

DEP SPECIFICATION

DESIGN AND FABRICATION OF MV SWITCHGEAR FOR NORTH AMERICAN APPLICATIONS

DEP 33.67.40.30-Gen.

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DESIGN AND ENGINEERING PRACTICE



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PART 1 INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for the design and fabrication of metal-clad (MC) medium voltage (MV) switchgear, including instruments and control, for use in North American applications.

Parts I and II include introductory and general information applicable to all (US and Canadian) MV switchgear.

Part III covers requirements for MV switchgear for US facilities from 4.76 kV up to 46 kV and it is written as amendments and supplements to IEEE Standard C37.20.2:2005, Standard for Metal-Clad Switchgear.

Part IV covers requirements for indoor medium voltage (2300 V to 46 kV) switchgear in Canadian facilities and is written in the form of supplemental requirements to be applied in addition to CSA Std. C22.2 No. 31-M:2004 reaffirmed in 2009. Part IV does not cover medium voltage motor controllers.

Part V covers documentation requirements.

Part VI covers supplemental non-technical requirements for all MV switchgear.

Part VII covers references associated with this standard for all MV switchgear.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process should be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal (or Electrical Technical Authority) may undertake all or part of the duties of the Contractor. The contractor may also be referred to as purchaser or buyer.

The **Principal's Electrical Technical Authority** is the discipline engineer appointed by the Principal and is responsible for all technical decisions associated with the work. The Principal's Electrical Technical Authority is responsible for technical integrity.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor. The Manufacturer/Supplier may also be referred to as Manufacturer/Supplier or seller.

The **Principal** is the party that initiates the project and ultimately pays for it. . The Principal may also include an agent or consultant, authorised to act for, and on behalf of, the Principal. The Principal may also be referred to as the owner or user.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
Arc resistant accessibility Type 1:	Equipment with arc-resistant designs or features at the freely accessible front of the equipment only.
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.
Arc resistant accessibility Type 1C:	Equipment with arc-resistant designs or features at the freely accessible front of the equipment only, plus the additional requirements of ANSI C37.20.7 Annex A, which are intended to reduce the collateral damage to adjacent compartments and equipment, and should not be interpreted to indicate any additional degree of protection for personnel.
Arc resistant accessibility Type 2C:	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 ANSI C37.20.7 Annex A, which are intended to reduce the collateral damage to adjacent compartments and equipment, and should not be interpreted to indicate any additional degree of protection for personnel.
Arc resistant equipment:	Equipment designed to withstand the effects of an internal arcing fault, as indicated by meeting test requirements of ANSI C37.20.7.
Internal arcing fault:	An unintentional discharge of electrical energy in air within the confines of an electrical equipment enclosure.
Observed	The word Observed means that the Principal and Contractor shall be notified of the timing of the inspection or test; however, the inspection or test shall be performed as scheduled, and if the Principal or Contractor is not present, the Manufacturer/Supplier shall proceed to the next step
Witnessed	The word Witnessed means that a hold shall be applied to the production schedule and that the inspection or test shall be carried out with the Principal or Contractor in attendance.

1.3.3 Abbreviations

ACO	Accredited Certification Organization
DEP	Design and Engineering Practice
NRTL	Nationally Recognized Testing Laboratory
NETA	International Electrical Testing Association

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced by this DEP are listed in (Part VII).

1.5 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of “DEPs on the Web”, available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.6 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.7 DATASHEETS

The applicable data sheet sections shall be completed and returned by the Manufacturer as part of the quotation:

- Use data sheet DEP 33.67.40.90-Gen. to specify MV switchgear for US applications.
- Use data sheet DEP 33.67.40.91-Gen. to specify MV switchgear for Canadian applications.

PART II GENERAL REQUIREMENTS

1.1 GENERAL

Part III of this DEP amends, supplements and replaces various clauses/paragraphs of IEEE C37.20.2:2005. Where ever reference is made to IEEE C37.20.2, it shall be understood to mean IEEE C37.20.2:2005 as amended by this DEP. Clauses of IEEE C37.20.2 that are not mentioned shall remain applicable as written.

For ease of reference, the clause numbering of IEEE C37.20.2 has been used throughout Part III of this DEP.

Part IV of this DEP provides supplemental requirements that shall be applied in addition to CSA Std. C22.2 No. 31-M:2004 reaffirmed in 2009.

In the event of conflicts between and/or among documents, the Manufacturer/Supplier shall contact the Contractor for resolution.

1.2 STATEMENT OF COMPLIANCE

The Manufacturer of the switchgear and its ancillary equipment shall confirm that the equipment fully complies with the quotation and the whole system is properly designed, constructed and suitable for the specified duty.

All performance values established in the pre-ordering meeting or quotation (whichever is the later) shall be regarded as maximum or minimum values as applicable.

These values shall also be guaranteed by the Manufacturer under the most arduous conditions specified in this DEP and the requisition.

Tolerances shall be in accordance with this DEP and the relevant reference publications.

All the equipment forming part of the order shall be tested individually and in combination at the Manufacturer's works to prove their capability and compliance with this DEP and the performance data.

The Manufacturer/Supplier shall comply with regulatory requirements applicable to the equipment for the location at which it will be installed; see also (Part I, 11.2).

Whenever equipment proposed by the Manufacturer/Supplier cannot fully meet the requirements of this DEP, such exceptions shall be clearly stated in the Manufacturer/Supplier's proposal with cross-references to the specific sections and subsections to which exceptions are taken. No exceptions shall be allowed unless approved by the Principal's Electrical Technical Authority in writing.

If no exceptions are taken to these specifications or drawings, a specific statement to that effect shall be included.

If any one of the components or the whole system does not comply with the specification and any agreed amendments, the Manufacturer/Supplier shall rectify and re-test the switchgear within a mutually agreed time.

1.3 LIFETIME and RELIABILITY

The equipment (including auxiliaries) covered by this standard shall be suitable for the specified operating conditions. Equipment shall be designed and constructed for a minimum service life and uninterrupted continuous operations as specified. It is recognized that this is a design criterion and that uninterrupted operation for this period of time involves factors beyond the Manufacturer/Supplier's control.

1.4 PRE-ORDERING MEETING

If deemed necessary by one of the parties involved, a pre-ordering meeting shall be arranged to define clearly the overall scope of supply, individual responsibilities and test methods.

**PART III REQUIREMENTS FOR MV SWITCHGEAR FOR US APPLICATIONS
(AMENDMENTS/SUPPLEMENTS TO IEEE C37.20.2:2005)****2.0 REFERENCES**

Add to this clause:

United States Coast Guard Requirements, 46 CFR, Chapter 1, Subchapter J, and Electrical Engineering (Offshore applications only).

5. RATINGS**5.5 TEMPERATURE LIMITATIONS****5.5.2 Temperature limits for insulating materials**

Add to this clause:

Insulating materials shall be Class 105.

5.5.3 Temperature limits for buses and connections

Add to this clause:

Buses and connections tin-surfaced or equivalent connecting joints shall have a hot-spot temperature rise of 65°C and a total temperature of 105°C.

Connections to insulated cables tin-surfaced or equivalent shall have a hot-spot temperature rise of 45°C and a total temperature of 85°C.

Add new clause:

5.8 CURRENT TRANSFORMER (CT) REQUIREMENTS

CTs shall be window type, single primary, and secondary and installed in a manner that can be readily maintained or replaced.

CTs shall be installed on the stationary circuit breaker stabs in order to be front accessible. This permits adding or changing of the CT's without removing high voltage insulation connections. In all cases, CT's shall be installed to allow for ease of maintenance or replacement.

The Manufacturer/Supplier shall match the selected protection relays and required instruments with the burden and accuracy class of the CTs.

CT polarity marker shall be visible from the front of the switchgear with shutters open or rear of the switchgear with the door open or cover removed where possible.

Opening of zero sequence CTs shall be large enough to accommodate power cables.

CT secondary circuits shall be routed away from high voltage components.

6. TESTS**6.3 PRODUCTION TESTS**

Add to this clause:

The entire switchgear shall be electrically and mechanically assembled into one single line-up prior to final testing, inspection and shipment.

7. CONSTRUCTION

7.1 BUSES AND PRIMARY CONNECTIONS

Add to this clause:

Bus contact areas shall be silver-plated or tin-plated as specified on the Data Sheet. Silver plating shall not be used in environments exposed to H₂S contamination.

All bus insulators and bus bar inserts shall be non-tracking, non-hygroscopic, flame retardant glass polyester or cycloaliphatic.

Bus lengths between insulators shall be insulated with either fluidized bed epoxy applied, liquid dipped, or extruded sleeving. Sleeve type or heat shrink tubing shall not be permitted.

Tapered bus shall not be used.

Non-tracking, non-hygroscopic, and flame retardant insulators shall be used whenever buswork passes through a barrier of any material.

All joints shall be plated and bolted using high tensile strength steel hardware, and conical (Belleville) washers.

All bus bar joints and insulator connection shall be covered with formed insulating boots and reusable non-metallic hardware.

The torque requirements for connections shall be determined, posted (in the rear of each cell) and used on all connections. The torque requirements shall also be noted on the manufacturer/supplier's drawings.

The load bus shall extend from the circuit breaker compartment into the cable compartment by means of insulating bushings.

The primary bus shall extend into the bus compartment by means of insulated bushings.

7.1.3 Cable and bus duct terminations

Replace this clause with:

Provisions for cable terminations shall be provided for each circuit breaker.

The cable entry shall be as specified on the Data Sheet.

The compartment shall have adequate space for the installation of stress cones, termination hardware, and a minimum bend radius based on the Contractor's MV power cable sizes.

Each cable terminal connection point shall meet the bolt hole requirements of NEMA CC 1-1993.

Lugs shall be furnished by the Manufacturer/Supplier and installed in the corresponding rear cable compartment in accordance with the contract drawings. The lug type shall be long barrel crimp type using NEMA 2 hole spacing.

The MC switchgear shall provide space for the devices used for making electrical and mechanical connections to the incoming and outgoing cables, bus duct, or bus transition as required.

All switchgear connections for cables, bus duct, or bus transition shall be located such that lugs or bus duct/bus transition links are readily accessible.

Removable boots shall be provided at each Contractor cable connection.

Add new clause:

7.1.6 Medium voltage wiring

All internal power wiring shall be rated for 8 kV service minimum, unshielded, with extra-flexible stranding and NRTL approved. The insulation shall be EPR with 175 mils of insulation thickness for sizes #2 AWG to 250 kcmil and 215 mils of insulation thickness for sizes 350 kcmil to 500 kcmil.

7.2 GROUNDING

Add to this clause:

The Manufacturer/Supplier shall furnish and install lugs in the corresponding rear cable compartment on the ground bus. Lugs shall be NEMA 2-hole (except where not available due to ground cable size), long barrel crimp-type compression lugs with an offset, and used for all power circuits that connect to the switchgear lineup. Each cubicle shall have grounding provisions made for terminating the wire to the ground bus.

Ground bus connections shall be solidly bolted. Use of self-tapping screws shall not be permitted for ground bus connections.

Manufacturer/Supplier shall furnish one NEMA 2-hole, long barrel, crimp-type compression lug with an offset at each end of the ground bus for the Contractor connection of the field grounding conductors for the size specified on the data sheet.

In each cubicle, the ground bus shall be extended toward the incoming power cable termination points to allow easy access for safety grounding connection of a portable grounding clamp device.

If specified on the data sheet, each phase bus power cable termination shall be provided with an apparatus ground clamp cable connection (ground ball stud) mounted as close as possible to the phase bus cable termination point for voltage testing and grounding.

7.3 CONTROL AND SECONDARY CIRCUITS AND DEVICES

7.3.1 General

Add to this clause:

All fuses shall be 250V rated and sized by the Manufacturer/Supplier.

7.3.2 Voltage transformer fusing

Replace this clause with:

The following requirements shall be met:

- a) Primary circuits of all voltage transformers shall include current-limiting fuses with an interrupting capacity of not less than the main switchgear power bus.
- b) Secondary circuits of all voltage transformers shall include fuses or their equivalent. If fuses are used, pull-out dead front fuse blocks shall be provided for each potential transformer.

7.3.3.2 Wire Size

Revise clause from:

Wiring for current transformer and shunt trip circuits shall be no less than No. 14 AWG, regardless of load.

To:

Minimum wire size for control circuits shall be no less than AWG No. 14, regardless of load. Current transformer circuits shall be AWG No. 10 minimum. Instrument wiring shall be AWG No. 18 minimum.

7.3.3.3 Wire protection and support

Add to this clause:

Wiring shall be routed neatly in vertical or horizontal planes. All wiring bundles shall be contained in covered synthetic wireways, except for flexible bundles which shall be in accordance with IEEE C37.20.2 Clause 7.3.3.1. An empty wireway shall be provided for Contractor wiring, as appropriate. Individual wires shall be secured with cable ties that are fastened to screw or positive tab type tie mounts. Adhesive backed mounts are not acceptable.

Wiring shall be installed in such a manner that its insulation does NOT contact sharp edges, burrs, or rough surfaces. Sharp edges, burrs, or rough surfaces shall be removed before wiring is installed.

7.3.3.4 Wire type

Add to this clause:

Instrument wiring shall be:

- a. Stranded tin-plated copper.
- b. Single twisted pair, triad or coax.
- c. Tape shielded with an individual copper drain wire. The drain wire shall be no less than one size smaller than the main conductor, except for coax.
- d. Overall jacketed.
- e. Manufactured by TAMAP approved supplier.
- f. Installed such that shields are NOT grounded in switchgear. However, shields shall be "carried across" terminal blocks and shall be continuous up to the final device. Bare shields are NOT acceptable. Bare shield shall be insulated from where it leaves the cable jacket to the device or the terminal strip terminal.

7.3.4 Secondary wiring terminals

Replace this clause with:

Stranded control wire shall have solderless terminals of the type wherein the body of the terminal is crimped or indented onto the conductor.

When approved by the Principal:

- Solderless terminals are not required for connection to devices that have integral pressure terminal connectors.
- The wire may be soldered into terminals or, where desirable, directly to devices such as secondary disconnecting contacts, or to soldered terminals on supervisory control and annunciator equipment.

Add to this clause:

Control and instrument wiring shall be terminated with solderless, insulated, locking fork-tongue terminals. Current transformer wiring shall be terminated with ring tongue terminals. All terminals shall be installed with crimp tool that requires a measured minimum amount of compression onto the connector/conductor before release. Wires that cannot be terminated with lugs shall use insulated ferrules. The ferrules shall be used instead of inserting the bare wire in the mechanical connector.

The installation of terminals requires each insulated conductor to be cut square and stripped sufficiently to allow insertion completely into the connector. Do not expose the bare conductor outside the mouth of the insulated sleeve. All connectors shall be given a "pull" test after installation on conductor and terminal block/device to verify connections are secure. Wire nut connections for installation and/or replacement shall not be used.

Each wire shall have an individual terminal with multiple terminal connections limited to two (2) and made only on terminal blocks on devices equipped with studs/nuts, or on tab terminals to accommodate the multiple terminal connections.

Splices and taps shall not be used in wiring within the cubicle. Wire shall be installed in a single continuous piece from termination point to termination point.