degree

Addition:

Unless defined otherwise in the Data Sheets, PSC Assemblies shall be suitable for use in a pollution degree 3 environment.

7.2 Special service conditions

Addition:

Requirements for special service conditions shall be as defined the Data Sheets.

Replacement of text:

Replace list item 1) Excessive with

1) voltage harmonics in the system ~~greater than THD = with a total harmonic distortion exceeding 8%.~~ %;

7.3 Conditions during transport, storage and installation

Replacement of text:

~~Any special conditions that arise, e.g. extended storage periods, shock and vibration and / or extreme temperatures, will be stated in the Requisition. Transport packing arrangements will be provided by the Manufacturer to meet User packing and storage requirements as defined in the Requisition; this shall include weights, lifting requirements and dimensions.~~

~~Requirements for external heater supply connection during storage and transit shall be defined in the Data Sheets.~~

8 Constructional requirements

~~This clause of Part 1 and Part 2 is applicable except as follows.~~

~~Additional subclauses:~~

8.0.101 General

~~PSC Assemblies shall be fully enclosed and shall consist of multi cubicle sections joined together to form a rigid freestanding assembly suitable for floor mounting, unless defined otherwise in the Data Sheets.~~

~~The floor shall not be considered as being part of the enclosure. PSC Assemblies shall be suitable for securing to longitudinal runs of channels flush with the floor surface, unless defined otherwise in the Data Sheets.~~

~~PSC Assemblies shall comprise one or more bus sections to which incoming units and outgoing units are connected. Bus sections shall be linked through bus coupler units. All functional units in PSC Assemblies shall be withdrawable, unless defined otherwise in the Data Sheets. The required quantity and type of functional units are defined in the Circuit Schedule.~~

~~As far as practical, higher power capacity functional units shall be accommodated in the bottom portion of the sections for ease of handling the withdrawable components.~~

~~When marine class is identified as a requirement in the Data Sheets, PSC Assemblies shall additionally be in accordance with stated requirements for low voltage switchgear and controlgear assemblies as defined in IEC 61892-3.~~

~~Removable covers intended to be removed for maintenance shall have retainable fastening means when undone (e.g. captive bolts and nuts).~~

8.0.102 Provision for future development

~~Unless defined otherwise in the Data Sheets, PSC Assemblies shall have the following provisions for future development:~~

- a. ~~10% fully equipped spare (unassigned) functional outgoing units as defined and designated in the Circuit Schedule;~~
- b. ~~10% free unequipped space provision for future functional units for outgoing circuits.~~

8.0.103 Technology readiness and obsolescence

~~The PSC Assemblies shall have a design and post FAT supported lifetime of at least 20 years under service conditions. Manufacturer shall have an obsolescence management plan in accordance with a recognised system for all PSC Assembly components by example to IEC 62402 as defined in the Data Sheets.~~

All provided equipment shall have

- a. ~~A production unit or full scale prototype built and installed; with full interface and function test program performed in the intended (or closely simulated) environment and operated for less than 3 years; the equipment might require additional support for the first 12 to 18 months of operation.~~

Or

- b. ~~Equipment that is field proven, installed and operating for more than three years with acceptable reliability, demonstrating low risk of early life failures in the field.~~

8.1 Strength of materials and parts

6.1.9 General

Addition:

The PSC Assemblies shall be designed for continuous operation at full load for at least 90 000 hours (10 years) without maintenance which would require the main busbars and the distribution busbars (dropper system) to be de energized. When operating under the specified service conditions, the main and distribution busbars including their connections shall not require planned maintenance during the lifetime of the assembly.

Functional units shall be designed for continuous operation at full load for at least 35 000 hours (4 years) without maintenance. Depending on User's operating environment, Manufacturer shall identify components that are not suitable for 4 years continuous operation.

6.1.10 Protection against corrosion

Addition:

Unless defined otherwise in the Data Sheets, the Manufacturer's standard painting and corrosion system can be used.

Manufacturers may offer their external standard surface finish colour unless defined otherwise in the Data Sheets.

8.2 Degree of protection provided by an ASSEMBLY assembly enclosure

8.2.1 Protection against mechanical impact (IEC 61439-2)

Replacement of text:

~~PSC Assemblies shall have external mechanical impact strength (IK) of minimum IK 08 as defined in IEC 62262 unless defined otherwise in the Data Sheets. code)~~

Replace subclause with

PSC assemblies shall have a degree of protection against mechanical impacts of at least IK07 in accordance with IEC 62262.

8.2.2 Protection against contact with live parts, ingress of solid foreign bodies and water

Addition (after last paragraph):

PSC Assemblies shall be provided with space heaters for anti condensation prevention in each section, where specified in the Data Sheets.

Space heaters shall:

- a. Be designed for operation at the voltage defined in the Data Sheets,

Have a minimum degree of protection of (IP 2X, code)

- b. Include an additional mechanical guard where the heater surface temperature exceeds 60°C,
- c. Be replaceable without a requirement to isolate main circuits within the section.

The heating system of each bus section of the PSC Assembly shall be separately supplied from a remote source unless defined otherwise in the Data Sheets and User Diagrams. The following provisions for each bus section heater supplies shall be made:

- a. Be protected by a MCB and 30 mA RCD or RCBO with 'loss of supply' volt free contact wired to terminals for remote supervision,
- b. Have a front of panel indicating LED lamp with a label engraved "Heater Supply On",
- c. Be controlled by a thermostat/hygrostat, as defined in the Data Sheets,
- d. If defined in User Diagrams, be fitted with a manual switch to bypass the thermostat/hygrostat control.

8.2.3 ASSEMBLY with removable parts

Addition to Replace first sentence of second paragraph: with

After installation in accordance with the removal of a removal part, minimum assembly manufacturer's instructions, the degree of protection of IP 2X an enclosed assembly shall be provided at least IP3X.

8.2.3 Assembly with removable parts

Add to third paragraph:

Shutters will not be dependent on gravity and shall automatically open/cover the main circuit contact apertures by the movement of the withdrawable unit.

Add to third paragraph

The actuation of shutters shall not be dependent on gravity.

Add new NOTE to third paragraph

NOTE Where the apertures inherently provide the degree of protection IP 2X, then IP2X, shutters can may be omitted.

Addition:

Any revealed accessible Add to subclause

Accessible shutters that prevent preventing access to normally live parts shall be marked with warning triangle signs stating voltage as follows: "DANGER VOLTS". Each set of accessible shutters in accordance with ISO 7010, Graphical Symbol W012 "Warning; Electricity".

Add to subclause

Accessible shutters for main circuit compartments (typically e.g. air circuit breakers (ACBs) and larger moulded case circuit breakers (MCCBs)) shall be capable of being individually operated and the.

Add to subclause

Accessible busbar shutters and accessible incoming circuit shutters shall be padlockable in the closed position. Accessible shutters shall be labelled in conformance with the following: or located within a compartment with a padlockable compartment access door.

Add to subclause

For withdrawable parts, accessible shutters shall be identified in accordance with Table 16

Add new Table 16

Table 16 – Accessible shutters labelling

| Equipment | Label Text |
|------------------------------|------------|
| Busbars | BUSBAR |
| Incoming unit supply circuit | SUPPLY |
| Outgoing unit feeder cables | CIRCUIT |

8.2.101 PSC ASSEMBLY with withdrawable parts (IEC 61439-2)

Addition to first paragraph:

Unless defined otherwise in the Data Sheets, the minimum degree of ingress protection for the external enclosure of a PSC Assembly shall be IP 31 for indoor use.

NOTE PSC Assembly ventilation requirements may incorporate lower levels of IP protection subject to agreement between User and Manufacturer.

8.4 Protection against electric shock

8.4.1 General

Addition:

HRC fuses and associated fuse carriers Add to subclause

Protection against electric shock shall only be be in accordance with IEC 60364-4-41.

8.4.2 Basic protection

8.4.2.3 Barriers or enclosures

Add after fourth paragraph

Air-insulated live parts inside enclosures or on the inside face of compartment doors that are accessible when they are fully isolated or when they offer with the compartment door open shall be protected against electric shock with a degree of protection to live parts of at least IP 2X when the fuses are inserted, have been withdrawn or are being withdrawn IPXXB.

NOTE IPXXB is stipulated in accordance with IEC 60529 as distinct to the use of designation IP2X as the door is opened and the danger is now access to hazardous parts within. IPXXB provides finger "touch-safe" protection against contact to live parts equivalent to IP2X.

8.4.6 Operating and servicing conditions

8.4.6.2 Requirements related to accessibility in service by authorized persons

8.4.6.2.1 General

Addition:

Where Add to first paragraph

Auxiliary and control ~~and/or bus wired auxiliary~~ supplies ~~to sections and / or functional units are provided~~ fed from ~~power sources~~ external sources, isolation points ~~to the PSC-assembly shall each~~ be provided for each individual functional unit or for the sections as detailed ~~with a padlockable isolation facility~~.

Add to subclause

Live parts within enclosures and live parts mounted on the ~~User Diagrams~~ internal face of compartment doors that are accessible with the compartment door open shall be protected against electric shock with a degree of protection of at least IPXXB.

8.4.6.2.4 Requirements related to accessibility for extension under voltage

Replacement of last paragraph:

The PSC Assembly is not required to be extended when operating under voltage.

Addition:

Busbars shall have pre-drilled extremities for possible future expansion.

8.4.6.2.6 Locking arrangements

Additional subclause:

Manufacturer's standard locking provision facilities shall be provided unless defined otherwise in the Data Sheets.

Add to subclause

Fuse-links and associated fuse carriers shall only be accessible when they are isolated or when protected against electric shock with a degree of protection of at least IPXXB during the replacement of fuse-links.

8.5 Incorporation of switching devices and components

8.5.2 ~~101~~ Removable parts

Add to subclause

Heavier withdrawable functional units shall be located in the lower half of the assembly sections with the lighter units located in the upper half.

Add to subclause

Withdrawable parts (IEC 61439-2) shall be labelled with their designated functional unit compartment number.

Addition:

Withdrawable functional units shall be marked to identify where the units shall be replaced in the PSC Assembly.

In the 'stab in' connections between the Add to subclause

Stab-in connection fixed and withdrawable parts, conducting contact surfaces of fixed parts shall be protected against oxidation.

Where defined in the Data Sheets Add to subclause

If specified, facilities for remote testing of withdrawable main circuit units shall be provided. This may include by means of extension umbilicals or specific test modules. Functionality /

Add to subclause

Withdrawable functional units shall have the following positions:

- a) connected – main circuit electrically connected, auxiliary circuits electrically connected;
- b) test – main circuit electrically disconnected, auxiliary circuits electrically connected;
- c) isolated – main circuit electrically disconnected, auxiliary circuits electrically disconnected;
- d) removed – functional unit physically removed from the PSC-assembly.

NOTE When fitted, auxiliary circuits can also include any copper or fibre optic communication cables to the withdrawable functional unit.

Add to subclause

For withdrawable functional units fitted with intelligent electronic devices (IEDs) that have remote control interface of module, it shall be agreed between User and Manufacturer possible to test the input/output (I/O) available via the IED remote control interface while the functional unit is in the test position.

8.5.2.102 Interlocking and padlocking of removable and withdrawable parts (IEC 61439-2)

Addition:

Add to first paragraph

The main circuit disconnect device of withdrawable functional units shall be mechanically interlocked to prevent opening and closing on to the distribution busbars with the door open.

Add to subclause

Physically identical withdrawable functional units shall be non-interchangeable with other units that have a different duty, circuit rating or control function.

Add to subclause

Withdrawable functional units ~~which are physically identical but electrically have a different function shall be non-interchangeable. Obstacles shall be employed to prevent insertion of a motor starter unit into a space for a contactor or plain feeder unit of the same physical size. Circuit breakers and functional units of the same compartment dimensions that have an identical duty, circuit rating and control function shall be interchangeable.~~

Mandatory interlocks shall be of a mechanical type and shall not rely on gravity. Add to subclause

Electrical interlocks ~~shall to external auxiliary circuits revert to a "fail safe" to a de-energized state condition when a withdrawable function unit is withdrawn.~~

8.5.3 Selection of switching devices and components

Addition:

The main incomers, bus couplers, and outgoing power feeder units rated 800 amps and above shall be provided with withdrawable ACBs or non withdrawable load switches unless defined otherwise in the Data Sheets. Outgoing power feeders rated 630 amps and below shall be controlled by fuse switch units or MCCBs. The motor starter functional units shall be comprised of a combination of fuse switch units or MCCBs, contactors and protection relays, configured in accordance with the User Diagrams. Lighting and small power feeders shall be with fuse switch units or MCCBs. When defined as required in the Circuit Schedule, outgoing functional units shall be provided with contactors for the automatic control of outdoor lighting circuits, or for ignition source control, or for load shedding schemes.

Where specified in the Data Sheets, electrical protection relays (IEDs) shall have communications protocols in compliance with IEC 61850. The User Diagrams shall define the required interconnectivity between the functional units and the external environment.

Addition to second paragraph:

Add to subclause

Outgoing circuits with rated current above 630 A shall be provided with withdrawable ACBs.

Add to subclause

Outgoing circuits with rated currents up to and including 630 A shall be protected with fuses or with circuit breakers.

Add to subclause

Lighting and small power feeders shall be provided with fuse-switch units or MCCBs.

Add to subclause

Switching devices shall simultaneously switch all phases or poles (i.e. 4 pole type for 3 phase + and when present, simultaneously switch the neutral systems).

Addition to fourth paragraph:

Unless defined otherwise on the Circuit Schedule, circuit breakers shall have selectivity category A or B depending on the duty as follows:

- d. **Category A for outgoing units not requiring selective protection.**
- e. **Category B for all other units requiring selective protection.**

By default, auxiliary control circuits shall be category A.

Where utilised, load switches shall be fault make, load break and comply with and be verification tested to IEC 60947-3 and have a utilization category AC 22.

Replacement of note text:

NOTE Guidance is given in IEC TR 61912-1 and IEC TR 61912-2, specifically Table 1. Selectivity Category B should be provided on circuit breakers above 100 amps where defined on the Circuit Schedule.

Add new subclause

8.5.3.101 Incoming and bus coupler units

Additional subclause:

8.5.3.101.1

Incoming main circuit and bus coupler functional units shall be fitted with protection, control, indication, located in separate vertical sections.

NOTE This does not preclude metering, interlocking, inter tripping and auto transfer (if any) facilities as defined auxiliary equipment or an outgoing functional unit being in the User Diagrams. Key interlock systems between upstream, same vertical section as an incomer or bus coupler.

8.5.3.101.2

Main incoming circuit units and bus coupler units shall be provided only when defined in with withdrawable ACBs or, if specified, switch-disconnectors.

8.5.3.101.3

Incoming main circuit and bus coupler functional unit switch-disconnectors shall have, as a minimum, utilization category AC-22 in accordance with IEC 60947-3.

8.5.3.101.4

Incoming main circuit and bus coupler functional unit switch-disconnectors shall have a short-time withstand current capacity at least equal to the User Diagrams main busbar rated short-time withstand current (I_{cw}) and duration.

8.5.3.101.5

For three-phase and neutral functional units, the neutral pole current rating shall be not less than that specified for the PSC-assembly neutral busbars.

The metering supply to volt and watt hour meters etc. shall be protected with HRC type fuses of the fully insulated pattern fixed directly to the busbar system with provision to allow safe change out as required. Secondary isolation for the metering supply shall be provided.

[Add new subclause](#)

8.5.3.102 Isolating switching devices (disconnectors)

Additional subclause:

Isolating8.5.3.102.1

An isolating switching devices shall consist of either be a switch (mechanical),switch, a disconnector fuse, or a fuse disconnectorand.

8.5.3.102.2

Switches, disconnectors, switch-disconnectors and fuse combination units shall comply be in accordance with and be verification tested to IEC 60947-3.

8.5.3.102.3

Switches, disconnectors, switch-disconnectors and have a utilization category AC-22 when fuse combination units used for switching mixed resistive and inductive loads and AC-23 when shall have a utilization category AC-22.

8.5.3.102.4

Switches, disconnectors, switch-disconnectors and fuse combination units used for switching motor loads or other highly inductive loads, number of operating cycles shall be to category shall have a utilization category AC-23.

8.5.3.102.5

Switches, disconnectors, switch-disconnectors and fuse combination units shall be designated for frequent operation, utilization category suffix A of IEC 60947-3 Table 4 unless defined otherwise in the Circuit Schedule.

8.5.3.102.6

Disconnecter-fuses and fuse-disconnectors shall comply with and be verification tested to IEC 60947-3 for uninterrupted duty, have as a minimum utilization category AC-23B, 23B for uninterrupted duty.

~~Shall have a~~8.5.3.102.7

Disconnecter-fuse and fuse-disconnector rated (conditional) short-circuit making capacity in conformity with the prospective short-circuit currents, as specified for (I_{cm}) shall be at least equal to the busbar system, rated short-time withstand current (I_{pk}).

8.5.3.102.8

Switching mechanisms shall be of the independent manual operating, air-break type with quick-snap action "make and break" features.

~~Shall~~8.5.3.102.9

Switching mechanisms shall be easily accessible and operable from the front of the PSC-assembly without opening a coverand.

8.5.3.102.10

Switching mechanisms shall have the "on" (I) and "off" (O) positions of the switches shall be clearly identified at the front of the switching device.

~~Switching of the neutral pole for motor circuits (where the neutral is used for only for the control circuit) may be implemented using suitably rated auxiliary contacts with a 3-pole switch provided such contacts meet the requirements for an isolating contact.~~

~~Auxiliary circuits that derive their power supply from an external source shall be connected via auxiliary switch contacts that de energize the circuits if the switching device is isolated.~~

8.5.3.102.11

All switches used for isolating a circuit shall be padlockable in the "off" position.

Add new subclause

8.5.3.103 Circuit breakers

Add new subclause

8.5.3.103.1 Air circuit breakers General

~~Additional Circuit breakers that are used in a main incomer or bus coupler or in feeders to sub-distribution switchboards shall have selectivity category B in accordance with IEC 60947-2.~~

Add new subclause:

~~Air circuit breakers (ACBs) shall be of the electric motor wound, spring stored energy closing type, provided with means for manually charging the closing mechanism.~~

ACB 8.5.3.103.2 Air circuit breakers

8.5.3.103.2.1

Air circuit breaker operating mechanisms shall have:

~~Aa shunt trip coil release of energized-to-trip type~~

A 8.5.3.103.2.2

~~Air circuit-breaker operating mechanisms shall have a closing release coil with an interlock to inhibit closing if when a trip condition exists~~

An 8.5.3.103.2.3

Air circuit-breaker operating mechanisms shall have an anti-pumping device

A 8.5.3.103.2.4

Air circuit-breaker operating mechanisms shall have spring stored energy.

8.5.3.103.2.5

Air circuit-breaker operating mechanisms shall have a spring charging motor ~~operating at phase to neutral or line-to-line voltage supply as defined in the Data Sheets.~~

Spring 8.5.3.103.2.6

Air circuit-breaker operating mechanisms shall have a ~~spring charged~~ ~~/discharged indicator~~ ~~, and~~

8.5.3.103.2.7

Air circuit-breaker operating mechanisms shall have a manual spring charge facility.

An 8.5.3.103.2.8

Air circuit-breaker operating mechanisms shall have an operations counter, ~~only when defined in the User Diagrams.~~

A8.5.3.103.2.9

Air circuit breakers shall be provided with a manual mechanical trip facility with a transparent cover guard ~~and clearly labelled when defined in the Data Sheets.~~

A8.5.3.103.2.10

~~In addition to contacts required for design of control power supply for tripping, closing, protection logic and indication functions, shall be defined in the Data Sheets. Individual auxiliary circuits, each air circuit breaker shall be provided with separate double pole MCB protection.~~

~~Control functionality and trip circuit supervision~~ ~~the specified number of ACBs shall be defined in the User Diagrams.~~

ACBs shall have at least the following volt free contacts wired as spares contacts to terminals in the outgoing terminal block:

- a. ~~Two normally open (52a) auxiliary contacts,~~

~~Two and~~ ~~normally closed (52b) auxiliary contacts, wired to terminal blocks.~~

- b. ~~One 'in service' position contact.~~

8.5.3.103.2.11

~~If specified, test blocks shall be installed on the air circuit breaker or associated instrument compartment door.~~

8.5.3.102.2.12

~~Test blocks shall allow for isolation of power monitoring and protective relay equipment inputs and outputs.~~

8.5.3.103.2.13

~~Test blocks shall be wired to provide three-phase (and neutral) bus voltage and three-phase (and neutral) currents.~~

Add new subclause

8.5.3.103.3 Molded case circuit breakers

Additional subclause:

MCCB 8.5.3.103.3.1

When remote tripping is specified, MCCB equipped outgoing feeder functional units (that are not in combination with a contactor) shall:

~~Be provided with have a shunt trip, where remote tripping is defined in the Circuit Schedule, facility.~~

- a. ~~Be manually actuated from the front of the panel without opening the door,~~
- b. ~~Have clear indication of the 'O' (off), 'Trip' and 'I' (on) positions,~~
- c. ~~Where defined in the Data Sheets, MCCBs shall be provided with a minimum of one set of auxiliary volt free contacts for trip and status indication.~~

8.5.3.104 Main circuit fuses

Additional subclause:

Where fuses are used 8.5.3.103.3.2

MCCBs that are the main circuit switching and isolation device for outgoing functional units shall be operable while the compartment door or drawer is in the closed position.

8.5.3.103.3.3

MCCBs that are the main circuit isolation device for main circuit protection, they shall conform to IEC 60269-1 and IEC 60269-2 and system type outgoing functional units shall be as defined padlockable in the Data Sheets. "off" position.

8.5.3.103.3.4

MCCB rated short-circuit making capacity (I_{cm}) shall be at least equal to the busbar rated peak withstand current (I_{pk}).

Add new subclause

8.5.3.104 Main circuit fuses

8.5.3.104.1

Fuses used for main circuit protection shall be high rupture~~ing~~ capacity (HRC) type general purpose fuse links, in accordance with IEC 60269-2.

8.5.3.104.2

Fuses used for main circuit protection shall be utilization category gG for non-motor feeders and utilization category aM~~+~~/gM for motor circuits to provide type 2 co-ordination, unless defined otherwise in the Data Sheets starters.

'DIN' fuses of the D type 8.5.3.104.3

Fuse holders shall only be applied up to maximum 63 amps and shall be backed up by short circuit current limiting devices of maximum 400 amps rating. Fuseholders shall provide a minimumhave a degree of protection of at least IP 2XIP2X.

If specified, fuse failure indication shall be provided as defined in User Diagrams.

8.5.3.104.4

Labels shall be located adjacent to main and auxiliary circuit fuses, confirming fuse ratings in accordance with circuit design.

Add new subclause

8.5.3.105 Motor starters and contactor feeders

Additional subclause:

8.5.3.105.1

Motor starters and contactor feeders shall be comprised of either provided with fuse or MCCB protected electromagnetic contactors as defined in the Data Sheets, with configuration as detailed in the Circuit Schedule. Functionality shall be as defined in the User Diagrams.

Front of panel components shall be defined in the User Diagrams. Emergency stop pushbuttons shall be red, mushroom head, stay put, manually reset type and shall operate irrespective of the status of any other controls or selector switches.

When defined in the User Diagrams, front of panel start pushbuttons shall be green, shrouded type and shall only be operative with the functional unit in the test position.

Motor starters, reversing 8.5.3.105.2

The short-circuit protection device for motor starters and contactor feeders shall conform to IEC 60947-4-1.

Contactors shall be suitable for both uninterrupted duty and class 12 intermittent duty (12 operating cycles per hour), with minimum utilization category AC 3 unless defined otherwise in the Circuit Schedule. A suitable current rating and utilization category combination shall be selected by the Manufacturer and agreed by the User.

NOTE Reference should be made to IEC 60947-1, Annex A for further guidance.

Contactors shall be selected to ensure that the motor start up current does not exceed the overload current withstand capability of contactors. Co-ordination between starters or contactor feeders and the associated short circuit protection devices shall conform to IEC 60947-4-1, type '2'. Where type '2' provide Type 2 co-ordination is achieved by use of a fuse link rated less than the maximum capacity of the fuse holder, a label shall be provided adjacent to fuse position with the following legend: "Maximum fuse rating _____ A to maintain IEC 60947-4-1 type '2' co-ordination" as indicated in the Circuit Schedule.

Mechanical endurance for 8.5.3.105.3

Unlatched contactors shall be of under-voltage release type.

8.5.3.105.4

Latched contactor feeders shall have a manual mechanical trip facility with a guarded manual release.

8.5.3.105.5

Contactors, motor starters and associated protective devices shall be in accordance with to IEC 60947-4-1.

8.5.3.105.6

Contactors shall be rated for uninterrupted duty with at least class 12 intermittent duty, with a utilization category of at least AC-3 in accordance with IEC 60947-1.

8.5.3.105.7

Contactors feeding motors in plugging or inching service shall have a utilization category of AC-4.

8.5.3.105.8

Contactor no-load operating mechanical endurance shall not be less than one million no load operating cycles.

For PSC Assemblies8.5.3.105.9

Emergency stop pushbuttons shall comply with IEC 60947-5-5.

8.5.3.105.10

Emergency stop pushbuttons shall be provided with a protective guard or shroud to prevent unintended operation.

8.5.3.105.11

The colour and marking of actuators shall be in accordance with IEC 60204-1.

8.5.3.105.12

Where colour defines function, actuators shall be green for use start/on 3 phase, 4 wire (TN) systems, and red for stop/off.

8.5.3.105.13

The control power supply shall be connected to the outgoing side of the main circuit isolating device for contactors shall that have an operating their control voltage circuit source derived from the phase and neutral on the circuit (load) side of the isolating device internally within each functional unit, unless defined otherwise in the Data Sheets. The

8.5.3.105.14

If a contactor control circuit supply shall be provided with fuse or MCB protection source derived internally from within each bus section is specified, a control power transformer shall be provided for each busbar section with the supplies wired in parallel to the functional units.

8.5.3.105.15

If a contactor control power source external to the PSC-assembly is specified, a control power circuit shall be provided in each vertical section with the functional unit supplies wired in parallel.

~~For PSC Assemblies for use on 8.5.3 phase, 3 wire (IT) systems, contactors shall have an operating control voltage of 230Vac unless defined otherwise in the Data Sheets, derived from a control transformer, one in each section to serve all.~~ 105.16

~~Contactor functional units in that section, unless defined otherwise in the Data Sheets. The primary windings of control with control power transformers shall be fuse or MCB protected. One pole of the provided with primary and secondary winding shall be provided with fuse or MCB overcurrent protection and the other pole shall be earthed through a link. The control circuit supply.~~

8.5.3.105.17

~~Contactor control circuits shall be provided with fuse or MCB miniature circuit breaker (MCB) protection external to within each functional unit as defined in the User Diagram.~~

~~If defined as required in the Data Sheets,~~ 8.5.3.105.18

~~When motor starter functional units shall have provisions for motor space heater supply. Motor, the motor space heater circuits shall be energized whenever the main circuit switching device is open when either in the service or the test position. The motor heater supply shall be automatically simultaneously isolated when the main circuit is isolated. The motor heater supply voltage shall be as defined in the Data Sheets and shall be distributed from dedicated motor heater auxiliary bus wiring within each bus section of the PSC Assembly while in the connected position or test positions.~~

~~When defined as required in the Data Sheets, earth fault protection function shall be manually reset from the front of compartment (resettable without opening the functional unit). Earth fault protection trip signal shall not be reset on loss of control power.~~

~~I/O requirements for intelligent type or hard-wired type signals (or combinations of both) shall be as defined in the User Diagrams.~~

Add new subclause

8.5.3.106 Motor protection

Additional subclause:

8.5.3.106.1

~~Motor protection functionality shall conform to ANSI /IEEE C37.2 and the following requirements:~~

a. ~~Three phase~~ Three phase ~~starter functional units shall be provided with~~ thermal overload protection (ANSI 49₇) ~~for each phase of the main circuit.~~

b. ~~Three phase~~ Three phase 8.5.3.106.2

Bimetallic type motor overload relays shall be ambient temperature compensated.

8.5.3.106.3

Solid-state overload relays and microprocessor based digital multifunction motor protection relays shall be provided with adjustable overload characteristic over the range of IEC 60947-4-1 trip classes from 10 to 30.

8.5.3.106.4

Motor starter functional units shall be provided with instantaneous overcurrent protection (ANSI 50) and/or definite-time short circuit overcurrent protection (ANSI 50/51₇) for each phase of the main circuit.

c. Protection relay supplied by 8.5.3.106.5

On solidly earthed systems, motor starter functional units feeding motors rated equal to or greater than 30 kW shall be fitted with core balance current transformers within the withdrawable part of the functional unit,

d. Setting(s) of protection relays shall be possible with a single-phase test supply,

e. Requirements for transformer actuated earth fault protection shall be as defined in User Diagrams. The sensitivity of the protection shall not exceed 10 % of the rated nominal motor current or 5 A, whichever is greater.

f. Overload relays protecting Ex e electric motors shall have a current/time characteristic below the maximum locked rotor time (t_0) as indicated on the Circuit Schedule and shall be certified,

g. Motors located in a hazardous area having a power rating exceeding 1,0 kW shall be individually protected against overload,

h. Over temperature 8.5.3.106.6

When earth fault protection is specified, it shall be manual reset only.

8.5.3.106.7

The protection using PTC thermistor / RTD shall be provided as required in the Circuit Schedule. Thermistor devices in functional units supplying motors with type of protection "eb" shall be in accordance with IEC 60079-14:2013, 11.3.

8.5.3.106.8

Motor thermal protection control units shall conform to be in accordance with IEC 60034-11.

8.5.3.106.9

Contactors shall be selected in accordance with the performance associated HRC fuse earth fault breaking current.

8.5.3.106.10

If IEDs are provided, the additional functional requirements listed in Table 17 shall be fulfilled.

Add new Table 17

Table 17 – Intelligent electronic device (IED) requirements within IEC 60034-11.

Where IEDs are specified, the following additional requirements shall be provided as listed below:

| | ANSI device code | IEC <u>Nomenclature</u> | Motors < 110 kW | Motors ≥ 110 kW | Motors ≥ 185 kW |
|--|------------------|-------------------------|-----------------|-----------------|-----------------|
| Locked rotor protection | 51LR | | O | X | X |
| Definite-time undercurrent protection | 37 | I< | O | O | O |
| Inverse-time unbalance protection based on negative phase-sequence current | 46 | I _{2>} | O | O | O |

| | | | | | |
|--|----|-----------------|---|---|---|
| Motor start-up <u>time</u> supervision-based on thermal stress calculation | 48 | $I^2 t$ | | X | X |
| Cumulative start-up time counter and restart disable function | 66 | Σt_{si} | | X | X |
| Lockout relay | 86 | | O | X | X |
| Front-of-panel protection reset | | | O | O | O |
| Key | | | | | |
| X = required | | | | | |
| O = optional, fit when user specified | | | | | |
| NOTE For IED motor protection relays, protection reset should be via the local IED HMI, accessible with the front compartment door closed. | | | | | |

NOTE 1. For IED8.5.3.106.11

Microprocessor based digital multifunction motor protection relays, protection reset shall be via the IED HMI which can be located other than at the front of panel, shall be provided with undervoltage ride-through and/or auto-restart functionality.

NOTE 2 X = User required, O = Fit only if defined as required in User Diagrams.

8.5.3.107 Motor restarting facilities

AdditionalAdd new subclause:

If defined as required in the Data Sheets, an automatic restart facility shall be provided to restart the motor after voltage dips.

8.5.3.1087 Integrated adjustable speed drives (ASD) and power semiconductor systems

Additional8.5.3.107.1

ASDs and PSSs shall be in accordance with IEC 60947-4-2.

8.5.3.107.2

Adjustable speed drives and soft starters shall be provided with a programmer or operator interface that is accessible with the front compartment door closed.

8.5.3.107.3

For applications that require a reduced voltage starter, solid-state soft starter type unit shall be provided.

8.5.3.107.4

Adjustable speed drives and soft starter units shall include facilities for isolation and bypass if indicated on the project drawings.

Add new subclause:

Technical performance requirements for these systems are not detailed in this specification. Adjustable speed drives and power semiconductor systems shall conform to IEC 60947-4-2.

Where these form an integral part of the PSC Assembly they shall meet the following minimum requirements unless defined otherwise in the User Diagrams:

- f. Selected and rated for continuous duty at kW rating as defined in the Circuit Schedule;
- g. Have front panel HMI for control and interrogation;
- h. Auxiliary power supplies control and functionality including protection requirements shall be as defined in the User Diagrams;
- i. Compartments upstream of protective devices shall have arc containment ratings in accordance with the IEC TR 61641 requirements defined for the PSC Assembly.

8.5.3.1098 Current transformers

Additional subclause:

8.5.3.108.1

Current Transformers (CTs) used for differential current protection and restricted earth fault schemes (transformers shall be in accordance with IEC 61869-2) shall be of:

8.5.3.108.2

Current transformer accuracy class as defined in the User Diagrams, shall be class 1 for measuring incoming devices.

Unless defined otherwise in the User Diagrams, CT [8.5.3.108.3](#)

Current transformer accuracy class shall be as a minimum: class 3 for measuring outgoing devices.

- a. Class 1 – Measuring incoming units,
- b. Class 3 – Measuring outgoing units,
- c. Class 5P – Protection.

Requirements for free issue CTs shall be as defined in the User Diagrams. CT wiring [8.5.3.108.4](#)

Current transformer accuracy class shall be class 5P for protective devices.

8.5.3.108.5

Current transformers connected to external circuits shall have shorting links located at the outgoing terminals. CT circuits shall have their

8.5.3.108.6

Current transformers secondary windings shall be connected to earth via one a single disconnecting link.

The Manufacturer shall provide details on ratio, output, class and accuracy for all manufacturer provided CTs in accordance with IEC 61869-2. Magnetization curves shall be provided for Class PX CTs.

Add new subclause

8.5.3.1409 Voltage transformers

Additional subclause:

8.5.3.109.1

Voltage transformers (~~VTs~~) shall be in accordance with IEC 61869-3.

a. ~~Be~~ 8.5.3.109.2

Voltage transformers shall be of dry insulation type with an earthed screen between the primary and secondary winding~~s~~.

b. ~~Have a secondary voltage of 110 V, unless defined otherwise in the Data Sheets,~~

c. ~~Be suitably~~ 8.5.3.109.3

Voltage transformers shall be protected by MCBs/~~or~~ fuses on the primary side~~and~~.

8.5.3.109.4

Voltage transformers shall be protected by MCBs on ~~the~~ secondary windings.

~~VT~~8.5.3.109.5

Voltage transformer accuracy class shall be ~~as a minimum~~ class 1.0 for measuring devices.

- a. ~~Class 1.0 – Measuring,~~
- b. ~~Class 3P – Protection.~~

~~Three-phase VTs~~8.5.3.109.6

Voltage transformer accuracy class shall be class 3P for protective devices.

8.5.3.109.7

With the exception of unearthing (IT) systems with insulation monitoring, three-phase voltage transformers shall be provided with star connection and neutral earthed at one point on the secondary. ~~An exception shall be~~

8.5.3.109.8

For unearthing (IT) systems with insulation monitoring, the voltage transformer on ~~IT~~ systems with insulating monitoring system, where the ~~VT~~ ~~on~~ the primary side shall be connected line to line.

~~VT~~8.5.3.109.9

Voltage transformer secondary connections shall be wired to terminals for external wiring when remote metering is required. ~~The secondary circuits shall be equipped with terminals with measuring bushings.~~

~~#~~8.5.3.109.10

Secondary circuits shall be equipped with terminals with measuring bushings.

8.5.3.109.11

When the ~~VT~~ voltage transformer secondary voltage is used for control or interlock, ~~a~~ MCB with signal contacts for trip indication shall be provided.

The Manufacturer shall provide details on ratio, output, class and accuracy for all manufacturer provided VTs in accordance with IEC 61869-3.

Add new subclause

8.5.3.1140 Unearthing electrical supplies (IT)

Additional subclause:

8.5.3.110.1

Insulation monitoring and earth fault detection shall be provided for PSC-~~A~~ assemblies with unearthing (IT) electrical supplies (IT).

The design**8.5.3.110.2**

Insulation monitoring and ~~provision of such systems~~earth fault detection shall include:

~~Continuous~~have continuous monitoring of insulation resistance of each bus section.

Provision**8.5.3.110.3**

Insulation monitoring and earth fault detection shall have provision for audible and electronic alarm indication of low insulation resistance ~~with data~~.

8.5.3.110.4

Insulation monitoring and earth fault detection shall have a communication interface for transmission of insulation resistance values and alarms to ~~switchgear data management units, a remote supervisory system~~.

Provision for**8.5.3.110.5**

Insulation monitoring and earth fault detection systems shall provide automatic location of earth faults ~~to either individual or grouped circuits and incoming or outgoing circuit level~~ by the use of ~~CTs~~current transformers fitted in motor starters or feeders ~~as defined in the Data Sheets~~.

Selectable**8.5.3.110.6**

Insulation monitoring and earth fault detection shall have selectable insulation impedance ranges.

Local**8.5.3.110.7**

Insulation monitoring and earth fault detection shall have local display of system insulation resistance value at each PSC-~~A~~ assembly.

j. ~~Detection system compatible with variable frequency drives and heater electronic burst firing control system.~~

~~Where stated in the Data Sheets, provision of a portable insulation fault location system shall be provided.~~

8.5.3.112**8.5.3.110.8**

Insulation monitoring and earth fault detection systems shall be compatible with adjustable speed drive and power semiconductor systems.

[Add new subclause](#)

8.5.3.111 Automatic or manual transfer system schemes

Additional subclause:

~~Where defined in the User Diagrams, an Automatic Transfer System (ATS) and a Manual Transfer System (MTS) shall be provided for switchgear that operates under normal conditions with bus section circuit breaker open. The principle for operation shall be as follows:~~

ATS operates as non-synchronous 8.5.3.111.1

k.—The transfer,

~~MTS operates as synchronous scheme shall be disabled if one or more transfer breakers are in the test, isolated or removed position.~~

~~An instantaneous overcurrent (ANSI 50) and earth fault (ANSI 50N) relays shall be provided in the incomer to block the auto-transfer if failed bus section has a fault.~~

8.5.8.5.3.111.2

~~Manual transfer schemes having no electrical interlocks, sync checks or controls shall have a key type interlock to achieve mechanical interlocking between circuit breaker operations.~~

8.5.3.111.3

~~The transfer scheme shall operate as indicated in the supplemental descriptions provided with the project drawings.~~

8.5.3.111.4

~~Transfer scheme logic shall be hardwired and/or software configured within devices integral to the PSC-assembly.~~

8.5.5 Accessibility

Addition:

~~All equipment~~ Add to subclause

~~The PSC-assembly height shall not exceed 2,5 m.~~

[Add new subclause](#)

8.5.5.101 Component accessibility

8.5.5.101.1

~~Equipment~~ shall be accessible from the front, except for cable termination chambers, which ~~shall~~ can be accessible from the ~~front or rear~~ or front, as defined in the Data Sheets. All components

8.5.5.101.2

~~Components~~ in back-to-wall or back-to-back mounted ~~PSC Assemblies~~ assemblies shall be accessible from the front only. All assembly components requiring

8.5.5.101.3

Removable covers shall be provided on main busbar compartments for access to busbar joint construction and maintenance shall be easily accessible activities.

~~Panels and cabinets where access is required for routine maintenance or inspection should have hinged doors which shall 8.5.5.101.4~~

~~Hinged doors shall open at least 95 degrees. Hinged doors should open around their ° on the vertical axis and shall not be obstructed by adjacent equipment or doors on the PSC Assembly.~~

8.5.5.101.5

Door restraints shall be provided for securing hinged doors in the open position in the following cases:

- a.) When placed on floating offshore installations;
- b.) When located outdoors (exposed to wind);
- c.) When door is equipped with electrical components.

~~Opening of hinged doors should be possible without using tools. Doors or covers that are required to be locked when equipment is in operation shall facilitate padlocking. Other fixed door locking devices with key shall not be used. Doors or covers which have components mounted (lamps, push buttons, etc.) shall be bonded to main assembly cabinet or earth bar.~~

Replacement of note text:

~~NOTE In some countries, national codes or regulations may further limit the minimum and maximum height. Unless defined otherwise in the Data Sheets, PSC Assembly height will be a maximum of 2,5m.~~

8.5.5.101.6

Doors required to be opened during normal operation shall have latches that are operated either by hand, captive screws using a flat-head screwdriver or similar means.

8.5.5.101.7

Hinged cable compartment doors shall be padlockable.

8.5.6 Barriers

Addition:

~~PSC Assemblies shall be built with metallic or non-metallic internal barriers to achieve the required form of segregation and 8.5.6.1~~

Add to subclause

PSC-assemblies shall provide the following minimum degrees of protection unless defined otherwise in the Data Sheets: in accordance with IEC 60529 and Table 18.

Add new Table 18

Table 18 – Minimum degrees of protection

| Location | Minimum degree of protection |
|--|------------------------------|
| Between horizontal busbar compartments and any other compartment | IP 2X |
| Between incoming and bus-coupler sections | IP 2X |
| Between main busbar systems of two separate sections | IP 2X |
| Between panels | IP 2X |
| Between compartment of each functional unit and other compartments | IP XXB |

8.5.8 Indicator lights and push-buttons

Replacement of text:

Where defined as required in the User Diagrams, discrete indication lamps shall be long life LED type and shall operate at the same voltage for interchangeability purposes, exceptions being indicating lights directly connected in heater supply circuits.

Indicator lightAdd to subclause

Status colour coding of indicator components and colour human machine interface (HMI) screens shall be in accordance with IEC 60073 and the illustrative table below unless defined otherwise in the Data Sheets:Table 19.

NOTE Colour coding of status indicator does not apply to IEDs or protection relays with a suite of status LEDs which are all the same colour.

Add new Table 19

Table 19 – Colour coding of status indicator

| Colour | Meaning | PSC-Assembly Application-assembly application | |
|--------|------------------------------|---|--|
| | | ACB | Motor starter-+ +/- contactor feeder) |
| Red | Danger | Closed (On) | Running (On) |
| Yellow | Warning/caution | Tripped | Tripped |
| Green | Safe | Open (Off) | Stopped (Off) |
| Blue | Mandatory significance | Trip circuit healthy (or unhealthy) | <u>Not applicable</u> |
| White | No specific meaning assigned | Voltage indication (Heater On) | Motor heater on |

NOTE Colours detailed in this table are in accordance with IEC 60073

Addition:

Add to subclause

Discrete indication lamps shall be LED types.

Add to subclause

Discrete indication lamps shall operate at the same voltage for interchangeability purposes except those directly connected to heater supply circuits.

Add new subclause

8.5.910 Auxiliary components

8.5.910.1 General

~~Front of panel control switches, meters, meter switches, position indicating lights, protection relays, etc. that are to be mounted on front of PSC Assembly panels shall be ergonomically arranged in a logical, symmetrical manner.~~

~~Where defined in the Data Sheets, test blocks for protection relay secondary injection testing shall be provided to allow relay testing and calibration from the front of the panel without disconnecting wiring.~~

8.5.10.1.1

Control and auxiliary device utilization categories shall be in accordance with IEC 60947-5-1.

8.5.10.1.2

~~Control and auxiliary devices shall conform to IEC 60947-5-1 with thermal/breaking capacities of contacts be mechanical duration class 1.~~

8.5.10.1.3

~~Control and auxiliary devices shall be rated for their application and conforming to IEC 60947-5-1 Table 1 and Annex A. The utilization categories and minimum characteristics shall be: 120 cycles per hour (each relay).~~

- a. ~~AC-15 for AC applications,~~
- b. ~~DC-13 for DC applications,~~

c. 8.5.10.1.4

~~Rated operational currents (I_e): 5A shall be at least 5 A at 230 V a.c.; 1A 110 V d.c., AC rated operational voltage and 1 A at 110 V DC rated operational voltage.~~

- d. ~~Service cycles: 120 cycles / hour (each relay),~~
- e. ~~Mechanical duration class: 1 (in millions of operation cycles),~~

8.5.10.1.5

AC switching elements shall be utilization category AC-15.

8.5.10.1.6

DC switching elements shall be at least utilization category DC-13.

8.5.10.1.7

Plug-in type ~~relays~~auxiliary components shall be provided with retaining clips.~~Where defined in the Circuit Schedule, emergency~~

8.5.10.1.8

Emergency shutdown interface relays shall be safety integrity level (SIL) rated in accordance with IEC 61511-1.

~~NOTE Reliability data shall be provided at proposal for SIL loop connected components in accordance with IEC 61511-1.~~

8.5.9~~10~~.2 Indicating and measuring devices

8.5.9~~10~~.2.1 GeneralAnalogue instruments

~~Indicating instruments shall be digital or analogue type as defined in the Data Sheets and shall have minimum accuracy class of 8.5.10.2.5.1.1~~

Analogue instruments shall be ~~flush mounted and conform to~~ in accordance with relevant the parts of IEC 60051.

8.5.9~~10~~.2.1.2 Analogue instruments

Analogue indicating ~~meters shall be of the square pattern type. Analogue device fascia's shall be white, with black pointers and the scale shall be in actual values. External zero adjustment shall be provided. instruments shall have a minimum accuracy class of 2,5.~~

8.5.10.2.1.3

Analogue instruments shall be flush mounted on the front of the PSC-assembly.

8.5.10.2.1.4

Analogue instruments shall display black characters on a white background identifying actual primary circuit values.

8.5.10.2.1.5

Analogue instruments shall be provided with pointer external zero adjustment facility.

8.5.10.2.1.6

Analogue ammeters and voltmeters shall be in accordance with IEC 60051-2.

8.5.10.2.1.7

Analogue ammeters and voltmeters shall have a deviation at the rated value of about 80 % of the full scale range.

~~Analogue voltmeters shall conform to IEC 60051-2 and shall have a voltage selector switch and shall have an off position. Voltmeters shall be operated from voltage transformers secondaries unless defined otherwise in the User Diagrams.~~

~~Analogue ammeters shall conform to IEC 60051-2 and shall have a selector switch and shall have an off position.~~
Ammeter[8.5.10.2.1.8](#)

~~Current transformer connected ammeter~~ selector switches shall be "make before break" type. ~~Analogue ammeters shall include a maximum demand indicator where used for incomers and ACB outgoing feeders or where defined on the User Diagrams.~~

~~The minimum scale reading for analogue ammeters on non-motor circuits shall not be less than 20% of the normal or full load reading.~~[8.5.10.2.1.9](#)

~~Analogue motor ammeters shall monitor single phase only and voltmeters shall have reduced full scale voltage selector switch equipped with an "off" position.~~

[8.5.10.2.1.10](#)

Voltmeters shall be operated from the voltage transformer secondary windings.

[8.5.10.2.1.11](#)

Analogue wattmeters and varmeters shall be rated for motor starting currents.

Analogue watt meters and VAr meters shall conform to IEC 60051-3 and shall be suitable for 3-phase unbalanced load.

[8.5.9.2](#), in accordance with IEC 60051-3.

[8.5.10.2.2](#) Digital instruments

[8.5.10.2.2.1](#)

Multi-functional digital measuring devices shall have an a minimum accuracy class of 1,0 unless defined otherwise in the Data Sheets and shall as a minimum be able to.

[8.5.10.2.2.2](#)

Multi-functional digital measuring devices shall display current, voltage and power factor per phase together with instantaneous and a running total of kWhrs.

Multi-functional digital measuring devices shall be equipped with back lights.

[8.5.9.10.2.4.3](#) Energy meters

[Energy meters and maximum demand](#)[8.5.10.2.3.1](#)

If specified, energy meters shall be solid state meter type in accordance with IEC 62052-11 with a default minimum accuracy class as defined in the Data Sheets or higher accuracy for specific schemes as defined in the User Diagrams and .

[8.5.10.2.3.2](#)

Energy meters shall be suitable rated for 3-phase unbalanced load. All watt hour integrating meters shall be fitted with a pulse transmitter for input to a remote supervisory system or a metering summation scheme measurement.

[Where](#)[8.5.10.2.3.3](#)

If specified in the User diagrams, energy meter test terminal blocks shall be provided on the panel front for testing the kWh meters and kWh meters. Meters shall be provided with maximum demand indicators of 30 minutes period adjacent to the respective energy meter.

8.5.9~~10~~.2.54 Transducers

~~Transducers shall be provided as indicated on the User Diagrams. Transducers shall comply with IEC 60688 and be wired to a separate terminal block for external connections. Unless defined otherwise in the Data Sheets, the transducer outputs shall be 4–20 mA. The output signal of the transducer shall not exceed 20 mA, even when the input value is more than 100% of the defined output range (e.g. during motor starting).~~

Transducers shall be in accordance with IEC 60688.

8.5.101 Description of the types of electrical connections of functional units (IEC 61439-2)

Addition:

Add to subclause

For withdrawable type functional units, the electrical connections shall be type (W.W.W) ~~in accordance with IEC 61439-2. When used, for~~

Add to subclause

For disconnectable type functional units, the electrical connections shall be type (D.D.F) ~~minimum~~

Add new subclause

8.5.102 Operation

8.5.102.1

PSC-assemblies shall be rated for continuous operation at rated load under normal service conditions for at least 45 000 h (5 years) without planned maintenance that requires de-energization of the busbars.

8.5.102.2

Functional units shall be designed for continuous operation at full load under normal service conditions for at least 45 000 h (5 years) without planned maintenance.

8.6 Internal electrical circuits and connections

8.6.1 Main circuits

Addition:

Busbar compartmentsAdd to first paragraph

Partitions shall be designed incorporated to prevent an internal arc propagation and the spread of fire occurrence in a bus section propagating to adjacent compartments and across bus coupler panels~~bus sections~~

The main (horizontal) and interconnecting (vertical) busbarsAdd to subclause

Busbars shall be manufactured from hard drawn, high conductivity electrolytic copper.

Add to subclause

The main busbars shall be of the same cross sectional area throughout the entire length of the PSC-Assembly to achieve the defined rated current.

~~The main and interconnecting busbars, phase and neutral, and joints shall be bare (uninsulated) unless defined otherwise in the Data Sheets.~~

Where busbars are insulated, Add to subclause

~~If specified, busbar insulating materials and busbar joint shrouds shall be of a flame retardant type in accordance with the relevant part of IEC 60684, and non-hygroscopic and non-tracking. The~~

Add to subclause

~~Where busbars are insulated, the insulation of the main busbar joints and to interconnecting busbar joints shall be removable and easily replaceable for joint inspection. The comparative tracking index (CTI as defined in IEC 60112) of the insulating material used for the supports and insulation of the busbar and dropper systems shall be at least 300. The CTI for the insulation materials used for the components protected by the short-circuit protective devices in the outgoing functional units shall be at least 175.~~

8.6.1.1 — Neutral

Additional Add to subclause:

~~Unless otherwise specified in the Data Sheets, the For PSC-Assembly shall be arranged for a TN-S power system with separate neutral (NE) and protective (PE) bars throughout the PSC Assembly. Unless defined otherwise in the Data Sheets, for assemblies incorporating a TN-S system neutral busbar, if specified, each incoming circuit (downstream of the stepdown transformer) circuit shall be provided with a an accessible removable link between the neutral busbar and the PE bar at the PSC Assembly. The link protective earth.~~

Add to subclause

~~Main circuit neutral/protective earthing links shall be located in such a position that its removal can take place removable without exposure to other live parts.~~

8.6.1.2 — Earth bar

Additional subclause:

~~A hard drawn high conductivity copper earth bar shall be provided along the full length of each PSC Assembly with provision for external earth cable connection at each end sized in accordance with IEC 61439-1, Annex B.~~

~~The earth bar shall be extended to all cable termination compartments and shall be easily accessible. Connection points for all functional shall be provided for terminating the cable earth leads and the external earth connections. For the termination of external earth connections the earth bar shall be provided with a M10 bolt at the bottom of each outgoing cable compartment and at the incoming panels. All metallic non-current carrying parts of the PSC Assembly including gland plates and hinged doors shall be bonded together and connected to the earth bar.~~

~~Internal bonding of different parts of the assembly enclosures can be achieved directly via bolted or welded steel to steel faces. Extraneous conductive parts including doors shall be bonded to the assembly structure. This may include flexible copper connections as defined in the Data Sheets and if provided, these shall be arranged such that they cannot be trapped when the door is opened or closed.~~

8.6.2 Auxiliary Circuits

Addition:

~~Main / Auxiliary circuits within the PSC Assembly shall be low smoke, zero halogen content unless otherwise defined in the Data Sheets.~~

Add to subclause

Earthed poles shall be connected via a removable link.

Functional unit auxiliary Add to subclause

~~Auxiliary circuits that derive their power supply from an external source shall be connected via auxiliary main switch contacts that de energize in accordance with the auxiliary circuits if status of the main circuit switching device is isolated unless defined otherwise in the User Diagrams.~~

Add new subclause

8.6.2.4101 Interface with supervisory systems

Additional subclause:

Each incoming 8.6.2.101.1

Incoming auxiliary supplyies shall be monitored with an alarm for loss of availability. A healthy circuit

8.6.2.101.2

Discrete input signals to remote supervisory systems shall be a volt-free closed circuit signal to indicate the defined status parameter.

8.6.2.101.3

The PSC-A assembly shall be provided with potential volt-free contacts wired to a terminal strip for sending the following alarm signals to a remote supervisory system or substation annunciator panel:

- a.) Tripped on fault for each ACB;
- b.) Protection / control supply failure for each bus section;
- c.) Common trip alarm for each bus section of busbar, with all individual motor starter fault controls wired together;
- d.) Trip circuit healthy alarm;
- e.) Relay watchdog alarm.

8.6.2.2 Interface with external equipment packages and control systems

Additional subclause:

The User requirement for interfaces with external packages and control systems shall be as identified on Circuit Schedule.

Where the communications protocol for individual functional units are different to those defined in section 8.5.3, these shall be identified in the Circuit Schedules for interface between the functional units and the control system.

For the purpose of this specification, there are three levels of interface (Circuit Schedule):

a. Level A System Interface – Hard Wired

Fundamental level of interface with direct acting hardwired connections to external packages or panels, in which remote devices are rated for the contactor operating voltage or any required LV/SELV interposing relays are located external to the PSC Assembly.

b. Level B System Interface – Serial & Hard Wired

Serial interface to external systems with additional hard wired interface as Level A.

c. Level C System Interface – Serial interface to external systems.

Full serial interface only.

If a functional unit is defined on the Circuit Schedule as forming part of a machinery package, the components shall conform to ISO 13489-1 and IEC 62061 for safety of machinery and control systems.

8.6.2.3 Device configuration and set-point responsibilities

Additional subclause:

The User and Manufacturer shall have joint responsibility for the creation and control of protection relay setting files. Manufacturer shall be responsible for functional logic files and User will be responsible for provision of the final protection relay settings. Manufacturer shall submit functional logic and protection settings files to User for review.

A responsibility matrix / flow chart shall be developed between both parties and used as an interface control document during all stages of the order.

8.6.5 Identification of the conductors of main and auxiliary circuits

Additional Add to subclause:

The identification of the conductors of main and auxiliary circuits shall be as follows unless defined otherwise in the Data Sheets: by alphanumeric notation and/or graphical symbols in accordance with Table 20.

NOTE Conductor identification by colour is not mandatory but where colour is used, the purchaser should identify local/project colour requirements.

Add new Table 20

Table 20 – Identification of conductors and terminals

| <u>Conductor Designated conductor</u> | <u>Mandatory marking</u> | <u>Supplementary colour when used</u> |
|---------------------------------------|--------------------------|---------------------------------------|
| <u>AC Circuits conductors</u> | | |

| | | |
|--|------------------------|--------------|
| Phase 1 | L1 | Brown |
| Phase 2 | L2 | Black |
| Phase 3 | L3 | Grey |
| Neutral | N | (Light) Blue |
| <u>Protective earth DC conductors</u> | PE and/or earth symbol | Yellow/Green |
| <u>DC Circuits</u> <u>Positive pole</u> | (+) | |
| <u>Positive</u> <u>Negative pole</u> | (+/-) | Red |
| <u>Negative pole</u> <u>NOTE</u> <u>Alphanumeric notations and symbols are in accordance with IEC 60445.</u> | (-) | Black |

Add new subclause

8.6.8 Earth bar

8.6.8.1

A hard-drawn high conductivity copper main earth bar shall be installed along the length of the PSC-assembly.

8.6.8.2

Dedicated termination points for all functional unit earthing and external earthing requirements shall be provided.

8.6.8.3

Earth bars shall incorporate spare M10 connection points at the bottom of outgoing cable compartments and incoming panels to facilitate external earth connections.

8.7 Cooling

Replacement of text:

8.7.1

Add new subclause

The PSC-Assembly shall be naturally ventilated type and comply with temperature rise limitations for the maximum design air temperature defined in the Data Sheets.

8.8 Terminals for external conductors

Addition:

~~All power (supply & load), and auxiliary cables shall enter from below unless defined otherwise for a PSC Assembly in the Data Sheets, or defined otherwise for individual circuits in the Circuit Schedule.~~

Terminals, both main and auxiliary, cable entries, support facilities for cable clamping, and earthing facilities shall be provided, suitable for the type, size and number of cables as defined in the Circuit Schedule. Add to subclause

In the absence of ~~User~~ defined field cable information, guidance shall be taken from ~~IEC 61439-1, Annex A~~ Table A.1, using the maximum cross-section values.

Replacement of fifth paragraph:

The internal width dimension of cable compartments shall be suitable for the specified cable type (quantity, conductor size and bending radii) to enable the cable connections to be performed easily and safely, but shall be of minimum internal width 400 mm. Space shall be provided in outgoing cable compartments for the use of a clip on ampere meter (ammeter).

Addition after last paragraph:

Add to subclause

Cable supports shall be provided for ~~and bracing points spanning~~ the full ~~entire~~ height of the PSC Assembly ~~cable compartments~~ at intervals not exceeding 450 mm ~~with adequate bracing and support for the cables shall be incorporated in cable compartments.~~

Add to avoid unrestrained movement under short circuit conditions subclause

Terminals shall be provided for the termination~~connection~~ of spare cores of all ~~external~~ auxiliary control cables as defined on the Circuit Schedule or User Diagrams and in addition, not less than shall be provided with a minimum of 10 % spare wired terminals shall be provided for future use without reducing the size of the field wiring allocated space.

~~For incomers and large power feeders, insulating phase separation screens shall be provided at the incomer cable connections and terminals for more than one power cable core per phase shall have termination facilities arranged to avoid crossing of phase cores.~~

~~Unless defined otherwise in the Data Sheets, removable, undrilled gland plates shall be provided in each vertical panel for glanding of power and control cables. Gland plate material shall be defined in the Data Sheets. In the case of single core cables with armour and/or lead sheathing, any requirement for special glands which allow for insulation between the armour/lead sheath and gland plate shall be defined in the Data Sheets.~~

~~At least 300 mm clearance shall be allowed between the gland plate and any internal equipment to permit easy cable installation and connection. For incomers and large power feeders, distance between base plate and cable connection plates shall be at least 400 mm.~~

Where defined in the Data Sheets, large incomers/feeders Add to subclause

Power cable terminals shall be provided with phase separation screens.

Add to subclause

The largest functional unit compartments shall be located at the bottom of the PSC section and have with provision for direct entry and termination.

Add to subclause

Where single core cables enter the PSC-assembly, the associated gland plates or transit frames shall be fabricated using a non-magnetic metal.

Add to subclause

Gland plates and multi-cable transit frames shall be connected directly to the main protective earth.

Add new subclause

8.8.4~~101~~ Terminals for control and auxiliaries

Additional subclause:

All wiring[8.8.101.1](#)

Wiring for external connections shall be brought out to individual terminals on ~~a readily an~~ accessible terminal block.

[8.8.101.2](#)

Terminals shall be of modular design in ~~conformance to~~ accordance with IEC 60947-7-1. ~~No more than one wire~~

[8.8.101.3](#)

A maximum of two conductors shall be ~~inserted into~~terminated on any one terminal ~~and parallel~~.

[8.8.101.4](#)

~~Parallel~~ connections shall be made using ~~purpose designed~~ cross connection links approved by the terminal manufacturer.

[8.8.101.5](#)

Terminal blocks shall be ~~logically~~ grouped by function and operating voltage.

[8.8.101.6](#)

~~Terminal blocks shall be separated from other groups using barrier plates or earthed terminals and shall be indelibly marked and voltage levels shall be clearly identified by labels. Terminals remaining~~

[8.8.101.7](#)

~~Terminals that remain live when following a functional unit is isolated isolation shall be provided with display~~ a warning label.

[8.8.101.8](#)

Terminals associated with external sources of supply shall ~~be provided with display~~ a warning label.

~~Unless specified otherwise in the Data Sheets, space for not less than~~ [8.8.101.9](#)

Space for a minimum of 10 % spare terminals to be installed, shall be provided for future use. ~~All spare~~

8.8.101.10

Spare I/O contacts of protection/auxiliary relays shall be wired up to the terminal blocks and numbered as per Manufacturer drawing.

8.8.101.11

Terminals associated with inductive current transformer circuits shall be provided with readily movable shorting links. Links used

8.8.101.12

Earthing links for earthing of control supplies and current transformers shall be readily movable for test purposes removable.

Equipment containing instrument or instrument 8.8.101.13

Instrument circuits/cables requiring special dedicated earthing shall be equipped with have separate instrument earth bar. IE bars shall be isolated from main earth bars.

8.8.101.14

When external cable conductors are terminated directly onto flat bar with cable lugs, the enclosure termination points shall have pre-drilled holes to the user defined diameters.

8.101 Internal separation of PSC-ASSEMBLIES assemblies (IEC 61439-2)

Addition:

Unless defined otherwise in the Data Sheets, form of internal Add to subclause

Internal separation shall be a minimum of Form 4a for ACBs ACB functional units and a minimum of Form 3b for all other functional units.

NOTE 3 OptionsAdd new subclause

8.102 PSC-assembly physical configuration

8.102.1

PSC-assemblies shall be fully enclosed and consist of multi-cubicle sections joined to form a rigid freestanding assembly for floor mounting.

8.102.2

Functional units with the greatest mass shall be in the lowest cubicles of the tier.

8.102.3

PSC-assemblies specified for marine installation shall be in accordance with IEC 60092-101:2018, Clause 4.

8.102.4

PSC-assemblies specified for offshore electrical installations shall be in accordance with IEC 61892-3:2019, 7.1 to 7.4.

Add new subclause

8.103 Enclosure space heaters

Add new subclause

8.103.1 Space heaters

8.103.1.1

If specified, PSC-assembly enclosure space heaters shall maintain the enclosure internal separation can air temperature at least 5 K above the specified minimum ambient air temperature.

8.103.1.2

PSC-assembly enclosure space heaters shall incorporate a mechanical guard where the heater surface temperature exceeds 60 °C.

8.103.1.3

PSC-assembly enclosure space heaters shall have a degree of ingress protection of at least IP2X in accordance with IEC 60529.

8.103.1.4

Each vertical section space heater circuit shall be protected by a MCB with a 30 mA residual current device (RCD) or by a residual current circuit breaker with overcurrent protection (RCBO).

8.103.1.5

PSC-assembly enclosure space heaters shall be wired to an accessible terminal block for connection to an external power source.

Add new subclause

8.103.2 Space heater supply monitoring

8.103.2.1

If space heater supply monitoring is specified, each bus section heater supply shall have a front of panel indicating LED lamp and labelled "Heater supply on".

8.103.2.2

If space heater supply monitoring is specified, each bus section heater supply shall have a loss of supply actuated volt-free signal wired to an accessible terminal block.

Add new subclause

8.103.3 Space heater current monitoring

If space heater load current monitoring is specified, a control unit shall be provided.

8.103.3.1

The space heater control unit supply disconnect shall be a circuit breaker which is padlockable in the “off” position.

8.103.3.2

The space heater control unit shall have a control circuit that includes a momentary push button.

8.103.3.3

The space heater control unit momentary push button shall energize the space heaters, bypassing the thermostat/hygrostat to verify the operation of the space heaters.

8.103.3.4

The space heater control unit shall be provided with an ammeter.

8.103.3.5

The space heater control unit ammeter shall have an appropriately sized scale such that the failure of a single space heater element results in a visible change in ammeter reading.

8.103.3.6

The normal operating ampacity of a space heater circuit shall be inscribed on the ammeter nameplate.

Add new subclause

8.104 Provision for future development

8.104.1

Pre-drilled holes shall be provided at free ends of bus bars for future on-site extension.

8.104.2

Unequipped spaces shall be fitted with the internal components to enable the subsequent installation of a functional unit in that space while the PSC-assembly busbars are energized.

8.104.3

The PSC-assemblies shall have a design and post factory acceptance test (FAT) supported lifetime of at least 20 years under service conditions.

8.104.4

The manufacturer shall have an obsolescence management plan in accordance with a recognized system for all PSC-assembly components by example to IEC 62402.

8.104.5

Provided equipment shall be field proven for at least three years.

[Add new subclause](#)

8.105 Condition based monitoring

[Add new subclause](#)

8.105.1 General

8.105.1.1

Condition based monitoring systems shall provide real-time continuous monitoring.

8.105.1.2

Real time monitored condition parameters shall be displayed on a front of panel mounted HMI.

8.105.1.3

Continuous monitoring systems shall include those detailed in BS EN 61439-1 and BS EN 61439-2 and defined in the Data Sheets communications interface(s) capable of conveying temperature data, status and alarming for each monitored point.

[Add new subclause](#)

8.105.2 Thermal monitoring

8.105.2.1

If specified, PSC-assemblies shall be equipped with factory-integrated continuous thermal monitoring technology.

8.105.2.2

Thermal monitoring shall include hotspot detection sensors for main incoming sections, i.e. main circuit breaker or lugs.

9 Performance requirements

This clause of Part 1 is applicable except as follows:

9.3 Short-circuit protection and short-circuit withstand strength

9.3.1 General

Addition:

[The Add to subclause](#)

PSC-Assembly-ies shall be designed, constructed and verification tested (as a special test) for "Internal Arc Containment" in accordance with the requirements of IEC TR 61641. The minimum requirement is for Arcing Class A. Where Arcing Class B and Arcing Class C assemblies are defined, the PSC Assembly shall withstand internal to provide personnel protection under arcing for 0,3 s. condition for restricted access authorized persons.

Add to subclause

The permissible short-circuit current under arcing conditions ($I_{p\text{arc}}$ and $I_{ps\text{-arc}}$) value shall be defined in the Data Sheets at least equal to the specified rated short-time withstand current (I_{cw}) for a minimum arc fault duration of 0,3 s.

Where defined as required in the Data SheetsAdd to subclause

PSC-assemblies with arcing class B or arcing class C classification, an internal arc fault detection within a functional unit shall be confined to that functional unit compartment.

Add to subclause

PSC-assemblies with arcing class B or arcing class C classification, an arc fault on a distribution busbar shall confine the arc to that section without propagating to the main busbars.

Add to subclause

Pressure-relief device or pressure-relief ducting, if required, shall be fully rated to withstand the forces associated with an arc fault within the PSC-assembly.

Add to subclause

If pressure-relief ducting with an outdoor exhaust vent is required, the exhaust ducting shall be provided with a wall penetration kit and exterior exhaust outlet equipped with environmental seals.

NOTE The wall penetration kit and exterior exhaust outlet can also require additional features to maintain the integrity of the wall or bulkhead being penetrated, such as fire rating or blast overpressure certification.

Add to subclause

Minimum room dimension requirements and other guidelines (e.g. pressure-relief flaps, arc ducts, exhaust vents) required to ensure the PSC-assembly arc fault protection for personnel safety and building integrity shall be provided.

Add to subclause

If specified, internal arc fault mitigation system shall be provided and integrated into the PSC-Assembly assembly in accordance with IEC TS 63107.

9.4 Electromagnetic compatibility (EMC)

Addition:

Default EMC environment shall be Environment A unless otherwise defined in the Data Sheets.

9.3.4 Co-ordination of protective devices

In third paragraph, replace "(e.g. by a warning label in the assembly or in the operating instructions, see 6.2)" with

by a warning label within the relevant functional unit compartments

10 Design verification

This clause of Part 1 and Part 2 is applicable except as follows:

10.10 Temperature-rise

10.10.1 General

Addition:

Design Add to subclause

~~For PSC-assemblies incorporating additional supervisory devices, the verification over and above the requirements of IEC 61439-1 and IEC 61439-2 temperature-rise shall be carried out in accordance with include the requirements defined in this Specification and Data Sheets in-service heat contribution from these additional components.~~

~~For each PSC Assembly type and rating offered, evidence of certified verification test certificates shall be included with proposals.~~

11 Routine verification

This clause of Part 1 and Part 2 is applicable except as follows.

11.1 General

Replacement **11.8 Mechanical operation (IEC 61439-2)**

Replace second sentence of first paragraph: with

~~The POQR will define the User requirements for routine verification.~~

~~All equipment covered by this specification Verification shall be subject to inspection include the checking of interlocking and testing by User at the Manufacturer works during manufacture. In certain cases, these activities can extend to Manufacturer's sub-suppliers works.~~

~~Prior to dispatch, the Manufacturer shall carry out the full routine tests in accordance locking arrangements associated with IEC 61439-1 removable and IEC 61439-2 on the total assembly, or withdrawable parts thereof if delivered separately, and the results shall be recorded in a test report.~~

~~A witnessed final factory routine verification, Factory Acceptance Test (FAT) shall be carried out on the complete assembled PSC Assembly to demonstrate the proper functioning of the complete assembly, including Intelligent Devices / Relays, etc. Transport the insertion interlocks of mechanically identical withdrawable functional units can be wired together instead of being joined at the busbars.~~

11.10 Wiring, operational performance and function

Add new subclause

11.10.1 Functional testing

Functional testing of the completed PSC-assembly shall include the following:

- a) operation of all circuit breakers and switching devices, including any auto-transfer schemes;
- b) electrical and mechanical interlocks;
- c) control devices that are either hard wired or communicating over a network and, if applicable, local HMI;
- d) current and voltage transformers or sensors;

NOTE Primary injection for current transformers is not required to comply with this requirement.

- e) circuit breaker trip units, protective relays and metering devices;
- f) indicator lights;
- g) circuit breaker drawout and mechanical insertions, including operation of the shutter mechanism;
- h) vertical section space heaters and thermostat/hygrostat if applicable;
- i) continuous thermal monitoring system if applicable;
- j) auxiliary equipment provided as part of the system design (e.g. interposing relay panel, mimic panel, remote racking equipment, and absence of voltage tester device);
- k) high resistance earthing system, if applicable;

Add new subclause

11.101 Electrical control and management system (ECMS) simulation test

Additional subclause:

~~The purpose of the simulation test is to check and validate the ECMS and interfaces with interconnected electrical assemblies. Where~~11.101.1

~~If specified in the Data Sheets, a simulation test shall be carried out between the remote HMI and electrical control devices on the PSC-A assemblies and the specific functions (remote control, restarting, automatic transfer, load shedding, etc.). The timing and location of the~~

11.101.2

~~The simulation test shall check and validate the ECMS and interfaces with interconnected electrical assemblies.~~

11.101.3

~~The ECMS simulation test shall be agreed between the User and the Manufacturer.~~

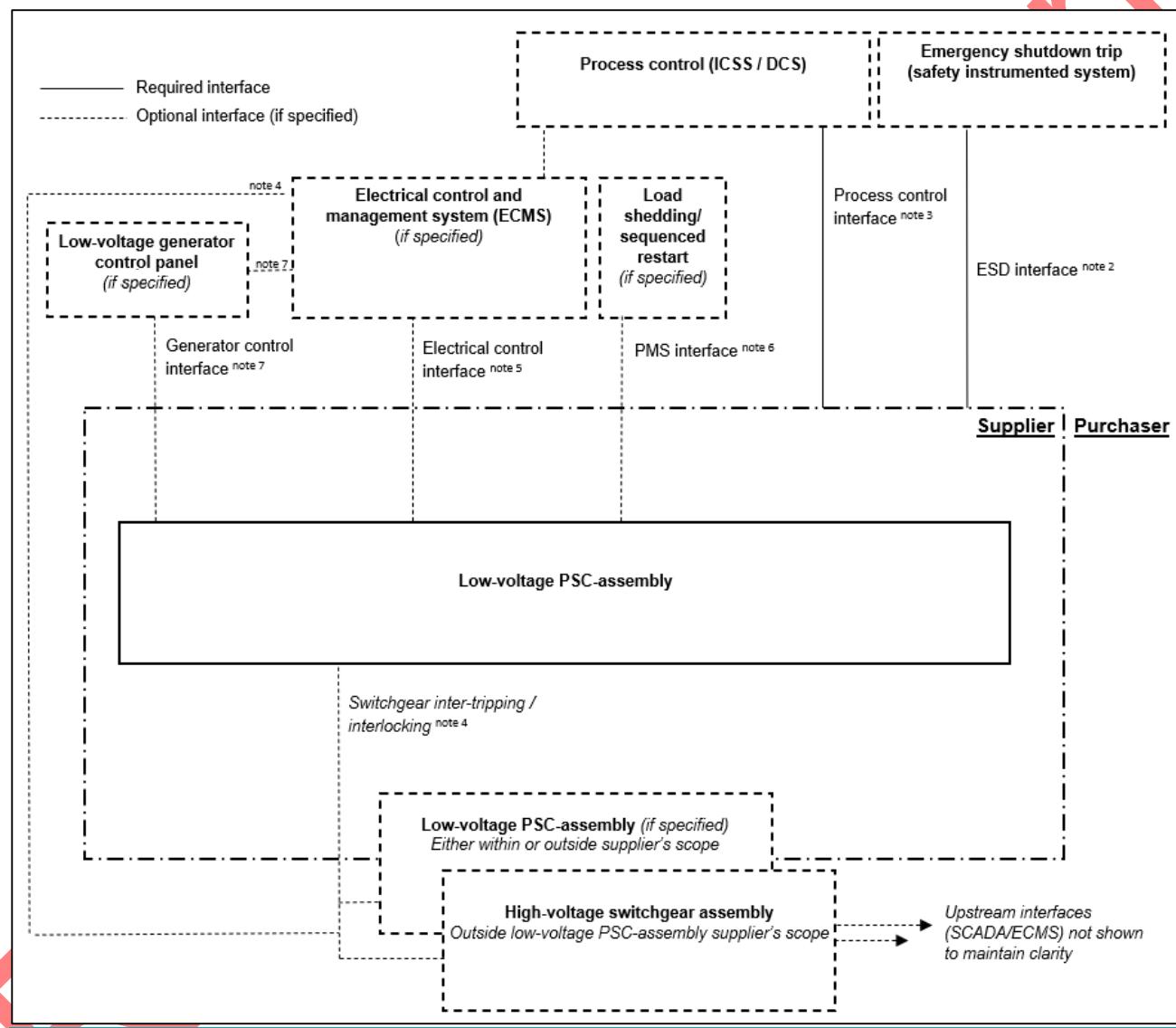
~~The tests shall be carried out in accordance with the tools and support (meeting, procedure and procedures, documentation) and tools proposed by the ECMS provider.~~

[Add new Annex HH](#)

Annex HH (informative)

Integration with external systems

[Add new Figure HH.1](#)



Note 1 This figure is for illustrative purposes only as control system integration topologies are user/project specific. This figure is not intended to assign any IEC 62264-1 hierarchy levels 0 to 4 or imply any demilitarized zone (DMZ) perimeter boundaries.

Note 2 High integrity emergency shutdown – highest priority interface. Assumed default is hardwired fail-safe. The alternate use of SIL rated digital protocol control is subject to user agreement.

Note 3 Interface between the automated process control system and process related load circuits. It is either discrete hardwired I/O or via digital protocol, or multiple interfaces (mainly via digital protocol but with hardwired motor stop/starts as defined by the user). The process control interface should be segregated/firewalled from the ECMS.

Note 4 Incoming circuit breaker intertripping/interlocking to either upstream high-voltage switchboards or interconnectors to adjacent low-voltage PSC-assemblies. The assumed default is hardwired from PSC-assembly to upstream or downstream switchboards, but it may also be IED-to-IED communication or via the ECMS.

Note 5 Non-process control/supervisory interface to an ECMS. It may also enable network connectivity to the process control system, other PSC-assemblies and generator control panels(s). The ECMS may enable authorized user interface for IED remote configuration / remote access.

Note 6 Interface to power management system (PMS) for load shedding and/or sequenced restart. The PMS may be integral to the ECMS with communication via the electrical control interface or a standalone load shedding system acting directly on the PSC-assembly circuits, (e.g. hardwired discrete trips, load start inhibits and status monitoring).

Note 7 It is typically for emergency/essential switchboards, PSC-assembly to generator control interface for the generator incomer circuit breaker control. The interface may be hardwired, IED-to-IED communication or via the ECMS.

Figure HH.1 – Communications interface block diagram

Redline Version

Bibliography

Additional references:

DNV RP A203 Qualification of New Technology

Add to Bibliography

IEEE C37.2, Standard for Electrical Power System Device Function Numbers, Acronyms, and Contact Designations

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IEC 62264-1, Enterprise-control system integration – Part 1: Models and terminology

IEC 62402 Obsolescence management – Application guide.

IOGP S-560D Data sheets for IEC 61439 – LV Switchgear and Controlgear Assemblies.

IOGP S-560L Supplier Deliverable Requirements List (SDRL) for IEC 61439 – LV Switchgear and Controlgear Assemblies.

IOGP S-560Q Purchase Order Quality Requirements (POQR) for IEC 61439 – LV Switchgear and Controlgear Assemblies.

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