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IOGP S-743, Supplementary Specification to IEEE Std C37.20.2 for Metal-Clad Switchgear, First Edition, January 2024

ADDENDUM 1

This addendum (Version 1.01) replaces Edition 1.0 published in January 2024.

List of updates

Clause/subclause	Update
3.2	New acronym "IED"
7.3.1	New subclauses f) and g)
7.3.4.2	Subclause replaced
7.3.4.6	Subclauses 7.3.4.6 * and 7.3.4.7 * replaced with single clause 7.3.4.6
7.3.12.1	New NOTE
7.3.12.2	"7.3.12.2.5" * replaced with "7.3.12.2.6" (to reflect the addition of subclause 7.3.12.2.6)
7.3.12.2.6	New subclause
7.3.12.8	"7.3.12.8.8" * replaced with "7.3.12.8.9" (to reflect the addition of subclause 7.3.12.8.9)
7.3.12.8.9	New subclause
7.17.5	Subclause amended (addition of "If provided" and deletion of "cable" *)
7.17.7	Subclause amended (addition of "If provided" and deletion of "cable" *)
Bibliography	Reference [B19] "IEC 62439-3" added (and subsequent numbering updated)
* Clause/subclause number from Edition 1.0.	

International Association of Oil & Gas Producers

SPECIFICATION
IOGP S-743

May 2025
Version 1.01

ADDENDUM 1 TO FIRST EDITION (JANUARY 2024)

Supplementary Specification to IEEE Std C37.20.2 for Metal-Clad Switchgear

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
1.01	May 2025	Addendum 1
1.0	January 2024	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).

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).

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Introduction

The purpose of the IOGP S-743 specification documents is to define a minimum common set of requirements for the procurement of metal-clad switchgear in accordance with IEEE Std C37.20.2, published January 2023, IEEE Standard for Metal-Clad Switchgear for application in the petroleum and natural gas industries.

The IOGP S-743 specification documents follow a common structure (as shown below) comprising a specification, also known as a technical requirements specification (TRS), a procurement data sheet (PDS), an information requirements specification (IRS) and a quality requirements specification (QRS). These four specification documents, together with the purchase order, define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Requirements Specification (TRS)

This specification is to be applied in conjunction with the supporting PDS, IRS and QRS as follows.

IOGP S-743: Supplementary Specification to IEEE Std C37.20.2 for Metal-Clad Switchgear

This specification defines technical requirements for the supply of the equipment and is written as an overlay to IEEE Std C37.20.2, following the IEEE Std C37.20.2 clause structure. Clauses from IEEE Std C37.20.2 not amended by this specification apply as written. Modifications to IEEE Std C37.20.2 defined in this specification are introduced by a description that includes the type of modification (i.e. *Add*, *Replace* or *Delete*) and the position of the modification within the clause.

NOTE Lists, notes, tables, figures, equations, examples and warnings are not counted as paragraphs.

IOGP S-743D: Procurement Data Sheet for Metal-Clad Switchgear (IEEE)

The PDS defines application-specific requirements. The PDS is applied during the procurement cycle only and does not replace the equipment data sheet. The PDS may also include fields for supplier-provided information required as part of the purchaser's technical evaluation. Additional purchaser-supplied documents may also be incorporated or referenced in the PDS to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-743L: Information Requirements for Metal-Clad Switchgear (IEEE)

The IRS defines information requirements for the scope of supply. The IRS includes information content, format, timing and purpose to be provided by the supplier, and may also define specific conditions that invoke the information requirements.

IOGP S-743Q: Quality Requirements for Metal-Clad Switchgear (IEEE)

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 PDS or in the purchase order.

The specification documents follow the editorial format of IEEE Std C37.20.2 and, where appropriate, the drafting principles and rules of ISO/IEC Directives Part 2.

The PDS and IRS are published as editable documents for the purchaser to specify application-specific requirements. The TRS and QRS are fixed documents.

The order of precedence of documents applicable to the supply of the equipment, with the highest authority listed first, shall be as follows:

a) regulatory requirements;

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

c) purchaser-defined requirements (e.g. PDS, IRS and QRS);

d) this specification;

e) IEEE Std C37.20.2.

1. Overview

1.1 Scope

Replace first sentence of second paragraph with

This standard applies to enclosed, indoor and outdoor MC switchgear assemblies rated above 1 kV ac and below 52 kV ac.

Add to subclause

This specification defines minimum technical requirements for the purchase of metal-clad (MC) switchgear equipment, including design features, fabrication quality, inspection, testing, shipment and documentation.

2. Normative references

Add to first paragraph

The following publications are referred to in this document, the PDS (IOGP S-743D) or the IRS (IOGP S-743L) in such a way that some or all of their content constitutes requirements of this specification.

Add to clause

46 CFR 111, *Title 46 – Shipping, Chapter I - Department of Coast Guard, Subchapter J - Electrical Engineering, Part 111 - Electrical Systems - General Requirements*

ABS MODU, Publication Number 6 Part 4, *Rules for Building and Classing Mobile Offshore Drilling Units - Part 4 Machinery and Systems*

ANSI/NEMA CC 1, *Electric Power Connection for Substations*

API Recommended Practice 14F, *Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Division 1, and Division 2 Locations*

API Recommended Practice 14FZ, *Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations*

ASCE/SEI 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*

ASME B30.26, *Rigging Hardware—Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings*

ASTM F855:2023, *Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment*

IEC 61850 (all parts), *Communication networks and systems for power utility automation*

IEC/IEEE 62271-37-013, *High-voltage switchgear and controlgear – Part 37-013: Alternating current generator circuit-breakers*

IEEE Std C37.04-2018, *IEEE Standard for Ratings and Requirements for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V*

IEEE Std C37.012, *IEEE Guide for the Application of Capacitive Current Switching for AC High-Voltage Circuit Breakers above 1000 V*

IEEE Std C37.20.7-2017, *IEEE Guide for Testing Switchgear Rated Up to 52 kV for Internal Arcing Faults*

IEEE Std C37.90, *IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus*

IEEE Std C62.11, *IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV)*

NEMA ICS 5, *Industrial Control and Systems: Control-Circuit and Pilot Devices*

UL DLAH, *GuideInformation - Circuit Breakers and Metal-clad Switchgear Over 1000 Volts*

Replace Clause 3 title with

3. Definitions and abbreviated terms

Add subclause 3.1 heading before first definition

3.1 Definitions

Add new definition

arc-resistant accessibility Type 2: An enclosure or assembly equipment with arc-resistant designs or features at the freely accessible exterior (front, back and sides).

Add new definition

arc-resistant accessibility Type 2B: An enclosure or assembly with arc-resistant designs or features at the freely accessible exterior (front, back and sides) and in the walls isolating the low-voltage control or instrument compartment(s).

NOTE—Suffix B for accessibility type indicates the equipment is arc-resistant even with the instrument or control compartment doors open. See IEEE Std C37.20.7 for additional details.

Add new definition

arc-resistant equipment: An equipment designed to withstand the effects of an internal arcing fault.

NOTE—This equipment is type tested as per the tests described in IEEE Std C37.20.7.

Add new definition

fault making rating: A rating intended for a grounding (earthing) switch installed on the load terminals of a controller, connected to a circuit that may contain stored electrical energy or have the possibility to close into an energized circuit.

Add new definition

grounding (earthing) switch: A permanently installed mechanical three-pole switching device used to connect the load side of a de-energized MV circuit breaker to ground (earth) for maintenance purposes.

Add new definition

internal arcing fault: An unintentional discharge of electrical energy in air or insulating gas within the confines of a switchgear enclosure.

Add new definition

main horizontal ground bus: The ground bus that provides common bonding between vertical sections throughout the entire length of the MC switchgear assembly.

Add new definition

manufacturer: An organization manufacturing and/or supplying equipment or services.

NOTE—Also referred to as "vendor", "seller" or "supplier".

Add new definition

short-circuit making current: The maximum value of prospective peak current of the circuit that the grounding (earthing) switch could be closed into at rated voltage.

Add new definition

touch safe: Protected from inadvertent contact by a finger using covers, recessing of terminals or the size of openings.

NOTE—"Touch safe" and similar terms, such as finger safe, are widely used to describe products but are not defined by industry standards. "Touch safe" is generally equivalent to IP 2X as per ANSI/IEC 60529, but most products are not tested to a particular IP rating.

Add new subclause

3.2 Abbreviated terms

ACO accredited certification organization

AHJ authority having jurisdiction

BIL basic impulse level

CBM condition-based monitoring

CPT control power transformers (or control power transformer assembly)

CT current transformer

FAT factory acceptance test

FLC full load current

GFCI ground fault current interrupter

IED intelligent electronic device

IRS information requirements specification

LED light emitting diode

LOTO lock-out-tag-out

LV low-voltage

MC metal-clad

MV medium-voltage

NC normally closed

NO normally open

NRTL nationally recognized testing laboratory

PDS procurement data sheet

PF power factor

PPE * personnel protective equipment

PT power transformer

QRS quality requirements specification

VT voltage transformer (or voltage transformer assembly)

* Cited in IOGP S-743J only.

4. Service conditions

Add new subclause

4.1 Dependability of materials and parts

4.1.1

The MC switchgear, excluding protection and control devices, shall have a minimum design life of 25 years at the rated current and under usual (normal) service conditions.

4.1.2

The electronic components (e.g., protection and control devices) shall have a minimum design life of 14 years under usual (normal) service conditions.

4.1.3

The MC switchgear shall be capable of operating continuously under the specified service conditions for a minimum of five years without requiring de-energization of the bus bars.

Add new subclause

4.2 Technology readiness and obsolescence

4.2.1

The MC switchgear, excluding electronic devices, shall be supported for a minimum of 25 years after delivery.

4.2.2

The obsolescence management plan shall be made available for MC switchgear components excluding devices that are required by procurement documents and that are not part of the manufacturer's standard offering.

NOTE—IEC 62402 is an example of an obsolescence management guide.

4.2.3

The manufacturer's proposal shall indicate whether the MC switchgear or any sub-component individually denoted has less than three years of proven operational service.

5. Ratings

5.6 Current transformer ratings

5.6.1 Current transformer mechanical rating

Replace third sentence with

CTs shall withstand the same short-circuit mechanical stresses as the associated circuit breaker short-time withstand current rating for a minimum of 2 s.

5.6.2 Current transformer thermal ratings

Replace third sentence with

CTs shall withstand the same short-circuit thermal stresses as the associated circuit breaker short-time withstand current rating for a minimum of 2 s.

5.7 Current transformer accuracies

Table 4—Standard accuracy ratings[a] for current transformers in MC switchgear

Replace seventh column "Relaying accuracy" with

Ratio	Relaying accuracy [c]
50:5	C or T10
75:5	C or T10
100:5	C or T10
150:5	C or T20
200:5	C or T20
300:5	C or T20
400:5	C100
600:5	C100
800:5	C100
1200:5	C100
1500:5	C100
2000:5	C100
3000:5	C100
4000:5	C100
5000:5	C100

7. Construction

7.1 Buses and primary connections

7.1.3 Cable terminations

Add new subclause

7.1.3.1

Cable terminations shall be provided with a NEMA two-hole pattern (i.e., ANSI/NEMA CC 1).

Add new subclause

7.1.3.2

Cable termination lugs shall be of compression type.

Add new subclause

7.1.3.3 Field cable termination area sizing

The field cable termination area shall be sized to provide space in accordance with the requirements given in 7.1.3.3.1 through 7.1.3.3.3.

7.1.3.3.1

Cable supports shall be provided with spacing no greater than 450 mm (18 in) from the cable termination point.

7.1.3.3.2

The field cable termination area shall provide space for conductor separation that allows for the installation of shielded cable terminations.

NOTE—Specific details for field cable sizes are typically detailed in the project drawings and documentation.

7.1.3.3.3

The field cable termination area shall provide space for the minimum bending radius for the cable installation.

NOTE—Specific details for field cable sizes are typically detailed in the project drawings and documentation.

7.1.5 Main bus splices

Add new subclause

7.1.5.1

Bolted power bus connections shall be secured with corrosion-resistant steel hardware (e.g., bolts, locking washers, flat washers, nuts, pressed threaded inserts).

Add new subclause

7.1.5.2

Cables shall not be used for main power buses inside the MC switchgear assembly.

Add new subclause

7.1.6

The main bus shall be pre-drilled on each end of the assembly for connecting adjacent sections without the need for additional bus supports or bracing.

Add new subclause

7.1.7

The current-carrying bus bars shall be tin-plated copper or silver-plated copper, as specified.

7.2 Grounding and bonding

Add new subclause

7.2.1

The dimensions of the main horizontal ground bus shall be a minimum of 6.35 mm ($^1/_4$ in) x 50.8 mm (2 in).

Add new subclause

7.2.2

The main horizontal ground bus shall be pre-drilled for connection of additional sections at each end without the need for additional bus supports or bracing.

Add new subclause

7.2.3

The main horizontal ground bus shall be drilled at each end for a NEMA two-hole lug (i.e., ANSI/NEMA CC 1) for field connections.

Add new subclause

7.2.4

Removable side sheet(s) or cover plate(s) attached with bolts or screws shall be provided on each end to allow connection of the main horizontal ground bus to additional sections.

Add new subclause

7.2.5

Ground bus joints shall be of through-bolt type (i.e., using a bolt that is secured with a hex nut or a pressed threaded insert).

Add new subclause

7.2.6

The ground bus shall be made of plated copper.

NOTE—Tin or silver plating is acceptable.

Add new subclause

7.2.7

The main horizontal ground bus shall be of uniform dimensions and continuous across the entire length of the MC switchgear assembly.

Add new subclause

7.2.8

The ground bus shall include provisions to connect a portable safety grounding clamp device in every circuit breaker compartment.

NOTE—The provisions for a portable safety grounding clamp device are not a substitution for a factory-installed grounding (earthing) switch.

Add new subclause

7.2.9

The ground bus in cable compartments shall be pre-drilled for connection of the field cable termination shield wire.

Add new subclause

7.2.10

The main horizontal ground bus shall be supplied with NEMA two-hole copper compression lugs for field connections at each end.

Add new subclause

7.2.11

Cable terminations on each phase bus bar shall be provided with a grounding ball stud with a removable, reusable insulating cover.

Add new subclause

7.2.12

Grounding ball studs shall be in accordance with ASTM F855.

NOTE—The selection guidance provided in ASTM F855:2023, Table 1 and Table 2 accounts for fault current level, duration and dc offset.

Add new subclause

7.2.13

The main horizontal ground bus shall be extended to the incoming power cable section.

Add new subclause

7.2.14

Hinged doors and panels equipped with powered devices shall be bonded to the enclosure with a flexible copper conductor connected between the hinged doors or panels and the MC switchgear ground bus or metallic structure.

7.3 Control and secondary circuits and devices

7.3.1 General

Add new subclause f)

f) Each branch circuit that is utilized for protection, control or monitoring devices shall be individually protected.

Add new subclause g)

g) Control power circuits that are sourced from the switchgear for a device or system external to the switchgear (e.g., transformer rapid pressure rise relays, motor start/stop circuits, device status) shall be individually protected.

7.3.2 Voltage and transformer fusing

Delete list subclause b)

Delete EXCEPTION

7.3.3 Control, secondary, and logic-level wiring

7.3.3.2 Wire size

Delete first paragraph

Delete embedded table

Delete EXCEPTION

Delete third paragraph (Wiring for current transformer...)

Add new subclause

7.3.3.2.1

Minimum conductor sizes for CT secondary wiring shall be No.12 AWG.

Add new subclause

7.3.3.2.2

Minimum conductor sizes for control wiring and auxiliary power circuits, except communication cabling, shall be No. 14 AWG.

Add new subclause

7.3.3.2.3

Minimum conductor sizes for analog and digital signals shall be No. 16 AWG shielded.

7.3.3.3 Wire protection and support

Add new subclause

7.3.3.3.1

Internal wiring shall be installed in a single continuous run from termination point to termination point, free of splices and taps.

Add new subclause

7.3.3.3.2

Wire and cable supports shall be permanently attached to the enclosure or the assembly (e.g., with screws or non-adhesive fasteners).

7.3.3.4 Wire type

Delete second list item from EXCEPTION

Delete sixth list item from EXCEPTION

Delete seventh list item from EXCEPTION

Add new subclause

7.3.3.4.1

Control wiring within the MC switchgear assembly shall be stranded tinned copper wire.

Add new subclause

7.3.3.4.2

If MC switchgear data communications are specified, the cabling and connections to the devices intended to be monitored and controlled shall be provided in accordance with the requirements given in 7.3.3.4.2.1 through 7.3.3.4.2.3.

7.3.3.4.2.1

The cabling and connection to the devices intended to be monitored and controlled shall be compatible with the specified communication protocol or combination of protocols.

7.3.3.4.2.2

The cabling and connection to the devices intended to be monitored and controlled shall be secured with a mechanical connecting means (e.g., screw-type connectors, RJ45 connectors).

7.3.3.4.2.3

The cabling to the devices intended to be monitored and controlled shall be rated for 600 V ac.

7.3.4 Secondary-wiring terminals

Add new subclause

7.3.4.1

Control wiring terminated on screw-type terminals shall use insulated, compression, locking fork tongue-type lugs.

Add new subclause

7.3.4.2

Control wiring terminated on intelligent electronic devices (IEDs) (e.g., microprocessor-based multifunction protective relays and meters) that do not have screw-type terminals shall be terminated with crimp-type ferrules or pin lugs.

Add new subclause

7.3.4.3

Internal wire terminations shall be marked with heat shrink-type wire markers or permanently marked.

Add new subclause

7.3.4.4

Internal wire termination markers shall be visible at the termination point without disassembling the cable bundle.

Add new subclause

7.3.4.5

Adhesive-type wire markers, labels and wire holders shall not be used for internal wire marking.

Add new subclause

7.3.4.6

Internal wiring shall be identified at both ends within 25.4 mm (1 in) of the termination, using one of the following methods:

a) machine-printed 360° slip-on wire markers;

b) heat-shrink wire markers;

c) permanent stenciling per wire with a unique tag or wire number.

7.3.5 Terminal blocks

Add new subclause

7.3.5.1

Terminal blocks shall be provided for external connections to the MC switchgear assembly.

Add new subclause

7.3.5.2

Exposed energized terminals of LV components (e.g., relays, terminal blocks, fuse holders) shall be provided as touch safe or covered by an insulating barrier.

Add new subclause

7.3.5.3

The MC switchgear internal wiring shall be connected to only one side of the field wiring terminal blocks.

Add new subclause

7.3.5.4

A maximum of two wires shall be terminated on an individual terminal.

Add new subclause

7.3.5.5

Terminal blocks and the associated wiring between shipping sections shall be permanently marked with identification matching the drawings.

Add new subclause

7.3.5.6

Individual MV circuit breaker compartments shall be provided with a minimum of 10 % spare terminals on the control wiring terminal blocks in the LV compartment.

Add new subclause

7.3.5.7

Terminal blocks shall be numbered and identified as designated on the approved schematic and wiring diagrams.

Add new subclause

7.3.5.8

All wiring entering or leaving a compartment connected to a device shall be terminated on terminal blocks in that compartment.

Add new subclause

7.3.12 Instruments, meters, and control devices

7.3.12.1 General

Control devices, meters and protective relays shall be installed between 0.61 m and 1.8 m (2 ft and 6 ft) from the bottom of the MC switchgear assembly.

NOTE—Control devices should be arranged so as to minimize misoperation of the circuit breaker (e.g., prevent placing the ammeter selector switch directly adjacent to the circuit breaker operation switch).

7.3.12.2 Microprocessor-based multifunction meters

If specified, power quality or microprocessor-based multifunction meters shall be provided in accordance with the requirements given in 7.3.12.2.1 through 7.3.12.2.6.

7.3.12.2.1

Power quality or microprocessor-based multifunction meters shall be provided with digital communication capability.

7.3.12.2.2

Power quality or microprocessor-based multifunction meters shall have a minimum accuracy of 0.5 %.

7.3.12.2.3

Power quality or microprocessor-based multifunction meters shall display the current and voltage for each phase.

7.3.12.2.4

Power quality or microprocessor-based multifunction meters shall display Hz, kVA, kW, kVAR and PF.

7.3.12.2.5

Power quality or microprocessor-based multifunction meters shall display harmonic order measurements.

7.3.12.2.6

Current coils of power monitoring equipment shall be capable of withstanding momentary CT secondary currents of 20 times the CT rating without sustaining damage.

7.3.12.3 Analog-type metering

If specified, analog-type metering shall be provided in accordance with the requirements given in 7.3.12.3.1 through 7.3.12.3.6.

7.3.12.3.1

Analog-type metering shall have a circular 250-degree-scale switchboard type.

7.3.12.3.2

Analog-type metering shall have a minimum accuracy of 1 %.

7.3.12.3.3

Analog-type metering shall be 115 mm (4.5 in) square.

7.3.12.3.4

Analog-type metering shall be flush mounted.

7.3.12.3.5

Analog-type ammeters shall be provided with a four-position rotary-type switch.

7.3.12.3.6

Analog-type voltmeters shall be provided with a four-position rotary-type switch for open-delta connected VTs or a seven-position switch for wye-connected VTs.

7.3.12.4 Protective relays

If protective relays are indicated on the single line or project drawings, these relays shall be provided in accordance with the requirements given in 7.3.12.4.1 through 7.3.12.4.8.

7.3.12.4.1

Protective relays shall be in accordance with the service conditions, ratings and testing requirements specified in IEEE Std C37.90.

7.3.12.4.2

Protective relays shall be multifunctional microprocessor based.

7.3.12.4.3

Protective relays shall have a trip indication with a manual reset function.

7.3.12.4.4

Protective relays shall provide an indication for each type of fault.

7.3.12.4.5

Protective relays shall have a digital communication capability.

7.3.12.4.6

Protective relays shall be provided with a minimum of two digital inputs and two digital outputs.

7.3.12.4.7

Protective relays shall be capable of performing the protective functions indicated on the single line or project drawings.

7.3.12.4.8

Protective relays shall be installed on the circuit breaker LV compartment door.

7.3.12.5 Selector switches

If MC switchgear style selector switches are indicated in the project drawings, these selector switches shall be provided in accordance with the requirements given in 7.3.12.5.1 through 7.3.12.5.3.

7.3.12.5.1

Selector switches shall be of rotary-cam type.

7.3.12.5.2

Selector switches shall have engraved escutcheon plates.

7.3.12.5.3

Selector switches shall have oval handles.

7.3.12.6 Circuit breaker control switches

If MC switchgear style circuit breaker control switches are indicated in the project drawings, these switches shall be provided in accordance with the requirements given in 7.3.12.6.1 through 7.3.12.6.3.

7.3.12.6.1

Circuit breaker control switches shall have pistol grip handles.

7.3.12.6.2

Circuit breaker control switches shall have momentary contact and spring return-to-center functionality.

7.3.12.6.3

Circuit breaker control switches shall have red for "closed" and green for "open" mechanical indication.

7.3.12.7 Lock-out relays

If door-mounted lock-out relays (i.e., IEEE Device 86) are indicated on the project drawings, these relays shall be provided in accordance with the requirements given in 7.3.12.7.1 through 7.3.12.7.5.

7.3.12.7.1

Lock-out relays shall have a manual reset type handle.

7.3.12.7.2

Lock-out relays shall operate in less than one cycle.

7.3.12.7.3

Lock-out relays shall have two positions, "Reset" and "Tripped".

7.3.12.7.4

Lock-out relays shall have the coil health monitored with a white indicating light.

7.3.12.7.5

If test switches are specified, the lock-out relay trip contacts shall be routed through separate test switch contacts.

7.3.12.8 Test switches

If specified, test switches shall be provided in accordance with the requirements given in 7.3.12.8.1 through 7.3.12.8.9.

7.3.12.8.1

Test switches shall be installed on the circuit breaker or the associated instrument compartment door.

7.3.12.8.2

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

7.3.12.8.3

Test switches shall be of FT-1 type.

7.3.12.8.4

Test switches shall be wired to provide three-phase bus voltages and three-phase line currents.

7.3.12.8.5

Individual test switches shall be wired in series on each side of protective relay trip output contacts.

7.3.12.8.6

A dedicated test switch per circuit breaker shall be provided for each lock-out device tripping more than one breaker.

7.3.12.8.7

If test switches are applied to CT circuits, the test switches shall be of shorting type.

7.3.12.8.8

Test switches shall be wired such that the voltage blades are de-energized when open.

7.3.12.8.9

Test switches shall be provided with a nameplate that identifies the function or service of each switch pole, with the text aligned directly above the associated pole.

7.3.12.9 Indication devices

If status indicator lights are specified or indicated on the project drawings, these lights shall be provided in accordance with the requirements given in 7.3.12.9.1 through 7.3.12.9.6.

7.3.12.9.1

Status indicator lights shall be installed on the circuit breaker LV compartment door.

7.3.12.9.2

Status indicating light colors shall depend on the status of the circuit breaker in accordance with the following:

— red for breaker closed or motor running;

— green for breaker open or motor stopped;

— amber for tripped;

— white for breaker trip coil health and lock-out relay health.

7.3.12.9.3

Status indicating lights shall be of clear LED type.

7.3.12.9.4

LED status indicating lights shall have a minimum illumination life of 100 000 hours.

7.3.12.9.5

Status indicating lights shall be replaceable.

7.3.12.9.6

Replacement of indicator lights shall not result in circuit breaker operation.

7.3.12.10 Auxiliary relays

If auxiliary relays are required, these relays shall be provided in accordance with the requirements given in 7.3.12.10.1 through 7.3.12.10.4.

7.3.12.10.1

Control relay output contacts and auxiliary (interposing) control-circuit device contacts for field wiring to external equipment shall have a contact ampacity performance rating for the intended switching application in accordance with NEMA ICS 5.

7.3.12.10.2

Surge suppressors shall be installed across control relay coils, except for electronic relays that include internal surge suppression.

7.3.12.10.3

Plug-in-type relays shall be provided with retaining clips.

7.3.12.10.4

Surface-mounted control and auxiliary relays shall not be mounted on the interior surface of the LV compartment door.

7.3.12.11 E-stop pushbutton

If specified, an emergency stop button (E-stop) function shall be provided for circuit breakers in accordance with the requirements given in 7.3.12.11.1 through 7.3.12.11.4.

7.3.12.11.1

The color of the emergency stop button shall be red.

7.3.12.11.2

The emergency stop button shall be of mushroom-head type.

7.3.12.11.3

The emergency stop button shall be of maintained push-to-operate type.

7.3.12.11.4

The emergency stop button shall be provided with a protective guard or shroud.

7.3.12.12 Motor protection relay

If motor protection relays are indicated on the single line or project drawings, these relays shall include the following functions:

a) Percentage of motor FLC

b) Percentage of thermal capacity utilized

c) Motor bearing temperature

d) Running time (cumulative) in hours

e) Operation count

f) Number of remaining starts

g) Motor start lock out

h) Motor stator winding temperature

i) Protective functions including thermal overload, underload, locked rotor, current imbalance, differential, short circuit, ground fault, under-voltage, under-frequency, phase imbalance and stall

7.4 Miscellaneous

7.4.1 Nameplate marking

Add new list item k)

k) Purchase order number

Add new list item l)

l) MC switchgear designation (i.e., tag number)

Add new subclause

7.4.1.1

Nameplates on compartment doors or panels shall be mounted with stainless steel screws.

Add new subclause

7.4.1.2

Nameplates shall be of engravable type with black letters on a white background.

Add new subclause

7.4.1.3

Circuit breaker compartment nameplates shall be a minimum of 25.4 mm (1 in) high x 63.5 mm (2.5 in) wide.

Add new subclause

7.4.1.4

The characters on the circuit breaker compartment nameplate shall be a minimum of 4.8 mm (0.1875 in) high.

Add new subclause

7.4.1.5

Individual nameplates shall identify door-mounted items (e.g., meters, switches, indicating lights and protective relays).

Add new subclause

7.4.1.6

Individual device labels shall identify the individual components within each compartment (e.g., terminals, relays, switches, fuse blocks).

Add new subclause

7.4.1.7

MC switchgear individual front and rear compartment doors or covers shall be provided with externally mounted nameplates.

Add new subclause

7.4.1.8

Nameplates on individual MC switchgear front and rear compartment doors or covers shall identify the equipment tag number, description and other information detailed in the project nameplate schedule or single line drawings.

Add new subclause

7.4.1.9

Cable compartment doors shall be provided with nameplates that identify the circuit breaker or circuit designation.

Add new subclause

7.4.1.10 Mimic bus representation

If specified, a mimic bus representation shall be installed on the front of the MC switchgear assembly in accordance with the requirements given in 7.4.1.10.1 through 7.4.1.10.5.

7.4.1.10.1

The mimic bus representation shall include current-carrying buswork within the MC switchgear.

7.4.1.10.2

The mimic bus representation shall include MV circuit breakers.

7.4.1.10.3

The mimic bus representation shall include MV supply sources.

7.4.1.10.4

The mimic bus representation shall include load designations.

7.4.1.10.5

The mimic bus representation shall include MV VTs.

Add new subclause

7.4.1.11

If an interlock system (e.g., key type, secondary selective, electrical, mechanical) is used, nameplates containing operational instructions shall be affixed on the front of the MC switchgear near the point of operation.

Add new subclause

7.4.1.12

Interior warning labels and device nameplates shall not be obscured by wiring and other components.

Add new subclause

7.4.1.13

Fuse holders shall be labeled to indicate the fuse size, type and identification matching the drawings.

7.4.3 Viewing panes

Add new subclause

7.4.3.1

If specified, a circuit breaker viewing window that allows for an unobscured view of the circuit breaker position during closed-door racking shall be provided.

Add new subclause

7.4.3.2

If specified, a viewing window that allows for an unobscured view of the circuit breaker mechanical open/closed status indicator shall be provided for each compartment containing an MV circuit breaker to view the circuit breaker mechanical open/closed status indicator with the door closed.

7.4.6 Service disconnecting means

Add new subclause

7.4.6.1

If a service entrance application is specified, the service entrance compartment shall have provisions for utility instrument transformers and meters as indicated on the project drawings and in the project documentation.

Add new subclause

7.4.6.2

If a service entrance application is specified, the service entrance compartment(s) shall be in accordance with local utility and AHJ requirements.

7.6 Precautionary labels

Add new subclause

7.6.1

Caution labels shall be provided on doors of compartments with an external ac voltage source.

Add new subclause

7.6.2

Caution labels shall be provided on doors of compartments with external powered space heaters to identify the space heater circuit panel and breaker information as detailed in the project drawings.

7.8 Shutters

Add new subclause

7.8.1

Shutters for MC switchgear circuit breaker compartments shall be equipped with provisions to padlock the shutters in the closed position.

Add new subclause

7.8.2

The padlock provisions for the shutter assembly for MC switchgear circuit breaker compartments shall be front accessible.

Add new subclause

7.8.3

Shutters for MC switchgear circuit breaker compartments shall be marked with a label indicating "Line" (for incoming feeders), "Main Bus" (for the main bus), or "Load" (for outgoing feeders).

NOTE—For switchgear with tie-breakers, the shutters are typically labeled with the corresponding main bus equipment or tag number as indicated in the project drawings.

Add new subclause

7.8.4

Shutters for MC switchgear circuit breaker compartments shall be identified using a label with a minimum character height of 50 mm (2 in).

7.9 Insulating materials for covering buses and connections

Delete third paragraph

Add new subclause

7.9.1 Bus bar insulation

The MC switchgear shall be provided with a fully insulated bus in accordance with the requirements given in 7.9.1.1 through 7.9.1.8.

7.9.1.1

The bus bar insulating material shall be non-hygroscopic.

7.9.1.2

The bus bar insulating material shall be flame retardant and track resistant.

7.9.1.3

MC switchgear assembly bus joints shall be covered with formed insulating boots.

7.9.1.4

Bolted joints shall not be insulated using tape in lieu of formed bus bar joint boots.

7.9.1.5

Bus joint insulating boots shall be attached with non-metallic hardware.

7.9.1.6

MC switchgear assembly bus joints at shipping splits shall be supplied with boots, attachment hardware and installation instructions.

7.9.1.7

MC switchgear bus bar insulation, except at the joints, shall be bonded to the bus bar and be of heat-shrink, liquid-dipped or fluidized-bed epoxy type.

7.9.1.8

Incoming supply and outgoing feeder connections (e.g., cable or bus) shall be covered with formed insulating boots.

Add new subclause

7.9.2 Bus bar supports

Supports for the main and current-carrying buses for the MC switchgear shall be provided in accordance with the requirements given in 7.9.2.1 through 7.9.2.3.

7.9.2.1

The material for the support of an insulated energized part shall be porcelain, cycloaliphatic epoxy or glass polyester.

7.9.2.2

The bus bar support material shall be non-hygroscopic.

7.9.2.3

The bus bar support material shall be flame retardant and track resistant.

7.17 Indoor MC switchgear, access, and ventilation

Add new subclause

7.17.1

MC switchgear enclosures shall be provided as Category B in accordance with Appendix B.

Add new subclause

7.17.2

The front doors of the MC switchgear shall be secured with latches or handles (i.e., cam or twist type) with less than one full rotational turn.

Add new subclause

7.17.3

Special tools shall not be required to open or close compartment doors.

Add new subclause

7.17.4

Hinged doors exceeding a height of 1143 mm (45 in) or a width of 610 mm (24 in) shall be provided with door keepers or positioners.

Add new subclause

7.17.5

If provided, rear compartment doors shall be removable or capable of being opened more than 90°.

Add new subclause

7.17.6

Full-height compartment doors shall be provided with a full-length hinge or with a minimum of three separate hinges.

Add new subclause

7.17.7

If provided, rear compartment doors shall be equipped with padlock provisions.

Add new subclause

7.17.8

The front doors of the MC assembly shall be capable of being opened more than 120°.

Add new subclause

7.17.9

The MC switchgear assembly shall be extendable on each end for the addition of vertical sections.

Add new subclause

7.17.10

Circuit breaker compartment doors shall be equipped with padlock provisions.

Add new subclause

7.17.11

A removable side sheet or cover plate attached with bolts or screws shall be provided on each end of the assembly, allowing access to the predrilled main and ground bus bars and interconnecting LV wiring.

Add new subclause

7.17.12

Removable panels weighing more than 16 kg (35 lbs) shall have two lifting handles.

7.18 Outdoor MC switchgear, access, and ventilation

Add new subclause

7.18.1

The roof shall be sloped to allow for drainage away from the front of the assembly.

Add new subclause

7.18.2

External joints shall be seal welded for the full length of the joint or bolted with gaskets.

Add new subclause

7.18.3

External gasketed joints shall be covered with a metal cap.

Add new subclause

7.18.4

Gaskets shall be held in metal retainers, channels or other means to prevent the gasket from being misaligned or dislodged during operation.

Add new subclause

7.18.5

Outdoor MC switchgear assemblies of three or fewer vertical sections shall have at least one 120-volt GFCI-protected receptacle located inside an exterior door.

Add new subclause

7.18.6

Outdoor MC switchgear assemblies of four or more vertical sections shall have at least one 120-volt GFCI-protected receptacle located on each end and inside an exterior door.

Add new subclause

7.18.7

The distance between the 120-volt GFCI-protected receptacles of an outdoor MC switchgear assembly consisting of four or more vertical sections shall not be more than 7.5 m (25 ft).

Add new subclause

7.18.8

Outdoor MC switchgear enclosures shall have one LED-type light fixture per vertical section located inside the exterior door.

Add new subclause

7.18.9

The nameplates located on exterior surfaces of outdoor MC switchgear shall be made of stainless steel.

7.19 Circuit breaker open/close position indication

Add new subclause

Circuit breaker open and closed positions shall be indicated by a color-coded mechanical means visible with the compartment door closed.

Add new subclause

7.24 Instrument and control power transformers

7.24.1 Voltage transformers

7.24.1.1

The secondary voltage shall be 120 V with the primary voltage indicated on the single line diagram.

7.24.1.2

VTs shall be protected by current-limiting primary fuses.

7.24.1.3

VTs shall be withdrawable.

7.24.1.4

VTs shall have the secondary winding protected by disconnecting-type current-limiting fuses or circuit breakers with one leg of the secondary winding grounded.

7.24.1.5

The VT BIL rating shall be at a minimum equal to the MC switchgear assembly BIL rating.

7.24.1.6

Secondary protective devices for VTs shall be located in the LV control compartment.

7.24.1.7

Fuse holders shall be labeled to indicate fuse size, fuse type and identification matching the drawings.

7.24.1.8

Provisions to padlock VTs in the disconnect or withdrawn position shall be provided.

7.24.2 Control power transformers

7.24.2.1

The kVA rating of the CPT shall include the MC switchgear loads in addition to the external loads indicated on the project drawings.

7.24.2.2

The kVA rating of the CPT shall include the larger of either the simultaneous tripping or charging of all the circuit breakers for 120 V ac control power applications.

7.24.2.3

The kVA rating of the CPT shall include a minimum of 15 % additional VA capacity.

7.24.2.4

The CPT BIL rating shall be at a minimum equal to the MC switchgear assembly BIL rating.

7.24.2.5

If internal ac control power is required, one CPT shall be provided for each incoming power source feeding the MC switchgear.

7.24.2.6

If multiple CPTs are provided internal to one MC switchgear assembly, an automatic control power transfer scheme shall be provided such that the control power is normally supplied from one control power source and transferred to one of the others in the event a control power source becomes unavailable.

7.24.2.7

The secondary voltage of an internal CPT shall be 240/120 V or 120 V, with the primary voltage as indicated on the single line diagram.

7.24.2.8

Primary windings for CPTs shall be protected by current-limiting fuses.

7.24.2.9

Secondary windings for CPTs shall be protected by disconnecting-type current-limiting fuses or molded-case circuit breakers with the neutral of the secondary winding grounded.

7.24.2.10

The CPT compartment door shall be equipped with provisions to be padlocked in the disconnected position.

7.24.2.11

CPT current-limiting primary fuses shall be coordinated with the magnetizing inrush current.

7.24.2.12

A control relay with a dry-type, Form C contact shall be provided for remote alarming of any loss of each control power source.

7.24.3 Current transformers

7.24.3.1

CT secondary connections, including taps from multi-ratio CTs, shall be directly wired out to accessible short-circuiting terminal strips.

7.24.3.2

CTs with the same rating and application shall be identical and interchangeable.

7.24.3.3

CT polarity shall be visible (e.g., CT markings are visible or a label is provided).

7.24.3.4

Phase CTs installed on stationary circuit breaker stabs shall be front accessible.

7.24.3.5

Wiring for CT secondary leads shall be terminated with insulated, compression ring-type lugs.

7.24.3.6

One direct connection shall be made from the CT short-circuiting terminal block to the ground bus, without intermediate terminations or splices.

7.24.3.7

The grounding conductor insulation color for CT grounding circuits shall be green or green with a yellow stripe.

7.24.3.8

The grounding wires shall be marked "CT Ground" at the short-circuiting terminal block and at the ground bus termination point.

Add new subclause

7.25 Circuit breakers

7.25.1

Power circuit breakers shall be rated, manufactured, tested and provided in accordance with IEEE Std C37.04, IEEE Std C37.09 and IEEE Std C37.20.2.

7.25.2

MV circuit breakers provided in the MC switchgear shall be provided in accordance with the requirements given in 7.25.2.1 through 7.25.2.11.

7.25.2.1

Circuit breakers provided in the MC switchgear shall be of three-pole type.

7.25.2.2

Circuit breakers provided in the MC switchgear shall be of vacuum-interrupter type.

7.25.2.3

Circuit breakers provided in the MC switchgear shall be of mechanical stored-energy type.

7.25.2.4

Circuit breakers provided in the MC switchgear shall be electrically operated.

7.25.2.5

Circuit breakers provided in the MC switchgear shall have provisions for manual open/trip without opening the compartment door.

7.25.2.6

Circuit breakers provided in the MC switchgear shall have provisions for manual charging of the spring mechanism.

7.25.2.7

Circuit breakers provided in the MC switchgear shall have an anti-pump operating mechanism.

7.25.2.8

Circuit breakers provided in the MC switchgear shall be provided with padlocking provisions for the test and withdrawn positions.

7.25.2.9

Circuit breakers provided in the MC switchgear shall be provided with padlocking provisions for keeping the breaker in the open position when connected to the main circuit.

7.25.2.10

MV circuit breakers in the MC switchgear shall have an operation counter.

7.25.2.11

Circuit breakers provided in the MC switchgear shall have a vacuum interrupter wear indicator.

NOTE—An alternative method of vacuum interrupter wear indication is a software algorithm-based vacuum interrupter condition monitoring.

7.25.3

Drawout circuit breakers shall be provided with a manual racking mechanism that allows for the connected, test and disconnected positions.

7.25.4

Circuit breaker compartment doors shall be able to be closed when the drawout breaker is in the test or disconnected position.

7.25.5

Mechanical indicators for charged or discharged spring conditions shall be visible when the circuit breaker is in the connected position with the door closed.

7.25.6

Circuit breakers shall be provided with a mechanical means to indicate breaker closed (red) and open (green) positions with the compartment door closed.

7.25.7

The close circuit and trip circuit(s) for each MV breaker shall be individually fused or protected by lockable molded-case circuit breakers in each breaker LV compartment.

7.25.8

A means to prevent overtravel of the circuit breaker during the racking operation shall be provided.

7.25.9

For generator applications of 10 MVA and larger, a generator circuit breaker meeting the requirements of IEC/IEEE 62271-37-013 shall be provided.

7.25.10

Circuit breaker trip circuits shall be monitored for loss of control voltage on the load side of the protective device with a dry, fail-safe contact for alarm provisions.

NOTE—One method of meeting this requirement is wiring a protective relay digital input to the load side of the protective device trip contact, providing trip circuit supervision logic in the protective relay and an alarm via a digital output contact from the protective relay.

7.25.11

In addition to contacts required for circuit breaker operations and indication, contacts shall be supplied in accordance with the requirements given in 7.25.11.1 through 7.25.11.4.

7.25.11.1

Two NO and two NC MOC contacts shall be wired out to terminal blocks.

7.25.11.2

Two NO and two NC TOC contacts shall be wired out to terminal blocks.

7.25.11.3

Two NO auxiliary contacts, device 52a, shall be wired out to terminal blocks.

7.25.11.4

Two NC auxiliary contacts, device 52b, shall be wired out to terminal blocks.

7.25.12

For capacitive current switching applications (i.e., capacitor banks, no-load cables, no-load transmission lines, and filter banks), circuit breakers shall be in accordance with IEEE Std C37.012.

NOTE — Depending on the magnitude of capacitive current, some derating of the MV circuit breaker may be required.

7.25.13

If 120 V ac control power is specified for circuit breaker control, a capacitive trip device with a dry-type, Form C alarm contact shall be provided for each circuit breaker.

NOTE — For external 120 V ac control power supply using a UPS, a capacitive trip device for each circuit breaker is not necessary.

Add new subclause

7.26 Arc-resistant design and construction

7.26.1

Arc-resistant assemblies shall be tested in accordance with IEEE Std C37.20.7-2017, for not less than 0.5 s, based on the prospective current of the highest rated circuit breaker without insertion of any current-limiting device in the test circuit.

7.26.2

Arc-resistant enclosures shall be tested at the rated maximum voltage of the equipment.

7.26.3

Where current-limiting or duration-limiting devices are used to achieve the arc resistant certification, the details of these devices shall be provided with the proposal.

7.26.4

Installation requirements for the arc-resistant MC switchgear (e.g., minimum room dimensions, room volume, requirements for plenums, clearance for arc vents) required for the performance of the arc-resistant MC switchgear shall be provided.

7.26.5

The circuit breaker and instrument compartment front doors of the MC switchgear shall be secured with latches (i.e., cam or twist type) with less than one rotational turn.

7.26.6

Special tools shall not be required to latch the circuit breaker or instrument doors.

7.26.7

Provisions for penetrating the LV compartment for field wiring within the controller shall not compromise the arc-resistant integrity of the compartment.

7.26.8

The arc-resistant design shall have provisions for the expansion of the MC switchgear.

7.26.9

The MC switchgear shall be provided with an interlock to prevent opening of the circuit breaker compartment door except for the following:

— the circuit breaker is in the disconnected position and the safety shutters are closed;

— the circuit breaker is in the test position and the safety shutters are closed.

7.26.10

The arc-resistant rating of the MC switchgear shall be maintained during closed-door racking of the withdrawable elements.

7.26.11

Circuit breakers shall be provided with a means to manually (i.e., mechanically) trip the circuit breaker with the door closed without compromising the integrity of the arc-resistant construction.

7.26.12

If an arc-resistant MC switchgear is specified, an additional nameplate shall be provided to identify the arc-resistant ratings of the MC switchgear in accordance with IEEE Std C37.20.7-2017, 6.3.

7.26.13

If a plenum is required, the plenum assembly shall be fully rated to withstand the forces associated with an arc fault within the MC switchgear assembly.

7.26.14

If a plenum with an outdoor exhaust is specified, the plenum assembly shall be provided with a wall penetration kit and exterior exhaust outlet equipped with environmental-type seals.

7.26.15

A tool-operated provision for deactivating the circuit breaker compartment door interlock while the circuit breaker is not in the test or withdrawn positions shall be provided.

Add new subclause

7.27 MC switchgear configuration

7.27.1

Incoming circuit breakers and tie circuit breakers shall be limited to one-high construction within the MC switchgear assembly.

7.27.2

Provisions shall be made for the addition of vertical sections at both ends of the MC switchgear assembly.

7.27.3

Provisions for additional vertical sections shall include the necessary hardware such as removable plates or side sheets furnished at the end of vertical sections, terminal blocks for vertical section interconnect wiring, pre-drilled main bus and pre-drilled ground bus.

7.27.4 Equipped and unequipped spaces

7.27.4.1

Equipped and unequipped spaces shall be capable of being modified to add circuit breakers of the same ampere rating, as indicated on the project drawings or single-line diagram, without a shutdown of the MC switchgear.

7.27.4.2

Equipped spaces shall be furnished with hardware, wiring, doors and ancillary equipment including CTs and monitoring devices.

NOTE—Only the addition of an MV circuit breaker is needed to complete an equipped space compartment.

7.27.4.3 Provisions for unequipped spaces

Unequipped spaces shall be provided in accordance with the requirements given in 7.27.4.3.1 through 7.27.4.3.3.

7.27.4.3.1

Unequipped spaces shall be provided with doors.

7.27.4.3.2

Unequipped spaces shall be provided with line and load side power stabs.

7.27.4.3.3

Unequipped spaces shall be provided with line and load side power stab covers or shutters.

7.27.4.4

Unequipped spaces shall not be used for mounting instrumentation, control devices or auxiliary equipment.

7.27.5

Cable entry provisions shall include removable gland plates for every vertical section.

7.27.6

If a cable bus or a bus duct is specified for the incoming line section, the necessary components (e.g., interface flange, bus extensions, supports, hardware, gaskets) for the MC switchgear to accept the cable bus or bus duct shall be provided.

7.27.7 Breaker interlocking or transfer scheme

If specified, an MV circuit breaker interlocking or transfer scheme shall be arranged in accordance with the requirements given in 7.27.7.1 through 7.27.7.3.

7.27.7.1

The transfer scheme shall be disabled if one or more transfer breakers are in the test or disconnected position.

7.27.7.2

Manual transfer schemes that do not have electrical interlocks (e.g., sync checks or transfer logic controls) shall have a key-type interlock to achieve mechanical interlocking between circuit breaker operations.

7.27.7.3

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

7.27.8

The MC switchgear point of access to initiate withdrawal of removable elements (e.g., VT, CPT, fuse drawer, circuit breaker) shall be located no more than 1.88 m (74 in) above floor level.

Add new subclause

7.28 Space heaters

7.28.1 Enclosure space heaters

7.28.1.1

Enclosure space heaters shall be wired to an accessible terminal block provided for connection to a single external power source for the MC switchgear assembly.

7.28.1.2

Enclosure space heaters shall be guarded by an expanded metal cage around the heaters.

7.28.1.3

Enclosure space heaters shall be operated at 120 V ac.

7.28.1.4

Enclosure space heaters shall be sized to provide a 5 K rise over the site ambient air temperature upper limit to prevent condensation.

7.28.1.5

Each enclosure space heater circuit shall be protected by a disconnect device with lock-out provisions (i.e., fuse or molded case circuit breaker).

7.28.1.6

Each enclosure space heater circuit shall be provided with an ammeter.

7.28.1.7

The ammeter for each enclosure space heater circuit shall have an appropriately sized scale such that failure of a single space heater element results in a discernible change in ammeter reading.

7.28.1.8

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

7.28.1.9

If specified, enclosure space heaters shall be installed in the MV circuit breaker and cable compartments.

7.28.1.10 Enclosure space heater automatic control

7.28.1.10.1

If enclosure space heater automatic control is specified, a control unit shall be provided in accordance with 7.28.1.10.2 and 7.28.1.10.3.

7.28.1.10.2

The control unit shall have a control circuit that includes a momentary test pushbutton.

7.28.1.10.3

The control unit momentary pushbutton (i.e., test pushbutton) shall energize the space heaters and bypass the space heater controls.

7.28.2 Motor space heaters

7.28.2.1

The MV circuit breakers identified for motor applications on the project drawings shall be provided with a normally closed contact (e.g., 52b with TOC, MOC) wired in series with an external power source such that the motor space heater is energized when the circuit breaker is open.

7.28.2.2

The supply power for motor space heaters shall be wired to an accessible terminal block provided for connection to an external power source.

7.28.2.3

Motor space heater circuits shall have a fused disconnect or lockable molded case circuit breaker located within the respective LV compartment of the MV circuit breaker.

7.28.2.4

Motor space heater circuits shall be supplied with an ammeter with an appropriately sized scale such that failure of the motor heater element results in a discernible change in the ammeter reading.

7.28.2.5

The external power supply for motor space heaters shall remain energized when the MV circuit breaker is open, in the test or disconnect positions.

7.28.2.6

A momentary pushbutton shall be provided to test the motor space heater and the ammeter circuit.

Add new subclause

7.29 MC switchgear accessories

7.29.1

A hand crank or handle shall be provided for moving the circuit breaker into the connected, test and disconnected positions.

7.29.2

A device for manually charging the stored energy mechanism of electrically operated circuit breakers shall be provided.

7.29.3 Remote electrical racking device

If specified, a remote electrical racking device shall be supplied and operate in accordance with the requirements given in 7.29.3.1 through 7.29.3.5.

7.29.3.1

The racking device shall move the circuit breaker in all positions (i.e., withdrawn, test, connected).

7.29.3.2

The racking device shall be operable with the door closed.

7.29.3.3

The racking device shall be operable at a distance of 6 m (20 ft) from the MV circuit breaker compartment.

7.29.3.4

The racking device shall automatically shut off when the breaker is in the connected position.

7.29.3.5

If an integral remote circuit breaker racking device is incorporated into the circuit breaker stationary housing, the power supply shall be wired to an accessible terminal block provided for connection to a single external power source for the MC switchgear assembly.

7.29.4

A lifting apparatus (e.g., lifting yoke) shall be provided to allow each size of circuit breaker in the assembly to be safely lifted off the compartment rails.

7.29.5

If not part of the circuit breaker compartment, one set of extension rails for each circuit breaker frame size shall be provided.

7.29.6

If specified, portable lift trucks for raising and lowering the circuit breakers from MC switchgear compartment rails shall be provided to accommodate each frame size contained within the complete MC switchgear assembly.

7.29.7 Remote handheld control station

If specified, a remote handheld control station shall be provided to operate the individual circuit breakers of the MC switchgear assembly in accordance with the requirements given in 7.29.7.1 through 7.29.7.5.

7.29.7.1

The control station shall operate the circuit breaker types and sizes provided in the assembly.

7.29.7.2

The control station shall perform the open and close functions for the circuit breaker.

7.29.7.3

The control station shall indicate the circuit breaker positions (i.e., open and closed).

7.29.7.4

The control station shall be provided with a minimum of 6 m (20 ft) of control cable.

7.29.7.5

In order to facilitate the interface of the handheld control station to the circuit breaker, a connection port shall be provided on each circuit breaker compartment door.

7.29.8

If specified, an accessory cabinet that is separate, key lockable and suitable for storage of supplied accessories shall be provided.

7.29.9 Thermal scanning inspection windows

If specified, thermal scanning inspection windows for infrared scanning of the equipment shall be provided in accordance with the requirements given in 7.29.9.1 through 7.29.9.3.

7.29.9.1

The thermal scanning inspection windows shall be provided for locations where external thermal scanning can detect hot spots in the MC switchgear assembly.

7.29.9.2

Thermal scanning inspection windows shall be NRTL or ACO approved.

7.29.9.3

Thermal scanning windows provided in arc-resistant MC switchgear shall be included in the type testing program for the qualification of the arc-resistant MC switchgear.

Add new subclause

7.29.10 Condition-based monitoring

7.29.10.1 Continuous thermal monitoring

If specified, a continuous thermal monitoring system shall be provided in accordance with the requirements given in 7.29.10.1.1 through 7.29.10.1.3.

7.29.10.1.1

The continuous thermal monitoring system shall be factory integrated.

7.29.10.1.2

The thermal monitoring system shall include hotspot detection sensors for areas of concern (e.g., cable connections, fuse clips, drawout connections and shipping split connections).

7.29.10.1.3

The continuous thermal monitoring system shall include communications to convey temperature data, status and alarming for every monitored point.

7.29.10.2 Local motor condition monitoring

If specified, a local motor condition monitoring system using manual data collection shall be provided in accordance with the requirements given in 7.29.10.2.1 through 7.29.10.2.4.

7.29.10.2.1

The local motor condition monitoring system shall be equipped with factory-integrated components within the MC switchgear assembly.

7.29.10.2.2

Connections to internal CT and VT circuits shall be through a test port located on the front door of the MC switchgear or at a remote interface panel.

7.29.10.2.3

Voltage at the test port shall be touch safe.

7.29.10.2.4

Voltage at the test port shall be less than 50 V.

7.29.10.3 Continuous motor condition monitoring

If specified, a continuous motor condition monitoring system shall be provided in accordance with the requirements given in 7.29.10.3.1 through 7.29.10.3.4.

7.29.10.3.1

The continuous motor condition monitoring system shall be factory integrated into the MC switchgear assembly.

7.29.10.3.2

The continuous motor condition monitoring system shall be capable of continuous monitoring and sensing as detailed in the project documentation.

7.29.10.3.3

The continuous motor condition monitoring system shall include communications to convey status and alarming for every monitored point.

7.29.10.3.4

The continuous motor condition monitoring system shall provide a methodology for the real-time analysis of rotor flux, rotor cage current signature analysis, end winding vibration, shaft voltage and shaft current.

7.29.10.4 Continuous partial discharge monitoring

If specified, a continuous partial discharge monitoring system shall be provided in accordance with the requirements given in 7.29.10.4.1 through 7.29.10.4.3.

7.29.10.4.1

The continuous partial discharge monitoring system shall be factory integrated into the MC switchgear assembly.

7.29.10.4.2

Partial discharge systems shall be capable of continuous sensing and monitoring of the MC switchgear assembly and connected equipment.

7.29.10.4.3

The continuous partial discharge monitoring system shall include communications to convey partial discharge data, status and alarming for each monitored point.

Add new subclause

7.30 Certifications

7.30.1

The MC switchgear shall be listed or certified by a NRTL for the United States or an ACO for Canada.

NOTE—Applications for the MC switchgear assembly in other countries may have additional requirements for certification (e.g., UL DLAH for US applications).

7.30.2

If specified, MC switchgear assemblies installed on floating offshore installations in United States Coast Guard (USCG) and American Bureau of Shipping (ABS) jurisdictions shall comply with 46 CFR 111 and ABS MODU, Publication Number 6 Part 4, respectively.

NOTE—Additional guidance and information for USCG and ABS requirements for the MC switchgear installed on floating facilities in US territorial waters can be found in API Recommended Practice 14F or API Recommended Practice 14FZ.

Add new subclause

7.31 Grounding (earthing) switch

7.31.1 General

If specified, grounding (earthing) switches shall be provided in accordance with the requirements given in 7.31.1.1 through 7.31.1.10.

7.31.1.1

The grounding (earthing) switch shall be permanently installed in the cable compartment and connected to the load side of the individual circuit breaker.

7.31.1.2

The grounding (earthing) switch shall be of three-pole type.

7.31.1.3

The grounding (earthing) switch position shall be visually verifiable without opening the compartment door.

7.31.1.4

A vacuum interrupter or device with equivalent functionality shall not satisfy the grounding (earthing) switch position verification in 7.31.1.3.

7.31.1.5

The grounding (earthing) switch shall be operated manually.

7.31.1.6

The grounding (earthing) switch shall be mechanically interlocked with the circuit breaker in the open and withdrawn positions.

7.31.1.7

In the open position, the grounding (earthing) switch shall have a rated maximum voltage for the line side terminals greater than or equal to the circuit breaker ratings.

7.31.1.8

In the open position, the grounding (earthing) switch shall have a rated insulation level for the line side terminals greater than or equal to the circuit breaker ratings.

7.31.1.9

The grounding (earthing) switch shall have a short-time withstand current rating greater than or equal to that of the circuit breaker for a minimum of 0.1 s.

7.31.1.10

The grounding (earthing) switch shall perform a minimum of 1000 de-energized operations with zero current flow through the circuit.

7.31.2 Grounding (earthing) switches with a fault close rating

If specified, grounding (earthing) switches with a fault close rating shall be provided in accordance with the requirements given in 7.31.1, 7.31.2.1 and 7.31.2.2.

7.31.2.1

The grounding (earthing) switch shall be provided with a short-circuit making current rating.

NOTE—The short-circuit making current rating for the grounding (earthing) switch can be equivalent to or less than the short-circuit making current rating of the associated circuit breaker. This rating is commonly selected based on the potential for stored energy associated with the load (e.g., capacitor bank, power factor correction equipment, long feeder cables, harmonic filters, rotating equipment).

7.31.2.2

The grounding (earthing) switch shall provide a minimum of two closing operations at the short-circuit making current rating.

8. Application guide for MC switchgear

Add to start of clause

The recommendations in this clause shall be considered normative requirements.

8.1 Unusual service conditions

8.1.4 Modification of equipment for unusual environments

8.1.4.1 Exposure to damaging fumes, vapors, steam, salt air, and oil vapors

Add new list subclause f)

f) The equipment shall be protected against deterioration from the specified corrosive gases using compatible coatings or material selection.

Add new list subclause g)

g) Silver-plated copper shall not be used for stationary current-carrying parts when in the presence of the specified corrosive gases.

NOTE—Stationary current-carrying parts do not include sliding contacts (e.g., breaker grounding shoe, primary disconnects). These types of current-carrying parts are silver plated to withstand wear.

8.1.4.6 Exposure to seismic shock

Replace second paragraph with

If seismic requirements are specified, the MC switchgear shall be provided in accordance with ASCE/SEI 7-16.

8.4 Continuous current rating and overload capability

8.4.3 Special continuous current ratings

Delete list subclause b)

8.7 Associated devices often used in MC switchgear

Add new subclause

8.7.2.5

If specified, surge protection devices (i.e., arresters and capacitors) shall be of single-phase station-class type.

Add new NOTE

NOTE—These devices are typically installed in primary service, overhead feeder and large motor feeder applications.

Add new subclause

8.7.2.6

If specified, the surge protection voltage rating of the arrester and capacitor shall be selected based on the system voltage and the grounding method used.

Add new subclause

8.7.2.7

If specified, surge protection connection leads to each phase and ground of the surge devices shall be a minimum length to their respective termination points.

Add new subclause

8.7.2.8

If surge protection is specified, wiring to surge protection devices shall be at least #6 AWG.

Add new subclause

8.7.2.9

If specified, surge arresters shall be in accordance with IEEE Std C62.11.

9. Guide for handling, storage, and installation

Add to start of clause

The recommendations in this clause shall be considered normative requirements.

9.2 Handling

9.2.2 Rigging

Add new subclause

9.2.2.1

Assembly design shall allow the MC switchgear shipping section to be rolled across the floor on pipes without causing the structure to deform or otherwise be damaged.

Add new subclause

9.2.2.2

Shipping sections of stationary structures shall be furnished with removable lifting angles, lugs or plates engineered in accordance with ASME B30.26.

Add new subclause

9.7 Shipping and preservation

9.7.1

Shipping splits comprised of multiple vertical sections shall be furnished with removable lifting angles, lugs or plates engineered for use with crane hooks or slings.

9.7.2

Items shipped separately from the MC switchgear, including removed circuit breakers, shall be clearly identified with the item description and the location of installation.

9.7.3 Shipping identification labels

9.7.3.1

Shipping splits of multiple vertical sections shall be provided with individual identification labels.

9.7.3.2

The identification labels of shipping splits of multiple vertical sections shall display the equipment number of the assembly of which these vertical sections are components.

9.7.3.3

The identification labels of shipping splits shall be visible and use a means of permanent attachment.

9.7.4

Shipping restraints (e.g., blocking, bracing) that require removal before energizing the equipment shall be clearly identified with tags, signs or markings.

9.7.5

Equipment and removable items shall be protected from dust, water, humidity and vibration during shipping and storage.

9.7.6

Instruments, relays, switches and meters installed on the MC switchgear doors shall be protected, blocked and braced to prevent damage during shipment.

9.7.7

Individual shipment packages shall be identified with the purchase order number, job number and equipment number.

9.7.8

Equipment release for shipment shall be approved by the user's identified authority (e.g., third-party inspector).

9.7.9 Space heater operation for storage

The electrical connection point for the space heaters in each shipping section shall be in accordance with the requirements given in 9.7.9.1 through 9.7.9.3.

9.7.9.1

The connection point shall be available without uncrating the equipment.

9.7.9.2

The connection point shall be labeled.

9.7.9.3

The connection point shall indicate the electrical service required.

Annex A

(informative)

Bibliography

Add to first paragraph

The following documents are informatively cited in the text of this document, IEEE Std C37.20.2, the PDS (IOGP S-743D) or the IRS (IOGP S-743L).

Add to annex

[B15] ANSI/IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

[B16] API Specification Q1, *Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry*

[B17] API Specification Q2, *Specification for Quality Management System Requirements for Service Supply Organizations for the Petroleum and Natural Gas Industries*

[B18] IEC 62402, *Obsolescence management*

[B19] IEC 62439-3, *Industrial communication networks – High availability automation networks – Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)*

[B20] IEEE 1584, *IEEE Guide for Performing Arc-Flash Hazard Calculations*

[B21] IOGP S-727, *Supplementary Specification to IEEE Std C37.20.1 Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear*

[B22] IOGP S-742, *Supplementary Specification to UL 347 Standard for Safety for Medium-Voltage AC Contactors, Controllers, and Control Centers*

[B23] ISO 9001, *Quality management systems — Requirements*

[B24] ISO 10005, *Quality management — Guidelines for quality plans*

[B25] ISO/IEC Directives, Part 2, *Principles and rules for the structure and drafting of ISO and IEC documents*

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