International Association of Oil & Gas Producers

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Supplementary Specification to UL 347 for Medium-Voltage AC Contactors, Controllers, and Control Centers

Public Review Draft

JIP33 JOINT INDUSTRY PROGRAMME

Revision history

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1.1	November 2026	Issued for Public Review
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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).

Public Review Draft

Table of contents

Foreword 1
Introduction 4
1 General 6
1.1 Scope 6
1.3 Dependability of materials and parts 6
1.4 Technology readiness and obsolescence 6
2 Normal and Special Service Conditions 7
2.2 Special service conditions 7
3 Terms, Definitions, and Abbreviated Terms 7
3.0 Abbreviated terms 7
3.1 General terms 8
3.4 Switching devices 9
3.202 Index of definitions 9
4 Controller and Control Center Ratings and Characteristics 10
4.4 Rated continuous current and temperature rise 10
4.7 Rated duration of short-circuit (t_k) 11
4.8 Rated supply voltage of operating devices and of auxiliary and control circuits (U_a) 11
4.107 Coordination with medium-voltage fuses 11
4.201 Characteristics of Class E2 controllers 11
5 Design and Construction 12
5.3 Provisions for protective grounding 12
5.4 Auxiliary and control equipment 13
5.10 Markings 13
5.11 Interlocks 15
5.12 Position indication 15
5.14 Spacings 16
5.102 Enclosures 16
5.103 Arc-resistant enclosures 20
5.201 Latched controllers 21
5.202 Power circuit isolating means 22
5.205 Internal wiring 22
5.206 Terminals and connections 24
5.209 Insulating material 26
5.210 Wire-bending space for field-installed conductors 26
5.213 Insulated bus 26
5.214 Controllers – general requirements 27
5.215 Instrument and control power transformers 29

Public Review Draft

5.216 Meters, protection, and control devices 31
5.217 Accessories 35
5.218 Enclosure space heaters 38
5.219 Motor space heaters 39
5.220 Reduced-voltage solid state controllers 40
6 Type Tests 40
6.2 Dielectric tests 40
7 Routine Tests 41
7.1 Power-frequency voltage withstand test on the main circuit 41
7.201 Routine tests – general 41
8 Shipping and Preservation 41
8.1 Shipping splits comprised of multiple vertical sections 41
8.2 Items shipped separately from the MV MCC 42
8.3 Shipping identification labels 42
8.4 Foreign materials requiring removal before energizing the equipment 42
8.5 Electrical connection point for space heaters 42
8.6 Protection against environmental and mechanical conditions 42
8.7 Instruments, relays, switches, and meters installed in MV MCC doors 42
8.8 Shipment identification 42
8.9 Equipment release for shipment 43
Annex A (Normative) — References 44
Bibliography 45

Public Review Draft

Introduction

The purpose of the IOGP S-742 specification documents is to define a minimum common set of requirements for the procurement of medium-voltage AC contactors, controllers, and control centers in accordance with UL 347, seventh edition, published November 2020, revised February 2025, UL Standard for Safety for Medium-Voltage AC Contactors, Controllers, and Control Centers, for application in the petroleum and natural gas industries.

The IOGP S-742 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 Specification

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

IOGP S-742: Supplementary Specification to UL 347 for Medium-Voltage AC Contactors, Controllers, and Control Centers

This specification defines technical requirements for the supply of the equipment and is written as an overlay to UL 347, following the UL 347 clause structure. Clauses from UL 347 not amended by this specification apply as written. Modifications to UL 347 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-742D: Procurement Data Sheet for Medium-Voltage AC Contactors, Controllers, and Control Centers (UL)

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-742L: Information Requirements for Medium-Voltage AC Contactors, Controllers, and Control Centers (UL)

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-742Q: Quality Requirements for Medium-Voltage AC Contactors, Controllers, and Control Centers (UL)

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 UL 347 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) UL 347.

1 General

1.1 Scope

In first sentence, add after "contractor-based controllers"

(NEMA Class E2 only)

Add to clause

This specification defines minimum technical requirements for the purchase (including design features, fabrication quality, inspection, testing, shipment and documentation) of MV MCC equipment.

1.2 Normative references, component standards, and general requirements

1.2.1 General

Add to clause

The documents listed in Annex A are referred to in this specification, the PDS (IOGP S-742D) or the IRS (IOGP S-742L) in such a way that some or all of their content constitutes requirements of these specification documents.

Add new clause

1.3 Dependability of materials and parts

1.3.1

The MV MCC (excluding protection and control devices) shall have a design life of at least 25 years at rated current and under normal service conditions.

1.3.2

The MV MCC shall be capable of operating continuously under normal service conditions for at least five years without requiring de-energization of the complete assembly or lineup.

1.3.3

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

Add new clause

1.4 Technology readiness and obsolescence

1.4.1

The MV MCC, excluding electronic devices, shall be supported for at least 25 years after delivery.

1.4.2

An obsolescence management plan shall be available from the manufacturer for all MV MCC components excluding devices that are required by the purchaser and not part of the manufacturer's standard offering.

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

Public Review Draft

1.4.3

Proposals shall indicate whether the MV MCC or any sub-component (individually denoted) has less than three years of proven operational service excluding devices that are required by the purchaser and not part of the manufacturer's standard offering.

2 Normal and Special Service Conditions

2.2 Special service conditions

Add new clause

2.2.4

If seismic requirements are specified, the MV MCC shall be designed in accordance with the requirements of ASCE/SEI 7-16.

Add new clause

2.2.5

If service conditions with environmental contamination are specified, the equipment shall be provided as detailed in Clauses 2.2.5.1 and 2.2.5.2.

2.2.5.1

The equipment shall be protected against deterioration from corrosive gases by the use of compatible coatings and material selection.

2.2.5.2

Silver-plated copper shall not be used for current-carrying parts when the presence of corrosive gases is identified.

Add new clause

2.2.6

If specified, MV MCC assemblies to be 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 MV MCC installed on floating facilities in US territorial waters can be found in API RP 14F and API RP 14FZ.

Replace Clause 3 title with

3 Terms, Definitions, and Abbreviated Terms

For the purposes of this document, the terms, definitions and acronyms given in UL 347 and this clause apply.

Add new clause 3.0 before clause 3.1

3.0 Abbreviated terms

ACO accredited certification organization

CBM condition-based monitoring

CT current transformer

FLC full load current

HMI human machine interface

IED intelligent electronic device

LED light-emitting diode

LV low voltage

MV medium voltage

MCC motor control center

NRTL nationally recognized testing laboratory

VT voltage transformer

3.1 General terms

Add new term

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

Add new term

3.1.226 **arc-resistant accessibility Type 2B**: An equipment with arc-resistant designs or features at the freely accessible exterior (front, back and sides) of the equipment only, including the additional requirements of IEEE Std C37.20.7.

NOTE: The equipment is arc-resistant even with the instrument or control compartment doors open.

Add new term

3.1.227 **arc-resistant equipment**: An equipment designed to withstand the effects of an internal arcing fault, as indicated by successfully meeting the test requirements of IEEE Std C37.20.7.

Add new term

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

Add new term

3.1.229 **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 per ANSI/IEC 60529, but most products are not tested to a particular IP rating.

Add new term

3.1.230 **manufacturer**: An organization manufacturing, assembling and/or supplying the equipment or services, and/or contractor on the project.

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

3.4 Switching devices

Replace term 3.4.104 with

3.4.104 **grounding (earthing) switch**:

Replace "[Vacant]" with definition

A permanently installed mechanical three-pole open-air switching device used to connect the load side of a de-energized MV controller power circuit to ground (earth) for maintenance purposes.

NOTE: Vacuum or any other sealed-type switching devices are not suitable to be used as grounding switches.

3.202 Index of definitions

A

Add after "arcing time (of a pole or a fuse)"

arc-resistant accessibility Type 2	3.1.225
arc-resistant accessibility Type 2B	3.1.226
arc-resistant equipment	3.1.227

G

Add after "grounding kit"

grounding (earthing) switch	3.4.104

I

Add after "interlock (interlocking device)"

internal arcing fault	3.1.228

Public Review Draft

M

Add after "making capacity (of a switching device)"

manufacturer 3.1.230

T

Add after "transient recovery voltage (TRV)"

touch-safe 3.1.229

4 Controller and Control Center Ratings and Characteristics

4.4 Rated continuous current and temperature rise

Add new clause

4.4.202 Bus bar requirements

4.4.202.1

All extendable (main) bus and non-extendable (vertical) bus shall be plated with the same plating material (tin-plated or silver-plated).

4.4.202.2

All bolted power bus connections shall be secured with corrosion-resistant steel hardware, including bolts, locking washers, and nuts or pressed threaded inserts.

4.4.202.3

Extendable buses shall be pre-drilled for connection of future sections on each end without the need for additional bus supports or bracing.

4.4.202.4

A removable cover shall be provided on each end of the assembly for access to the predrilled extendable bus bars.

4.4.202.5

Tapered bus design for the extendable (main) bus or non-extendable (vertical) bus shall not be used.

4.4.202.6

Extendable (main) and non-extendable (vertical) current-carrying bus bars shall be tin-plated copper or silver-plated copper as specified.

Public Review Draft

4.4.202.7

The fastening means for power bus splices or connections shall employ provisions to negate the effect of temperature cycling and bus material cold flow or creep.

4.7 Rated duration of short-circuit (t_k)

4.7.2 Rated duration of short-circuit for extendable power bus

Add to clause

For close-coupled applications without a protective device or scheme between the MV switchgear main bus and the MV MCC extendable bus, the rated duration of short-circuit (t_k) for extendable power bus for the MV MCC assembly shall meet the short-time short-circuit duration of the MV switchgear main bus.

NOTE 1: The default value for the rated duration of short-circuit (t_k) for MV switchgear main bus is 2 seconds.

NOTE 2: MV MCCs close coupled to an MV switchgear whose sole purpose is to feed the MV MCC are excluded.

4.8 Rated supply voltage of operating devices and of auxiliary and control circuits (U_a)

Add new clause

4.8.4

Contactors shall be capable of remaining closed during a system voltage sag or dip down to 65 % of the nominal voltage.

4.107 Coordination with medium-voltage fuses

Replace second paragraph with

The MV fuses shall be located on the supply side of the controller.

The MV fuses shall have a short-circuit breaking capacity greater than the available current (symmetrical) under short-circuit conditions at their location.

4.201 Characteristics of Class E2 controllers

4.201.2

Add to clause

Power circuit fuses for motor protection shall be of the current-limiting type (Type R) designed for motor starting applications.

Public Review Draft

5 Design and Construction

5.3 Provisions for protective grounding

5.3.203 Ground bus

Add to clause

5.3.203.1

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

5.3.203.2

The ground bus shall be drilled at each end for a NEMA two-hole lug for field connections.

5.3.203.3

Removable cover plate(s) attached with bolts or screws shall be provided to allow connection of the ground bus to future sections.

5.3.203.4

Ground bus joints shall be through-bolted, i.e., hex nut, pressed threaded insert.

5.3.203.5

The ground bus shall be 6.35 mm (1/4 in) by 50.8 mm (2 in) minimum in size.

5.3.203.6

The ground bus shall be made of plated copper.

NOTE: Tin or silver plating is acceptable.

5.3.203.7

The horizontal ground bus shall be uniform and continuous across the entire length of the MCC.

5.3.203.8

The horizontal ground bus shall extend to the incoming line section and be supplied with the specified quantity and size NEMA 2-hole compression-type lugs.

5.3.203.9

The ground bus shall include provisions to connect a portable safety grounding clamp device in each controller compartment.

5.3.203.10

The ground bus shall be pre-drilled to accommodate the connection of the shield wire from the field cable termination in each controller compartment.

Public Review Draft

5.3.203.11

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

5.3.206 Grounding of instrument and control circuits

Add new clause

5.3.206.1

The CT short-circuiting terminal block shall be connected to the ground bus via one direct connection without intermediate terminations or splices.

Add new clause

5.3.206.2

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

Add new clause

5.3.206.3

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

Add new clause

5.3.209

Hinged doors and panels with powered devices shall be bonded to the enclosure with a flexible copper conductor connected between hinged doors or panels and the MV MCC ground bar or metallic structure.

5.4 Auxiliary and control equipment

Add new clause

5.4.1

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

5.10 Markings

5.10.203 Additional markings for control centers

Add new clause

5.10.203.1

The MV MCC shall be listed or certified by an NRTL for the United States or ACO for Canada.

NOTE: Applications for this equipment in other countries may have additional requirements for certification.

Public Review Draft

Add new clause

5.10.203.2

An overall assembly nameplate shall be mounted on the MV MCC main incoming unit with the following information:

a) purchase order number;

b) MV MCC designation (tag number);

c) month and year of manufacture.

Add new clause

5.10.203.3

MV MCC individual controller rear doors or covers shall be provided with externally mounted nameplates to identify the equipment tag number.

Add new clause

5.10.203.4

Each controller shall have a nameplate on the front door with the following information:

a) equipment tag number;

b) equipment name;

c) equipment HP rating, kW/kVA rating or FLC.

Add new clause

5.10.203.5

Separate nameplates shall be provided to identify door-mounted items such as meters, switches, indication lights and other devices.

Add new clause

5.10.203.6

Separate device markers/labels shall be provided to identify each component (e.g. terminals, relays, switches, wiring and other devices) within each unit in accordance with project drawings/diagrams.

Add new clause

5.10.203.7

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

Public Review Draft

Add new clause

5.10.203.8

Nameplates on the exterior of the controller compartment shall be mounted with stainless steel fasteners.

Add new clause

5.10.203.9

Controller compartment nameplates shall be at least 25.4 mm (1 in) wide by 63.5 mm (2.5 in) long.

Add new clause

5.10.203.10

Controller compartment nameplate characters shall be at least 4.8 mm (0.1875 in) high.

Add new clause

5.10.203.11

If a key-type interlock system is utilized, nameplates containing operational instructions shall be affixed on the front of the MV MCC near the point of operation.

Add new clause

5.10.203.12

Interior warning labels and device nameplates shall be located such that they are not obscured by wiring or other components.

5.11 Interlocks

5.11.201 Isolating means interlocks

In first sentence, add after "mechanical"

and electrical

Add to second sentence

for the mechanical interlock

5.12 Position indication

5.12.201 Isolating means – position indication

Replace first sentence of second paragraph with

The isolation gap or a mechanically operated indicator shall be visible without opening the MV compartment door of the controller (e.g., through a viewing pane).

Public Review Draft

5.14 Spacings

5.14.201 General

Add to first paragraph

If the MV MCC is operating at a nominal voltage greater than 5 kV, the routing of controller internal unshielded power cabling shall include mitigations to prevent partial discharge between the phase conductors and ground.

NOTE: Mitigations may include ensuring a minimum air gap or the use of additional insulating materials.

5.102 Enclosures

5.102.202 General Requirements

Add new clause

5.102.202.1

MV MCC assembly shall consist of steel structures as detailed in Clauses 5.102.202.1.1 through 5.102.202.1.3.

5.102.202.1.1

The MV MCC shall be metal-enclosed.

5.102.202.1.2

The MV MCC shall be comprised of free-standing vertical sections.

5.102.202.1.3

The MV MCC assembly shall be dead front to allow safe operation of the units.

Add new clause

5.102.202.2

Each controller shall be in a separate compartment.

Add new clause

5.102.202.3

Motor controllers shall have dedicated LV control compartments as detailed in Clauses 5.102.202.3.1 through 5.102.202.3.4.

5.102.202.3.1

LV compartments shall have separate doors.

5.102.202.3.2

LV compartments shall be externally accessible.

Public Review Draft

5.102.202.3.3

LV compartments shall not contain MV components.

5.102.202.3.4

LV compartments shall contain all control and protection components.

Add new clause

5.102.202.4

Enclosures shall allow for mounting pad level variation of +/-3.175 mm ($^1/_8$ in) within 900 mm (3 ft) without affecting alignment or operation of removable elements, doors or mechanical interlocks.

Add new clause

5.102.202.5

Controllers shall be furnished at a maximum of two-high per vertical section.

Add new clause

5.102.202.6

Hinged doors that are located on the front of the assembly and exceed a height of 1 143 mm (45 in) or a width of 610 mm (24 in) shall be provided with door keepers or positioners.

Add new clause

5.102.202.7

Two-high vertical sections shall be provided with barriers to separate wiring between the controllers as detailed in Clauses 5.102.202.7.1 and 5.102.202.7.2.

5.102.202.7.1

Each vertical section shall have dedicated and enclosed raceways for outgoing power cables.

5.102.202.7.2

Two-high vertical sections shall have separate raceways or compartmentalization for load and field control cables for each controller.

Add new clause

5.102.202.8

If specified, cable terminations for the incoming section shall be provided as detailed in Clauses 5.102.202.8.1 through 5.102.202.8.5.

5.102.202.8.1

Cable terminations shall be provided with supports for the incoming cables to prevent mechanical stress on the busbars.

Public Review Draft

5.102.202.8.2

Cable terminations shall be provided with NEMA two-hole pattern at the cable termination point.

5.102.202.8.3

Cable terminations shall be provided with space to accommodate shielded cable terminations and formed insulating boots.

5.102.202.8.4

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

5.102.202.8.5

Grounding ball studs shall meet the requirements of ASTM F855.

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

Add new clause

5.102.202.9

If bus duct or cable bus is specified for the incoming connection, the components required for the MV MCC to accept the bus duct or cable bus shall be provided.

NOTE: Required components include, but are not limited to, interface flange, bus extensions, supports, hardware, gaskets.

Add new clause

5.102.202.10

Controllers shall have sufficient space for the separation of MV feeder and LV field control cables.

Add new clause

5.102.202.11

An enclosed continuous horizontal metal wireway for control and communications wiring shall be provided in each section along the entire MV MCC.

Add new clause

5.102.202.12

Barriers shall be provided to separate the extendable power bus from other compartments.

Public Review Draft

5.102.203 Control centers

Add new clause

5.102.203.1

The MV MCC shall be designed to allow the safe installation of additional controllers, i.e., contactor, control and auxiliary cabling, into a factory-prepared space for future controller(s) (see Clause 5.212.3) while the MV MCC is energized and in operation.

Add new clause

5.102.203.2

The MV MCC shall be extendable on at least one end.

5.102.209 Barriers

Add to clause

With the isolating switch open, any MV parts within the controller compartment that remain energized shall be protected from incidental contact as determined by the rod entry test in Clause 6.207.

5.102.210 Outdoor enclosure considerations

Add new clause

5.102.210.1

Outdoor MV MCC exterior door gaskets shall be held in metal retainers, channels, or other means to prevent the gasket from being misaligned or dislodged during operation.

Add new clause

5.102.210.2

Roofs of outdoor MV MCCs shall be sloped to permit drainage away from the front of the assembly.

Add new clause

5.102.210.3

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

Add new clause

5.102.210.4

Bolted and gasketed external joints of outdoor MV MCCs shall be covered with a metal cap to prevent the entry of dust, rain and snow.

Public Review Draft

Add new clause

5.102.210.5

An outdoor MV MCC assembly of three or fewer vertical sections shall have at least one 120-volt GFCI-protected receptacle located inside an exterior door.

Add new clause

5.102.210.6

An outdoor assembly 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 clause

5.102.210.7

In an outdoor assembly of four or more vertical sections, the distance between the 120-volt GFCI-protected receptacles shall be no more than 7.5 m (25 ft).

Add new clause

5.102.210.8

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

Add new clause

5.102.210.9

For outdoor MV MCC applications, handles, latches, hinges and fastening hardware shall be made of corrosion-resistant material.

Add new clause

5.103 Arc-resistant enclosures

5.103.1

Arc-resistant enclosures shall be tested in accordance with the requirements of IEEE Std C37.20.7-2017, for not less than 0.5 second.

5.103.2

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

5.103.3

The manufacturer shall identify the methodology defined in IEEE Std C37.20.7-2017 that is utilized to achieve the arc resistance certification of the MCC (full withstand capability without protective device, self-extinguishing, current-limiting fuses or duration-limiting device).

5.103.4

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

5.103.5

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

5.103.6

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

5.103.7

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

5.103.8

Minimum room dimension requirements and other guidelines (e.g., for arc vents, plenum or arc duct) required for the performance of the MV MCC arc-resistant features shall be provided to ensure the building integrity and personnel safety.

5.103.9

Front doors (main and instrument compartments) of the MV MCC shall be secured with latches, i.e., cam or twist-type with less than one rotational turn.

NOTE: The use of tie-down bolts to secure front doors will not meet this requirement.

5.103.10

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

5.103.11

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

5.103.12

The arc-resistant design shall have provisions for the future expansion of the MV MCC.

5.201 Latched controllers

5.201.3 Stored-energy electrical release

Replace clause with

An electrical release provided on latched controllers shall be powered from an external control power supply.

5.202 Power circuit isolating means

5.202.3 Operation of isolating means

Add new list item d)

d) isolated from the line connectors with a mechanically-driven isolating shutter, leaving no exposure to medium voltage.

Add new clause

5.202.7

Isolating switches shall be constructed to ground the load side of the switch in the open position.

5.205 Internal wiring

5.205.1 Conductors

5.205.1.1

Replace second sentence with

Conductors shall have a temperature rating no less than 90 °C (194 °F) unless shown suitable with corresponding temperature rise test data.

Add new clause

5.205.1.4

Flame-retardant, 600 V insulated stranded tinned copper wire shall be used for internal control wiring between components of MV MCC assemblies and terminals for connection to external controls, metering or instrumentation.

NOTE: Preferred wire is type SIS as listed in NFPA 70 (NEC) or an equivalent such as XHHW, RFHH-2, RFHH-3.

Add new clause

5.205.1.5

Minimum conductor sizes shall be as detailed in Clauses 5.205.1.5.1 through 5.205.1.5.3.

5.205.1.5.1

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

5.205.1.5.2

Minimum conductor sizes for control wiring shall be No. 14 AWG.

5.205.1.5.3

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

Public Review Draft

Add new clause

5.205.1.6

Wiring that crosses a door or panel hinge shall be provided as detailed in Clauses 5.205.1.6.1 through 5.205.1.6.7.

5.205.1.6.1

Wiring shall be stranded single conductor.

5.205.1.6.2

Wiring shall withstand repeated door movement without sustaining damage to wire strands or insulation.

5.205.1.6.3

A strain relieving loop shall be formed across the hinge and secured to the equipment at both ends.

5.205.1.6.4

The wiring installation shall not prevent the door from opening less than 90 degrees.

5.205.1.6.5

The wire loop shall be protected between the securements to prevent damages to the wire insulation as the door is moved.

5.205.1.6.6

No sharp edges or objects shall be allowed in the path swept by the wire loop as the door is operated.

5.205.1.6.7

If the wire is No. 14 AWG or larger, the wire shall be no less flexible than Class C or D stranding.

Add new clause

5.205.1.7

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

Add new clause

5.205.1.8

If MV MCC data communication is specified, the cabling and connection to the devices intended to be monitored and controlled shall be provided as detailed in Clauses 5.205.1.8.1 through 5.205.1.8.3.

5.205.1.8.1

Data communication cabling and connection shall be compatible with the specified communication protocol or combination of protocols.

Public Review Draft

5.205.1.8.2

Data communication cabling and connection shall have a mechanical means (e.g., screw-type connectors, RJ-45 connector) to prevent unintended separation of the communication network cable connections.

5.205.1.8.3

Data communication cabling shall be shielded type to minimize interference from electromagnetic interference or radio frequency interference within the MV MCC assembly.

5.205.2 Support for internal wiring

Add to clause

Adhesive-type supports shall not be permitted.

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

5.206 Terminals and connections

5.206.2 Wiring terminals

5.206.2.2

Replace clause (including list items) with

Terminal points for field connection of MV incoming and outgoing conductors shall consist of bus bars provided with a NEMA two-hole pattern as a minimum.

Add new clause

5.206.4 Internal Wiring

5.206.4.1

Exposed energized terminals of LV components (e.g., relays, terminal blocks, fuse holders) having a line to ground voltage of greater than 50 V shall be provided as touch-safe or covered by an insulating barrier to prevent incidental contact.

5.206.4.2

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

5.206.4.3

Control wiring shall be terminated using insulated compression lugs on screw-type terminals.

NOTE: Spade, fork, ring, or bootlace lugs are the typical lug types used for the terminals and connectors on the components.

5.206.4.4

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.

5.206.4.5

DC control power circuits leaving the MV MCC for any external location (e.g., motor start/stop circuits) shall be individually fused.

5.206.4.6

Terminal blocks shall be provided for all external connections to the MV MCC.

5.206.4.7

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

5.206.4.8

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

5.206.4.9

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

5.206.4.10

Individual controllers shall be provided with a minimum of 10 % spare control terminal blocks.

Add new clause

5.206.5 Wire markers

5.206.5.1

Internal wire terminations shall be marked with heat shrink-type wire markers or permanently marked such that the markings are visible at the termination point without disassembling the cable bundle.

5.206.5.2

Adhesive-type wire markers and labels shall not be used.

5.206.5.3

Internal wire terminations shall have a unique designation as assigned on the approved schematic and wiring diagrams.

5.206.5.4

Internal wire terminations shall have the assigned designation at both ends.

5.206.5.5

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

Public Review Draft

5.209 Insulating material

Replace first sentence with

Material for the support of an uninsulated live part shall be porcelain, cycloaliphatic epoxy, glass polyester or other material found acceptable for the support of an uninsulated live part.

NOTE: The use of porcelain or cycloaliphatic epoxy is generally recommended for higher voltages.

5.210 Wire-bending space for field-installed conductors

Add new clause

5.210.1

The field cable termination area shall be sized to provide the necessary space for the following:

a) cable support and securement;

b) conductor separation;

c) cable and conductor bending;

d) conductor termination, including stress-cones.

Add new clause

5.210.2

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

Delete "optional" from clause 5.213 title

5.213 Insulated bus

5.213.1 General

Replace first sentence with

A system for insulating the bus bars and bus joints shall be supplied.

5.213.2 Insulated bus requirements

Replace clause with

The MV MCC shall be provided with fully insulated bus as detailed in Clauses 5.213.2.1 through 5.213.2.8.

5.213.2.1

Extendable (main) and non-extendable (vertical) bus bars and bus connections shall be insulated.

5.213.2.2

The bus bar insulating material shall have high dielectric properties, be non-hygroscopic, flame retardant and track resistant.

Public Review Draft

5.213.2.3

MV MCC assembly bus joints shall be covered with formed insulating boots.

NOTE: The taping of bolted joints does not meet this requirement.

5.213.2.4

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

5.213.2.5

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

5.213.2.6

A representative sample of each insulated bus bar size, insulation type and voltage rating shall withstand, without breakdown, the test for bus bar insulation described in Clause 6.2.202.5.

5.213.2.7

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

5.213.2.8

The incoming supply connections (e.g., cable or bus) shall be covered with formed insulating boots.

5.214 Controllers – general requirements

Add new clause

5.214.1

Drawout-type contactors shall be provided with a separate stationary isolation means.

Add new clause

5.214.2

Contactors shall be vacuum interrupter-type.

Add new clause

5.214.3

Controllers that have multiple contactors (e.g., multi-speed or reversing applications) shall have a common isolation switch and fuses.

Add new clause

5.214.4

Vacuum contactor interrupters shall be provided with visible wear indicators or wear gauge accessories.

Public Review Draft

Add new clause

5.214.5

Contactors shall be electrically held for motor starters.

Add new clause

5.214.6

Contactors shall be electrically operated and mechanically latched for transformer feeder units.

Add new clause

5.214.7

Contactors of the same type and ratings shall be interchangeable.

Add new clause

5.214.8

Contactor shall be accessible without the need for removal of additional barriers or covers.

Add new clause

5.214.9

Each controller within a vertical section shall be segregated into three electrically and physically isolated areas, i.e., power bus compartment, the MV component compartment (e.g., isolation switch, power fuses, contactor), and the LV control compartment.

Add new clause

5.214.10

Separate hinged doors shall be provided for the MV and LV compartments within the controller assembly.

Add new clause

5.214.11

In addition to contacts required for design of control logic and indication, each controller shall be provided with the specified number of normally open and normally closed auxiliary contacts wired to terminal blocks.

Add new clause

5.214.12

Contactors shall have separate close and hold coils, or a single coil design with reduced hold-in voltage applied (e.g., economizer circuit).

Public Review Draft

Add new clause

5.214.13

If individual CPTs are provided for the control power source, provisions for testing the controller shall be provided as detailed in Clauses 5.214.13.1 through 5.214.13.5.

5.214.13.1

The circuit for testing the controller shall be provided with a male receptacle or an external power source for the test supply.

5.214.13.2

The circuit for testing the controller shall be located in the LV compartment of the controller.

5.214.13.3

The circuit for testing the controller shall be provided with a three-position selector switch to switch between normal CPT supply, “off” position, and test supply.

5.214.13.4

The testing circuit for the controller shall be provided with an interlocking means to prevent the test supply source from back feeding the main bus via the CPT.

5.214.13.5

The testing circuit for the controller shall be provided with an interlock to prevent the normal control power from feeding into the test power source when in NORMAL mode.

Add new clause

5.214.14

Looping or multi-turns of wiring through CTs shall not be permitted.

Add new clause

5.214.15

The controller shall be supplied with a means to detect a blown fuse (single phase condition) that causes the contactor trip.

NOTE: This requirement may be satisfied by the protective relay on the controller.

Add new clause

5.215 Instrument and control power transformers

5.215.1 Voltage transformers

5.215.1.1

Inductive VTs shall be in accordance with IEEE Std C57.13.

NOTE: This requirement does not preclude the use of other voltage sensing technologies.

5.215.1.2

Secondary voltage shall be 120 V with primary voltage indicated on the one-line diagram.

5.215.1.3

VTs for metering or protective relaying purposes shall be protected by current-limiting primary fuses.

5.215.1.4

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

5.215.1.5

The VT BIL rating shall be the same as the MV MCC assembly.

5.215.1.6

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

5.215.1.7

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

5.215.2 Control power transformers

5.215.2.1

The kVA rating of the CPT shall be sized to include the controller loads in addition to the external loads indicated on the project drawings.

5.215.2.2

The kVA rating of the CPT shall include at least 15 % additional capacity.

5.215.2.3

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

5.215.2.4

Secondary voltage shall be 120 V.

5.215.2.5

The primary fuses for the CPT shall coordinate with the secondary protection of the transformer.

5.215.2.6

CPTs shall be protected by current-limiting primary fuses.

Public Review Draft

5.215.3 Current transformers

5.215.3.1

Inductive CTs for metering or protective relaying purposes shall be in accordance IEEE Std C57.13.

NOTE: This requirement does not preclude the use of the other current sensing technologies.

5.215.3.2

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

5.215.3.3

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

5.215.3.4

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

5.215.3.5

Window type 600 V class CTs shall not be used to monitor field installed MV conductors.

Add new clause

5.216 Meters, protection, and control devices

5.216.1 Metering

5.216.1.1

If metering is indicated on the one-line or project drawings, microprocessor-based multifunction meters shall be provided as detailed in Clauses 5.216.1.1.1 through 5.216.1.1.5.

5.216.1.1.1

Microprocessor-based multifunction meters shall be provided with digital communication capability.

5.216.1.1.2

Microprocessor-based multifunction meters shall have 0.5 % accuracy or better.

5.216.1.1.3

Microprocessor-based multifunction meters shall display current and voltage for each phase.

5.216.1.1.4

Microprocessor-based multifunction meters shall display kW, kVARS and power factor.

5.216.1.1.5

Microprocessor-based multifunction meters shall display harmonic order measurements.

Public Review Draft

5.216.1.2

If specified, analog-type metering shall be provided as detailed in Clauses 5.216.1.2.1 through 5.216.1.2.4.

5.216.1.2.1

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

5.216.1.2.2

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

5.216.1.2.3

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

5.216.1.2.4

Analog-type metering shall be flush mounted.

5.216.1.3

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

5.216.1.4

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

5.216.1.5

Instruments and meters shall have 5 A current and/or 150 V potential coils for operation with instrument transformers.

5.216.1.6

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

5.216.2 Protective relays

5.216.2.1

If protective relays are indicated on the one-line or project drawings, they shall be provided as detailed in Clauses 5.216.2.1.1 through 5.216.2.1.7.

5.216.2.1.1

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

5.216.2.1.2

Protective relays shall be multifunctional microprocessor based.

Public Review Draft

5.216.2.1.3

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

5.216.2.1.4

Protective relays shall provide indication for each type of fault.

5.216.2.1.5

Protective relays shall have digital communication capability.

5.216.2.1.6

Diagnostic information shall include device status, warning status, time to reset, trip status, time to overload trip and historical event recording.

5.216.2.1.7

A minimum of two digital inputs and two digital outputs shall be provided.

5.216.2.2

If specified, test switches shall be provided as detailed in Clauses 5.216.2.2.1 through 5.216.2.2.5.

5.216.2.2.1

Test switch shall be installed on the controller or associated instrument compartment door.

5.216.2.2.2

If specified, test switch shall allow for isolation of protective relay equipment inputs and outputs.

5.216.2.2.3

Test switches shall be FT-type or equivalent.

5.216.2.2.4

Test switches shall be wired to provide three-phase bus potential and three-phase line current.

5.216.2.2.5

If specified, test switches shall be wired in series with protective relay trip output contacts.

5.216.2.3

If motor protection relays are indicated on the one-line or project drawings, they shall include the following functions:

a) percentage of motor FLC;

b) percent thermal capacity utilized;

c) motor bearing temperature;

d) running time (cumulative) in hours;

e) operation count;

f) number of remaining starts;

g) motor start lockout;

h) protective functions including thermal overload, underload, locked rotor, current imbalance, stall, phase loss and zero sequence ground fault;

i) under-voltage ride-through and/or auto-restart functionality for the equipment as shown on the single line diagram;

j) motor stator winding temperature.

5.216.2.4

A separate dedicated set of fuses or circuit breakers shall be provided for each power supply that is utilized for protection, control or monitoring devices in each controller.

5.216.2.5

If door-mounted lockout relays (device 86) are supplied, they shall be provided as detailed in Clauses 5.216.2.5.1 through 5.216.2.5.4.

5.216.2.5.1

Lockout relays shall have a manual reset-type handle.

5.216.2.5.2

Lockout relays shall operate in less than one cycle.

5.216.2.5.3

Lockout relays shall have two positions, "Reset" and "Tripped".

5.216.2.5.4

The coil "health" of lockout relays shall be monitored with a white indicating light.

5.216.3 Indication and control devices

5.216.3.1

If status indicator lights are specified, they shall be in accordance with the requirements given in Clauses 5.216.3.1.1 through 5.216.3.1.4.

5.216.3.1.1

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

5.216.3.1.2

Indicating light colors shall be red (contactor closed), green (contactor opened) and amber (tripped).

Public Review Draft

5.216.3.1.3

Indicating lights shall be LED-type with a minimum of 100 000 hours illumination life.

5.216.3.1.4

Replacement of indicator lights shall not result in contactor operation.

5.216.3.2

Door mounted devices (e.g., push buttons, selector switches) shall have a heavy-duty rating as defined in NEMA ICS 5.

5.216.3.3

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

5.216.3.4

If specified, an emergency stop button (E-stop) function shall be provided for all controllers as detailed in Clauses 5.216.3.4.1 through 5.216.3.4.4.

5.216.3.4.1

The color of the emergency stop button shall be red.

5.216.3.4.2

The emergency stop button shall be mushroom-head type.

5.216.3.4.3

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

5.216.3.4.4

The emergency stop button shall be provided with protective guard.

5.216.3.5

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

Add new clause

5.217 Accessories

5.217.1

If specified, a remote handheld control station shall be provided to operate the individual controllers in the MV MCC assembly as detailed in Clauses 5.217.1.1 through 5.217.1.5.

Public Review Draft

5.217.1.1

The control station shall allow for the operation of all controller types and sizes provided in the assembly.

5.217.1.2

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

5.217.1.3

The control station shall provide status of the contactor (open or closed).

5.217.1.4

The control station shall only operate the controller with the door closed.

5.217.1.5

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

5.217.2

If specified, vertical section doors and panels shall include NRTL or ACO approved thermal scanning inspection windows for infrared scanning of the equipment without opening the equipment doors or removing covers.

NOTE: Thermal scanning windows provided in arc-resistant MV MCC should be included in the type testing program for the qualification of the arc-resistant MV MCC.

5.217.3

If applicable, a MV fuse puller shall be provided for each single controller type.

5.217.4

One set of spare MV fuses shall be provided for each size and type of fuse used.

NOTE: This requirement includes main unit fuses, CPT fuses, and fuses for VTs.

5.217.5

One set of special tools required for the installation and maintenance of the equipment supplied shall be provided.

5.217.6 Condition-based monitoring

5.217.6.1

If specified, continuous thermal monitoring shall be as detailed in Clauses 5.217.6.1.1 through 5.217.6.1.3.

5.217.6.1.1

The continuous thermal monitoring system shall be factory integrated.

5.217.6.1.2

Thermal monitoring shall include hotspot detection sensors for areas of concern (e.g., cable connections, fuse clips, stab connections and shipping split connections).

5.217.6.1.3

Continuous thermal monitoring systems shall include communications to convey temperature data, status and alarming for each monitored point.

5.217.6.2

If specified, a local motor condition monitoring system (manual data collection) shall be provided as detailed in Clauses 5.217.6.2.1 through 5.217.6.2.3.

5.217.6.2.1

The local motor condition monitoring system shall be equipped with factory-integrated components.

5.217.6.2.2

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

5.217.6.2.3

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

5.217.6.3

If specified, continuous motor condition monitoring system shall be as detailed in Clauses 5.217.6.3.1 through 5.217.6.3.4.

5.217.6.3.1

The continuous motor condition monitoring system shall be factory integrated.

5.217.6.3.2

The system shall be capable of continuous monitoring and sensing.

5.217.6.3.3

The system shall include communications to convey status and alarming for each monitored point.

5.217.6.3.4

The 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.

5.217.6.4

If specified, continuous partial discharge monitoring equipment shall be provided as detailed in Clauses 5.217.6.4.1 through 5.217.6.4.3.

Public Review Draft

5.217.6.4.1

The continuous partial discharge monitoring system shall be factory integrated.

5.217.6.4.2

Partial discharge systems shall be capable of continuous sensing and monitoring of motor characteristics.

5.217.6.4.3

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

5.217.7

Two-high assemblies shall be provided with a lifting device.

Add new clause

5.218 Enclosure space heaters

5.218.1

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

5.218.2

Enclosure space heaters shall be guarded by an expanded metal cage around the heaters to prevent burns due to incidental contact.

5.218.3

Enclosure space heaters shall be operated at 120 Vac.

5.218.4

Enclosure space heaters shall be sized to provide a 5 K rise over ambient temperature to prevent condensation.

5.218.5

Each enclosure space heater circuit shall be protected by a circuit breaker or fuse that also functions as a disconnect device with lockout provisions.

5.218.6

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

5.218.7

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

Public Review Draft

5.218.8

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

5.218.9 Enclosure space heater thermostat control

If enclosure space heater automatic control is specified, a control unit shall be provided as detailed in Clauses 5.218.9.1 and 5.218.9.2.

5.218.9.1

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

5.218.9.2

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

Add new clause

5.219 Motor space heaters

5.219.1

The controllers identified for motor applications on the project drawings shall be provided with a normally closed "M" contact wired in series with an external power source such that the motor space heater is energized when the contactor is open.

5.219.2

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

5.219.3

Motor space heater circuits shall have a fused disconnect or circuit breaker that is lockable and located within the respective controller LV compartment.

5.219.4

If specified, the motor space heater circuit shall be supplied with an ammeter with an appropriately sized scale.

5.219.5

The external power supply for the motor space heaters shall not be switched off with the MV controller isolation switch.

5.219.6

If specified, a pushbutton shall be provided to test the motor space heater and ammeter circuit.

Add new clause

5.220 Reduced-voltage solid state controllers

5.220.1

Solid state controllers shall be supplied with the following:

a) bypass vacuum contactor;

b) microprocessor-based control module.

NOTE: This requirement is in addition to the controller requirements identified in previous clauses.

5.220.2

Silicon controlled rectifiers shall be provided with the following:

a) voltage transient protection;

b) overvoltage protection;

c) optical isolation between the power section and the control section.

5.220.3

The solid state voltage controller shall provide at least the following starting functions:

a) voltage ramp;

b) current limit;

c) across-the-line.

5.220.4

A separate protection relay shall be provided in accordance with Clause 5.216.2 to protect the controller.

6 Type Tests

6.2 Dielectric tests

6.2.201 Impulse withstand tests

6.2.201.3 Impulse voltage withstand test sequence

Replace second sentence with

Control, CT secondary and auxiliary circuits shall be grounded in these tests.

Add after second sentence

The MV motor circuit fuses (class E2 controllers) and control circuit fuses shall be in place during these tests:

Public Review Draft

7 Routine Tests

Add to clause

The MV MCC shall be electrically and mechanically assembled into a single line-up prior to testing and inspection.

7.1 Power-frequency voltage withstand test on the main circuit

Delete third paragraph

Add to clause

If grounding ball studs are specified, they shall be installed at their designated termination points prior to the dielectric tests.

7.201 Routine tests – general

Add to clause

Functional testing of the completed MV MCC assembly shall include the following:

a) operation of all controllers and associated isolation switches;

b) operation of switching devices;

c) electrical and mechanical interlocks;

d) control devices that are either hard wired or communicating over a network and, if applicable, local HMI;

e) VTs or sensors;

f) controller protective relays and metering devices;

g) indicator lights;

h) non-stationary contactor mechanical insertions and removals;

i) vertical section space heaters and thermostat if applicable;

j) condition monitoring equipment or systems if applicable;

k) auxiliary equipment provided as part of the system design (e.g., interposing relay panel, mimic panel);

l) fuse removal and replacement facilities.

Add new clause

8 Shipping and Preservation

8.1 Shipping splits comprised of multiple vertical sections

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.

Public Review Draft

8.2 Items shipped separately from the MV MCC

Items shipped separately from the MV MCC, including removed contactors, shall be clearly identified with the item description and the location of installation.

8.3 Shipping identification labels

8.3.1

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

8.3.2

Identification labels of shipping splits of multiple vertical sections shall display the equipment number of the assembly that the vertical sections are components of.

8.3.3

Identification labels of shipping splits shall be securely attached and visible.

8.4 Foreign materials requiring removal before energizing the equipment

Foreign materials (e.g., blocking, bracing) requiring removal before energizing the equipment shall be clearly identified with tags, signs or markings.

8.5 Electrical connection point for space heaters

The electrical connection point for the space heaters shall be as detailed in Clauses 8.5.1 through 8.5.3.

8.5.1

The connection point shall be available without uncrating the equipment.

8.5.2

The connection point shall be clearly labelled.

8.5.3

The connection point shall indicate the electrical service required.

8.6 Protection against environmental and mechanical conditions

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

8.7 Instruments, relays, switches, and meters installed in MV MCC doors

Instruments, relays, switches and meters installed in the MV MCC doors shall be protected, blocked and braced to prevent damage during shipment.

8.8 Shipment identification

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

Public Review Draft

8.9 Equipment release for shipment

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

Public Review Draft

Annex A
(Normative) — References

Add row items 28 to 36 to table

Item	United States	Canada	Mexico
28	ABS MODU, *Publication Number 6 Part 4 Rules for Building and Classing Mobile Offshore Drilling Units - Part 4 Machinery and Systems*	—	—
29	ASCE/SEI 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*	ASCE/SEI 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*	ASCE/SEI 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*
30	ASTM-F855, *Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment*	ASTM-F855, *Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment*	ASTM-F855, *Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment*
31	IEC 61850 (all parts), *Communication networks and systems for power utility automation*	IEC 61850 (all parts), *Communication networks and systems for power utility automation*	IEC 61850 (all parts), *Communication networks and systems for power utility automation*
32	IEEE Std C37.20.7-2017, *Guide for Testing Metal-Enclosed Switchgear Rated Up to 52 kV for Internal Arcing Faults*	IEEE Std C37.20.7-2017, *Guide for Testing Metal-Enclosed Switchgear Rated Up to 52 kV for Internal Arcing Faults*	IEEE Std C37.20.7-2017, *Guide for Testing Metal-Enclosed Switchgear Rated Up to 52 kV for Internal Arcing Faults*
33	IEEE Std C37.90, *IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus*	IEEE Std C37.90, *IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus*	IEEE Std C37.90, *IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus*
34	IEEE Std C57.13, *IEEE Standard Requirements for Instrument Transformers*	IEEE Std C57.13, *IEEE Standard Requirements for Instrument Transformers*	IEEE Std C57.13, *IEEE Standard Requirements for Instrument Transformers*
35	NEMA ICS 5, *Industrial Control and Systems: Control-Circuit and Pilot Devices*	NEMA ICS 5, *Industrial Control and Systems: Control-Circuit and Pilot Devices*	NEMA ICS 5, *Industrial Control and Systems: Control-Circuit and Pilot Devices*
36	46 CFR 111, *Title 46 – Shipping, Chapter I - Department of Coast Guard, Subchapter J - Electrical Engineering, Part 111 - Electrical Systems - General Requirements (For United States offshore only)*	—	—

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Add Bibliography

Bibliography

The following documents are informatively cited in the text of this specification, the PDS (IOGP S-742D) or the IRS (IOGP S-742L).

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

API Specification Q1, *Quality Management System Requirements for Organizations Providing Products for the Petroleum and Natural Gas Industry*

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

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*

IEC 62402, *Obsolescence management*

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

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

ISO 9001:2015, *Quality management systems — Requirements*

ISO 10005, *Quality management — Guidelines for quality plans*

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