

Supplementary Specification to IEEE Std C37.20.1 Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

Revision history

VERSION	DATE	PURPOSE
1.0	September 2021	Issued for Use

Acknowledgements

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

Disclaimer

Whilst every effort has been made to ensure the accuracy of the information contained in this publication, neither IOGP nor any of its Members past present or future warrants its accuracy or will, regardless of its or their negligence, assume liability for any foreseeable or unforeseeable use made thereof, which liability is hereby excluded. Consequently, such use is at the recipient's own risk on the basis that any use by the recipient constitutes agreement to the terms of this disclaimer. The recipient is obliged to inform any subsequent recipient of such terms.

Please note that this publication is provided for informational purposes and adoption of any of its recommendations is at the discretion of the user. Except as explicitly stated otherwise, this publication must not be considered as a substitute for government policies or decisions or reference to the relevant legislation relating to information contained in it.

Where the publication contains a statement that it is to be used as an industry standard, IOGP and its Members past, present, and future expressly disclaim all liability in respect of all claims, losses or damages arising from the use or application of the information contained in this publication in any industrial application.

Any reference to third party names is for appropriate acknowledgement of their ownership and does not constitute a sponsorship or endorsement.

Copyright notice

The contents of these pages are © International Association of Oil & Gas Producers. Permission is given to reproduce this report in whole or in part provided (i) that the copyright of IOGP and (ii) the sources are acknowledged. All other rights are reserved. Any other use requires the prior written permission of IOGP.

These Terms and Conditions shall be governed by and construed in accordance with the laws of England and Wales. Disputes arising here from shall be exclusively subject to the jurisdiction of the courts of England and Wales.

Foreword

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

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

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

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

Table of Contents

	Foreword	1
	Introduction	3
1.	Scope	5
2.	Normative references	5
3.	Definitions	5
4.	Normal (usual) service conditions	6
4.1	Seismic design	6
4.2	Environmental contamination	6
4.3	Dependability of materials and parts	7
4.4	Technology readiness and obsolescence	7
5.	Ratings	7
5.3	Rated power frequency	7
5.7	Phase current transformer accuracies	8
6.	Test	8
6.3	Production tests	8
7.	Construction	9
7.1	General requirements	9
7.2	Materials and finish	18
7.3	Barriers	18
7.4	Buses and connections	18
7.5	Access doors and covers	19
7.7	Indoor LV switchgear	20
7.8	Outdoor LV switchgear	20
7.10	Arrangements with stationary circuit breakers	21
7.12	Primary cable space	22
7.13	Precautionary labels	23
7.14	Lifting devices	23
7.15	LV power circuit breakers	23
7.16	Instrument and control power transformers	25
7.17	Instruments, meters and control devices	27
7.18	Enclosure space heaters	31
7.19	Accessories	32
7.20	Shipping and preservation	33

Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of metal-enclosed low-voltage power circuit breaker switchgear in accordance with IEEE Std C37.20.1-2015, Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear, and amendment IEEE Std C37.20.1A, March 2020 for application in the petroleum and natural gas industries.

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



JIP33 Specification for Procurement Documents Supplementary Technical Specification

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

IOGP S-727: Supplementary Specification to IEEE Std C37.20.1 Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1a-2020, following the IEEE Std C37.20.1-2015 clause structure. Clauses from IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1a-2020 not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1a-2020 defined in this specification are identified as Add (add to clause or add new clause), Replace (part of or entire clause) or Delete.

IOGP S-727D: Procurement Data Sheet for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear (IEEE)

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

IOGP S-727L: Information Requirements for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear (IEEE)

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

IOGP S-727Q: Quality Requirements for Metal-Enclosed Low-Voltage Power Circuit Breaker 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 data sheet or in the purchase order.

The terminology used within this specification and the supporting data sheet, QRS and IRS follows that of IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1a-2020 is in accordance with ISO/IEC Directives, Part 2 as appropriate.

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

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

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order, project drawings);
- c) purchaser defined requirements (procurement data sheet, IRS, QRS);
- d) this specification;
- e) IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1a-2020.

1. Scope

Add to clause

This specification defines minimum technical requirements for the purchase (including design features, fabrication quality, inspection, testing, shipment and documentation) of LV switchgear equipment. This specification does not apply to LV switchgear installed in hazardous (classified) areas.

2. Normative references

Add to clause

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

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

API RP 14 FZ, *Recommend 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*

CAN/CSA C60044:08 (Parts 3–8), *Instrument Transformers CSA C60044*

CAN/CSA C61869-2:14, *Instrument Transformers - Part 2: Additional requirements for current transformers*

CAN/CSA C61869-3:14, *Instrument Transformers - Part 3: Additional Requirements for Inductive Voltage Transformers*

CSA C22.2 No. 31-14, *Switchgear assemblies*

IEC 62402, *Obsolescence management*

IEEE Std C37.13, *IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures*

IEEE Std C37.20.2, *IEEE Standard for Metal-Clad Switchgear*

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*

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

NEMA 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*

UL 1436, *Standard for Safety Outlet Circuit Testers and Similar Indicating Devices*

UL 1558, *Standard for Safety Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear*

46 CFR 111, *Title 46 - Shipping, Chapter I - Department of Coast Guard, Subchapter J - Electrical Engineering, Part 111 - Electrical Systems - General Requirements (for US offshore only)*

3. Definitions

Add new definition

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

Add new definition

arc resistant accessibility Type 2B: Equipment with arc-resistant designs or features at the freely accessible exterior (front, back and sides) of the equipment only, plus the additional requirements of IEEE Std C37.20.7. The equipment is arc resistant even with the instrument or control compartment doors open.

Add new definition

arc resistant equipment: 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 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

low voltage (LV): 1000 Vac and below, 3200 Vdc and below.

Add new definition

manufacturer: Organization manufacturing and/or supplying the equipment or services, and/or contractor on project.

NOTE— Manufacturer may alternatively be referred to as "vendor", "seller" or "supplier".

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

4. Normal (usual) service conditions

Add new clause

4.1 Seismic design

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

Add new clause

4.2 Environmental contamination

If other service conditions with environmental contamination are specified, the equipment shall be provided as detailed in clauses 4.2.1 through 4.2.3.

4.2.1

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

4.2.2

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

4.2.3

The corrosion protection method shall be identified in the equipment specification sheet.

Add new clause

4.3 Dependability of materials and parts

4.3.1

The switchgear and sub-components shall be designed for continuous operation for at least five years at rated current and under normal service conditions.

4.3.2

Under normal service conditions, the bus bars shall not be required to be de-energized for maintenance for the initial five-year operational period.

Add new clause

4.4 Technology readiness and obsolescence

4.4.1

The LV switchgear, excluding electronic components, shall have a design life of and be supported for at least 20 years after delivery.

4.4.2

An obsolescence management plan shall be available from the manufacturer for all switchgear 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.

4.4.3

Proposals shall indicate whether the LV switchgear 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.

5. Ratings

5.3 Rated power frequency

Replace second sentence with

Ratings for ac equipment shall be based on an operating frequency of either 50Hz or 60 Hz.

5.7 Phase current transformer accuracies

Add to clause

For relaying applications, accuracies shall conform to IEEE Std C37.20.2, Table 4.

6. Test

6.3 Production tests

6.3.1 General

Add new clause

6.3.1.1

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

Add new clause

6.3.1.2

Functional testing of the completed LV switchgear assembly shall include the following:

- a) Operation of all circuit breakers and switching devices, including any auto-transfer schemes.
- b) Electrical and mechanical interlocks.
- c) All control devices that are either hard wired or communicating over a network and, if applicable, local human machine interface (HMI).
- d) Current and voltage transformers or sensors.

NOTE—Primary injection for current transformers (CT) is not required to comply with this requirement.
- e) Circuit breaker trip units, protective relays and metering devices.
- f) Indicator lights.
- g) Circuit breaker drawout and mechanical insertions (including operation of the shutter mechanism).
- h) Vertical section space heaters and thermostat if applicable.
- i) Continuous thermal monitoring system if applicable.
- j) Auxiliary equipment provided as part of the system design (e.g. interposing relay panel, mimic panel, remote racking equipment, and absence of voltage tester device).
- k) High resistance grounding (HRG) system, if applicable.

6.3.2 Dielectric tests

Delete last sentence of first paragraph

Delete second sentence of second paragraph

Add new clause

6.3.2.1

If grounding studs are specified, they shall be installed prior to the dielectric tests.

Add new clause

6.3.2.2

If cable lugs are specified, they shall be installed prior to the dielectric tests.

7. Construction

7.1 General requirements

Add to clause

LV switchgear shall be provided in accordance with the one-line diagrams, circuit breaker control schematics and IOGP S-727D.

7.1.1 Buses and primary connections

Replace first sentence with

Buses and primary connections shall be plated copper.

7.1.1.3 Cable terminations

Add new clause

7.1.1.3.1

Incoming and outgoing cable termination points shall be provided with a NEMA two-hole pattern as a minimum.

Add new clause

7.1.1.3.2

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

Add new clause

7.1.1.3.3

If cable termination lugs for the incoming section(s) are supplied by the manufacturer, they shall be provided as detailed in clauses 7.1.1.3.3 a) through d).

- a) Termination lugs shall be a NEMA two-hole pattern minimum.
- b) Termination lugs shall be compression type.
- c) Termination lugs shall be sized for the specified incoming cables.
- d) Termination lugs shall be arranged to provide clearances as required in 7.4.

Add new clause

7.1.1.5

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

Add new clause

7.1.1.6

Bolts that have been torqued shall be marked with paint or other visible mark to indicate that proper torque has been applied.

Add new clause

7.1.1.7

A label listing torque requirements for bolted joints connections and cable lug terminations shall be installed on each vertical section inside the cable compartment.

Add new clause

7.1.1.8

When a neutral bus is specified, it shall meet the requirements detailed in clauses 7.1.1.8 a) through d).

- a) The neutral bus shall extend to the full length of the switchgear.
- b) The neutral bus shall be insulated from ground.
- c) The neutral bus shall have same continuous current rating and short-circuit ratings as the main bus.
- d) The neutral bus shall have a means to disconnect the neutral service conductors without disconnecting the field installed cabling, i.e. removable bus link, when the power system is solidly grounded.

Add new clause

7.1.1.9

Cables shall not be used for power buses, i.e. main horizontal or vertical tie buses, inside the LV switchgear assembly.

Add new clause

7.1.1.10

Space shall be provided to allow field installation and servicing of shipping split joint connections with an accessible bus cover removed, i.e. assembly of joints and access with a torque wrench.

Add new clause

7.1.1.11

For front access only LV switchgear applications, space shall be provided for field installation and servicing of shipping split joint connections with a front accessible bus cover removed.

Add new clause

7.1.1.12

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

7.1.2 Grounding

7.1.2.2 LV ac switchgear

Replace first sentence with

A copper ground bus shall be included.

Add new clause

7.1.2.2.1

The ground bus shall be 6.35 mm by 50.8 mm (¼ in by 2 in) minimum in size.

Add new clause

7.1.2.2.2

The ground bus shall be installed at the rear of the LV switchgear assembly.

Add new clause

7.1.2.2.3

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

Add new clause

7.1.2.2.4

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

Add new clause

7.1.2.2.5

For three-phase ungrounded systems, a ground fault detection system with a visual indication shall be provided.

Add new clause

7.1.2.2.6

If specified, grounding ball studs in accordance with in ASTM F855 shall be provided in locations as indicated in the data sheet and project drawings.

NOTE—Ball studs should be selected based upon the ASTM F855 Grade. The selection guidance provided in Table 1 and Table 2 account for fault current level, duration, and dc offset.

Add new clause

7.1.2.4 Grounding for current transformer circuits

7.1.2.4.1

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

7.1.2.4.2

The grounding wires insulation color shall be green.

7.1.2.4.3

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

Add new clause

7.1.2.5 High resistance grounding system

7.1.2.5.1

If specified, a high resistance ground system for each source of supply shall be provided with the switchgear assembly.

7.1.2.5.2

If high resistance ground systems are specified, they shall include the features detailed in clauses 7.1.2.5.2 a) through e).

- a) High resistance ground system shall have a control and monitoring system that provides system status and alarm outputs.
- b) High resistance ground system shall have a neutral-to-ground voltage measurement and neutral current measurement.
- c) High resistance ground system shall have a pulsing function in order to assist with the location of the ground fault.
- d) High resistance ground system shall have tapped resistors, adjustable between 1 A and 10 A.
- e) High resistance ground system shall have a portable ground fault detector with case (one unit per purchase order).

7.1.2.5.3

High resistance grounding systems shall have control power disconnects and neutral disconnects that are lockable with a padlock.

7.1.2.5.4

For secondary selective systems using a double-ended switchgear arrangement, the tie circuit breaker shall be electrically interlocked with the high resistance grounding systems to prevent it from closing when a ground fault exists on both buses.

7.1.2.5.5

Externally visible and permanently mounted operating instructions shall be installed on the front of the switchgear assembly door at the controls for each ground fault system.

7.1.2.5.6

If the high resistance grounding system is an external type, it shall be Underwriters Laboratories (UL) listed.

7.1.3 Control and secondary circuits and devices, and all wiring

7.1.3.1 General (Addendum 1 of March 5, 2020)

Add new clause f)

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

7.1.3.3 Control, secondary, and logic-level wiring (Addendum 1 March 5, 2020)

7.1.3.3.2 Wire size (Addendum 1 March 5, 2020)

Replace fourth paragraph with

Minimum conductor sizes shall be as follows:

- a) No. 10 AWG for CT secondary wiring.
- b) No. 14 AWG for all control and other wirings except communication wiring.

7.1.3.3.3 Wire protection and support (Addendum 1 March 5, 2020)

Add to clause

Adhesive-type supports shall not be permitted.

7.1.3.3.4 Wire type (Addendum 1 March 5, 2020)

Delete second bullet item from exception list (for low energy signal communication cables)

Add new clause

7.1.3.3.5 Data communications

If LV switchgear data communications are specified, the cabling and connection to the devices intended to be monitored and controlled shall be provided as detailed in clauses 7.1.3.3.5 a) through c).

- a) Data communication cabling and connection shall be compatible with the specified communication protocol or combination of protocols.
- b) 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 made in wireways and between vertical sections.
- c) Data communication cabling shall be rated for 600 Vac.

Add new clause

7.1.3.3.6 Wire markers

7.1.3.3.6.1

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.

7.1.3.3.6.2

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

7.1.3.3.6.3

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

7.1.3.3.6.4

Internal wire terminations shall have the same assigned number at each end and at each location where it is terminated.

7.1.3.5 Terminal blocks (Addendum 1 March 5, 2020 — formerly 7.1.3.3)

Add new clause

7.1.3.5.1

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 provide protection from incidental contact.

Add new clause

7.1.3.5.2

Trip and close circuits shall be provided with pullout dead-front type fuse blocks or miniature circuit breakers.

Add new clause

7.1.3.5.3

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

Add new clause

7.1.3.5.4

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

Add new clause

7.1.3.5.5

A maximum of two wires shall be terminated on any one terminal.

Add new clause

7.1.3.5.6

Terminal strips located in individual compartments shall be provided with a minimum of 10% spare control terminal blocks without reducing the size of the field wiring allocated space.

7.1.3.6 Designation of auxiliary switches and contact — Addendum 1 March 5, 2020 (formerly 7.1.3.4)

Replace second sentence of third paragraph with

The open–closed position of the circuit breaker shall be designated for the contacts with the circuit breaker in the connected and test positions.

7.1.4 Miscellaneous

7.1.4.1 Nameplate marking

Add new list item j)

j) Purchase order number

Add new clause

7.1.4.1.1

The LV switchgear individual compartment doors, both front and rear, shall be provided with externally mounted nameplates to identify the equipment tag number, description and other information as detailed in the project nameplate schedule or single line drawings.

Add new clause

7.1.4.1.2

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

Add new clause

7.1.4.1.3

Nameplates on the front of the compartment shall be mounted with stainless steel screws.

Add new clause

7.1.4.1.4

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

Add new clause

7.1.4.1.5

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

Add new clause

7.1.4.1.6

Separate nameplates shall identify door mounted items (e.g. meters, switches, indicating lights and other similar devices).

Add new clause

7.1.4.1.7

Separate device markers shall identify the individual components within each compartment (e.g. terminals, relays, switches, fuse blocks and other similar devices).

Add new clause

7.1.4.1.8

When a secondary selective, electrical interlock or mechanical interlock system is specified, nameplates containing operational instructions shall be affixed on the front of the LV switchgear near the point of operation.

Add new clause

7.1.5 Arc-resistant design and construction

7.1.5.1

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

7.1.5.2

If a plenum with an outdoor exhaust is required, it shall be provided with a wall penetration exterior exhaust with environmental type seals to limit the exchange of outside air and prevent driven rain and insects from entering the plenum.

7.1.5.3

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

7.1.5.4

Minimum room dimension requirements and other guidelines (e.g. for plenum or arc duct) related to the performance of the arc-resistant LV switchgear shall be provided.

7.1.5.5

Front doors of LV switchgear shall be secured with latches, i.e. cam or twist type with less than 1 full rotational turn.

7.1.5.6

Special tools shall not be required to latch the front compartment doors.

7.1.5.7

If accessories are required to maintain the arc-resistant rating of the switchgear with the circuit breaker removed (e.g. solid door), the quantity for each circuit breaker rating (e.g. physical size) shall be specified.

7.1.5.8

Control and instrument compartments shall be separate from the circuit breaker and bus compartments and designed to minimize the passage of arc fault products.

7.1.5.9

Circuit breaker monitoring and controls necessary for maintenance and troubleshooting shall be located in a Type 2B control and instrument compartment.

NOTE—Wiring integral to the breaker cradle/cassette secondary terminals may be located in the circuit breaker compartment (e.g. MOC, TOC, cell switch).

7.1.5.10

The LV switchgear shall be designed for closed-door racking of the power circuit breakers that maintains the integrity of the arc-resistant design.

7.1.5.11

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

7.1.5.12

The methodology to achieve the arc-resistant certification of the LV switchgear as defined in IEEE Std C37.20.7-2017, i.e. full withstand capability without protective device, self-extinguishing, current-limiting circuit breaker/fuses or duration-limiting device, shall be identified on the nameplate of the assembly.

7.1.5.13

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

7.1.5.14

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

Add new clause

7.1.6 Certifications

7.1.6.1

The LV switchgear shall be listed or certified by a nationally recognized testing laboratory (NRTL) for the United States or accredited certification organization (ACO) for Canada.

NOTE—Applications for this equipment in other countries may have additional requirements for certification (UL 1558 for US applications).

7.1.6.2

If specified, the LV switchgear 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 LV switchgear installed on floating facilities in US territorial waters can be found in API RP 14 F/FZ.

7.2 Materials and finish

7.2.2 Finishes and color

Replace fifth paragraph with

Unpainted parts and hardware shall be plated for corrosion resistance or be made of stainless steel.

7.3 Barriers

Add to clause

Sheet steel barriers shall be provided between all power and control compartments.

7.4 Buses and connections

Replace first sentence with

Bus and connections shall be either bare or insulated as specified.

Delete NOTE

Add to clause

If bus insulation is specified, the requirements in clauses 7.4.1 through 7.4.6 shall apply.

7.4.1

Bus and bus bar joint insulating materials shall be non-hygroscopic, flame retardant and tracking resistant.

7.4.2

Bus bar joints shall be covered with formed insulating boots attached with non-metallic hardware.

7.4.3

Taping shall not be used in lieu of bus bar joint boots.

7.4.4

Bus insulation materials shall meet or exceed the maximum voltage rating of the LV switchgear.

7.4.5

Bus bar joint insulating boots shall be installed at the factory other than at the shipping split joints.

7.4.6

If an insulated main bus is specified, the field installed bus bar joint insulating boots shall be supplied with attachment hardware and installation instructions.

7.5 Access doors and covers

Delete second paragraph

Add new clause

7.5.1

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

Add new clause

7.5.2

Breaker compartment doors shall be provided with door handle latches that require deliberate operation to open the door.

Add new clause

7.5.3

Provisions shall be made for padlocking breakers in the test and disconnected positions.

Add new clause

7.5.4

Bolted doors and removable panels shall be secured with captive slotted fasteners, machine screws, machine bolts engaging captive nuts or tapped holes in structural members.

Add new clause

7.5.5

Access to cable compartments shall be as detailed in clauses 7.5.5 a) through 7.5.5 g).

- a) Cable compartment shall be full height doors.
- b) Cable compartment doors shall be removable or capable of being opened beyond 90°.
- c) Cable compartment doors shall be hinged in full length or three hinges minimum.
- d) Cable compartment doors shall be bolted or with latches.
- e) Cable compartment doors shall be pad-lockable.
- f) Cable compartment doors shall be equipped with doorkeeper or positioner.
- g) Cable compartment doors shall be provided with a nameplate identifying the circuit breaker or circuit designation.

Add new clause

7.5.6

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

7.7 Indoor LV switchgear

7.7.1 General

Add to clause

Enclosures shall be NEMA 1 rated as a minimum.

Add new clause

7.7.4

If non-ferrous metals such as aluminum are used for eddy current heating reasons, they shall be of equivalent strength and rigidity to the steel sections.

7.8 Outdoor LV switchgear

7.8.2 Requirements

Add new clause

7.8.2.1

Enclosures for outdoor LV switchgear shall be designed and fabricated in accordance with clauses 7.8.2.1.1 through 7.8.2.1.5.

7.8.2.1.1

Gaskets shall be held in metal retainers to prevent moving during assembly.

7.8.2.1.2

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

7.8.2.1.3

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

7.8.2.1.4

External joints shall be covered with a metal cap to prevent the entry of dust, rain and snow.

Add new clause

7.8.2.2

Outdoor LV switchgear assemblies shall be provided with at least one 120-volt GFCI-protected receptacle inside the exterior door.

Add new clause

7.8.2.3

Where an outdoor assembly includes four or more vertical sections, at least one 120-volt GFCI-protected receptacle shall be provided on each end with a maximum distance between the receptacles of 7.5 m (25 ft).

Add new clause

7.8.2.4

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

7.10 Arrangements with stationary circuit breakers

Replace clause with

Stationary circuit breakers shall not be provided

Add new clause

7.11.8 LV Switchgear configuration

7.11.8.1 Provisions for future equipment

7.11.8.1.1

Provisions shall be made for the addition of vertical sections with future breakers at both ends of the line-up.

7.11.8.1.2

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

7.11.8.2

In secondary selective LV switchgear arrangements, i.e. double-ended, each main and tie breaker shall be in separate vertical sections.

NOTE—This does not preclude metering, auxiliary equipment or a feeder breaker being in the same vertical section with the main breaker or tie breaker.

7.11.8.3

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

7.11.8.3.1

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

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

7.11.8.3.2

Unequipped spaces shall be provided with:

- a) doors.
- b) line and load side power stabs.
- c) line and load side power stab covers.

7.11.8.3.3

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

7.11.8.3.4

Blank spaces provided in the LV switchgear assembly shall be empty cubicles with doors and without power stabs or other equipment.

7.11.8.3.5

Blank spaces shall be prepared with steelwork such that the blank space can be equipped in the field without cutting or welding.

7.11.8.4

If a breaker interlocking or transfer scheme is specified, it shall be arranged in accordance with clauses 7.11.8.4.1 through 7.11.8.4.3.

7.11.8.4.1

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

7.11.8.4.2

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

7.11.8.4.3

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

Add new clause

7.11.9

If the circuit breaker is in the test or disconnected position or has been withdrawn from the cubicle, automatic shutters shall be provided in the breaker compartments to prevent incidental contact with live parts of the primary circuit.

7.12 Primary cable space

Add to clause

Barriers shall be provided between the cable and bus compartments to protect against incidental contact with the main or vertical bus bars while cable terminations are made.

7.13 Precautionary labels

Add new clause

7.13.1

Caution label shall be provided on the doors of compartments with an external voltage source.

Add new clause

7.13.2

A caution label shall be provided on the door of each vertical section with external powered space heaters indicating the panel and breaker information as detailed in the project drawings.

7.14 Lifting devices

Replace first paragraph with

A traveling overhead crane mounted on top of each switchgear assembly or a wheeled hoist shall be provided to facilitate lifting circuit breakers to and from the appropriate compartments.

Add new clause

7.15 LV power circuit breakers

7.15.1

Circuit breakers shall be three pole, air-break and stored-energy type with drawout construction.

7.15.2

LV power circuit breakers shall be rated and tested in accordance with IEEE Std C37.13, IEEE Std C37.16, IEEE Std C37.17 and IEEE Std C37.50, as applicable.

7.15.3

Electrically operated circuit breakers shall have provisions for manual operation and manual charging of the spring mechanism.

7.15.4 Trip unit

7.15.4.1

Circuit breakers shall be provided with a microprocessor based integral trip unit.

7.15.4.2

Circuit breakers shall be provided with direct-acting overcurrent trip unit.

7.15.4.3

Trip unit shall be solid state RMS sensing.

7.15.4.4

Trip unit shall record phase currents at the time of the most recent trip event.

7.15.5

The trip device display on the circuit breaker shall be visible with the compartment door closed.

7.15.6

The application of current-limiting fuses to extend the circuit breaker rating shall cause the breaker to trip if any of the fuses operate.

7.15.7

Drawout circuit breakers shall be provided with a manual racking mechanism, including a handle, which allows for the three positions: connected, test and disconnected.

7.15.8

Circuit breakers shall be provided with padlocking provisions for all drawout positions.

7.15.9

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

7.15.10

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

7.15.11

In addition to contacts required for circuit breaker operations and indication, the following shall be supplied and wired out to accessible terminals:

- a) Two normally open (NO) and two normally closed (NC) mechanism operated contacts (MOC) or internal auxiliary contacts.
- b) Two normally open (NO) and two normally closed (NC) truck operated contacts (TOC).

7.15.12

If the circuit breaker trip unit is equipped with an arc energy reducing system, a means to indicate that the function has been activated, i.e. local and remote, shall be provided.

NOTE—This feature is usually referred to as "maintenance mode".

7.15.13

If the circuit breaker or trip unit is equipped with an instantaneous override or similar function, documentation shall be provided with the proposal to identify the trip value and which circuit breakers will be equipped with this function.

7.15.14

Close and trip circuits for each LV power circuit breaker shall be individually fused or protected by molded-case circuit breakers in each breaker compartment.

7.15.15

If zone selective interlocking is specified, the system shall incorporate all main circuit breakers, tie circuit breakers (if present) and feeder circuit breakers.

7.15.16

If specified, zone selective interlocking shall be a two-tier system for assemblies without a tie breaker or a three-tier system for assemblies with a tie-breaker.

7.15.17

The load side of the trip circuit protective device for each circuit breaker shall be monitored for loss of control voltage with a dry fail-safe contact.

7.15.18 Circuit breaker position indicator

7.15.18.1

A circuit breaker position indicator shall be provided to indicate the breaker positions i.e. disconnected, test and connected.

7.15.18.2

The circuit position indicator shall be visible without opening the compartment door.

7.15.19

Fuses used to extend circuit breaker interrupting or withstand ratings shall be identified in the submittal drawings as part of the circuit breaker information.

Add new clause

7.16 Instrument and control power transformers

7.16.1 Voltage transformers (VT)

7.16.1.1

VTs shall be provided as indicated on the one-line diagram and in accordance with IEEE Std C57.13.

7.16.1.2

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

7.16.1.3

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

7.16.1.4

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

7.16.1.5

VTs shall have the same insulation level as the switchgear.

7.16.1.6

Secondary protective devices for VTs shall be located in the LV control compartment, separate from circuit breaker compartment.

7.16.1.7

Fuse holders shall be labelled to indicate the size and type of fuse and to identify the VT (e.g. Phase "A" VT).

7.16.2 Control power transformers (CPT)

7.16.2.1 CPT KVA rating

7.16.2.1.1

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

7.16.2.1.2

The kVA rating of the CPT shall be the larger of either the simultaneous tripping or charging of all the circuit breakers.

7.16.2.1.3

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

7.16.2.2

The CPT basic impulse level rating shall be the same as the switchgear.

7.16.2.3

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

7.16.2.4

Secondary voltage shall be 240/120 V or 120 V, with primary voltage as indicated on the one-line diagram.

7.16.2.5

Primary windings shall be protected by disconnect-type current-limiting fuses.

7.16.2.6

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

7.16.2.7

One CPT shall be provided for each primary power source feeding the switchgear if internal AC power is required.

7.16.2.8

If multiple CPTs are provided in one switchgear lineup, the assembly shall be provided with an automatic control power transfer scheme such that the control power is normally supplied from one control power source and transferred to one of the other(s) in the event a control power source becomes unavailable.

7.16.3 Current transformers

7.16.3.1

CTs for metering or protective relaying purposes shall be rated in accordance with the requirements of IEEE Std C57.13 and as indicated on the one-line diagram(s).

7.16.3.2

CTs shall be window type, provided with 600 Vac insulation class for primary and secondary windings.

7.16.3.3

CT burden calculations, including metering or relay burden ratings for the associated devices, shall be provided.

7.16.3.4

CT characteristic curves shall be provided for all CTs.

7.16.3.5

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

7.16.3.6

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

7.16.3.7

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

Add new clause

7.17 Instruments, meters and control devices

7.17.1

If specified, microprocessor-based multifunction meters shall be provided as detailed in clauses 7.17.1 a) through e).

- a) Microprocessor-based multifunction meters shall be provided with digital communication capability.
- b) Microprocessor-based multifunction meters shall have 0.5% accuracy or better.

- c) Microprocessor-based multifunction meters shall display current and voltage for each phase.
- d) Microprocessor-based multifunction meters shall display kW, kVARS and PF.
- e) Microprocessor-based multifunction meters shall display harmonic order measurements.

7.17.2 Breaker status indication

7.17.2.1

Indicating lights shall be provided for circuit breaker status.

7.17.2.2

Circuit breaker status indicating lights shall be clear LED type with 100,000-hour illumination life.

7.17.2.3

Circuit breaker status indicating lights shall be replaceable.

7.17.2.4

Circuit breaker status indicating lights shall have colored lenses: closed (red), open (green), tripped (amber).

7.17.3 Analog-type metering

7.17.3.1

If analog-type metering is specified, they shall be provided as detailed in clauses 7.17.3.1 a) through d).

- a) Analog-type metering shall have a circular 250-degree-scale switchboard type.
- b) Analog-type metering shall have a minimum 1% accuracy.
- c) Analog-type metering shall be 115 mm (4.5 in) square.
- d) Analog-type metering shall be flush mounted.

7.17.3.2

Ammeters shall be provided with four-position rotary type switch.

7.17.3.3

Voltmeters shall be provided with four-position rotary type switch for open delta connected PTs or seven-position switch for wye connected PTs.

7.17.4 Control switches

7.17.4.1

Control switches shall be rotary cam type.

7.17.4.2

Control switches shall have engraved dial plates.

7.17.4.3

Control switches shall have oval handles.

7.17.5

Meters, switches and relays shall be installed such that the top of the device is between 610 mm (2 ft) and 1.8 m (6 ft) from the floor.

NOTE—Control devices should be arranged in such a manner as to minimize misoperation of the circuit breaker (e.g. avoid placing the ammeter selector switch directly adjacent to the circuit breaker operation switch).

7.17.6 Circuit breaker control switch

7.17.6.1

Circuit breaker control switch shall have pistol grip handles.

7.17.6.2

Circuit breaker control switch shall have momentary contact, spring return to center.

7.17.6.3

Circuit breaker control switch shall have red (“closed”) and green (“open”) mechanical indication.

7.17.7

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

7.17.8

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

7.17.9

If specified, test switches shall be provided as detailed in clauses 7.17.9 a) through e).

- a) Test switch shall be installed on the circuit breaker or associated instrument compartment door.
- b) Test switch shall allow for isolation of power monitoring and protective relay equipment inputs and outputs.
- c) Test switches shall FT-1 type.
- d) Test switches shall be wired to provide three-phase bus potential and three-phase line current.
- e) Test switches shall be wired in series with protective relay trip output contacts.

7.17.10

For lockout devices tripping more than one breaker, a dedicated test switch shall be provided for each lockout contact per circuit breaker.

7.17.11

If protective relays are indicated on the one-line or project drawings, they shall be provided as detailed in clauses 7.17.11 a) through e).

- a) Protective relays shall be compliant with the service conditions, ratings and testing requirements specified in IEEE Std C37.90.
- b) Protective relays shall be multifunctional microprocessor-based.
- c) Protective relays shall have a trip indication with a manual reset function.
- d) Protective relays shall provide indication for each type of fault.
- e) Protective relays shall have digital communication capability.

7.17.12

If door-mounted lockout relays (Device 86) are supplied, they shall comply with the clauses 7.17.12 a) through d).

- a) Lockout relays shall have a manual reset type handle.
- b) Lockout relays shall operate in less than one cycle.
- c) Lockout relays shall have two positions - "Reset" and "Tripped".
- d) Lockout relays shall have the coil "health" monitored with a white indicating light.

7.17.13

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.

7.17.14

Control power circuits leaving the switchgear for a location external to the switchgear (e.g. transformer rapid pressure rise relays, motor start/stop circuits) shall be individually fused.

7.17.15

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.

7.17.16

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

7.17.17

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

Add new clause

7.18 Enclosure space heaters

7.18.1

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

7.18.2

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

7.18.3

Space heaters shall be operated at 120 Vac.

7.18.4

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

7.18.5 Space heater thermostat control

If thermostat control is specified, a control unit shall be provided as per clauses 7.18.5.1 through 7.18.5.5.

7.18.5.1

The control unit supply disconnect shall be a circuit breaker equipped with a means to lockout.

7.18.5.2

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

7.18.5.3

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

7.18.5.4

The control unit shall be provided with an ammeter.

7.18.5.5

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

7.18.5.6

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

7.18.6

Each space heater circuit shall be protected by a molded-case circuit breaker or fuse that will also function as a disconnect device.

Add new clause

7.19 Accessories

7.19.1

If not integrated into the circuit breaker design, a hand crank or handle shall be provided for moving the breaker into the connected, test and disconnected positions.

7.19.2

If not integrated into the circuit breaker design, a device for manually charging the stored energy operating mechanism of electrically operated breakers shall be provided.

7.19.3

If specified, a remote electrical racking device shall be supplied and operate as detailed in clauses 7.19.3 a) through d).

- a) The racking device shall move the circuit breaker in all positions (withdrawn, test, connected).
- b) The racking device shall operate with the door closed.
- c) The racking device shall include a minimum of 6 m (20 ft) of control cable.
- d) The racking device shall automatically shut off when the breaker is in the “connected” position.

7.19.4 LV switchgear condition-based monitoring (CBM)

If continuous thermal monitoring is specified, it shall be in accordance with clauses 7.19.4.1 through 7.19.4.4.

7.19.4.1

LV switchgear assemblies shall be equipped with factory-integrated continuous thermal monitoring technology.

7.19.4.2

Thermal monitoring shall include hotspot detection sensors for main incoming sections, i.e. main circuit breaker or lug, and other areas of concern such as individual compartments or shipping split connections.

7.19.4.3

Continuous thermal monitoring systems shall include communications capable of conveying temperature data, status and alarming for each monitored point.

7.19.5

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

7.19.6

If specified, the circuit breaker compartment(s) shall be provided with an absence of voltage tester device that is NRTL listed to UL 1436 in order to assist with establishing an electrically safe work condition and provide a means of verification of isolation without opening the compartment front or rear door.

7.19.7

If specified, a circuit breaker test cabinet shall be provided as detailed in clauses 7.19.7 a) through d).

- a) Circuit breaker test cabinet shall be designed for wall mount installation.
- b) The test cabinet shall allow for the operation of each power circuit breaker type and frame size provided in the assembly.
- c) The test cabinet shall indicate the status of the circuit breaker under test including its internal auxiliary contacts (52A and 52B).
- d) The test cabinet shall be provided with the required cabling and connectors to operate each breaker frame size outside of the switchgear assembly.

Add new clause

7.20 Shipping and preservation

7.20.1

Shipping sections of stationary structures shall be furnished with removable lifting angles, lugs or plates engineered for use with crane hooks or slings.

7.20.2

Items shipped separately from the switchgear, including removable elements, shall be clearly identified with item description and location of installation.

7.20.3

Shipping sections of stationary structures shall be provided with individual identification tags bearing the equipment number of the assembly of which it is a component.

7.20.4

Shipping section identification tags shall be permanently attached and visible.

7.20.5

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

7.20.6

The electrical connection point for the space heaters shall be as detailed in clauses 7.20.6 a) through c).

- a) The connection point shall be available without uncrating the equipment.
- b) The connection point shall be clearly labelled.
- c) The connection point shall indicate the electrical service required.

7.20.7

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

7.20.8

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

Registered Office

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

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

Brussels Office

Avenue de Tervuren 188A
B-1150 Brussels
Belgium

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

Houston Office

15377 Memorial Drive
Suite 250
Houston, TX 77079
USA

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

| www.iogp.org

