

DEP SPECIFICATION

**GAS-INSULATED, METAL-ENCLOSED SWITCHGEAR (GIS)
AND CONTROLGEAR FOR RATED VOLTAGES ABOVE
52 kV
(AMENDMENTS/SUPPLEMENTS TO IEC 62271-203)**

DEP 33.67.51.32-Gen.

February 2017

DESIGN AND ENGINEERING PRACTICE



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PART I INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for gas-insulated, metal-enclosed switchgear and controlgear assemblies for rated voltages above 52 kV for onshore and fixed offshore applications.

NOTE: Switchgear for rated voltages above 52 kV is often referred to as high voltage (HV) switchgear

Part III of this DEP amends, supplements and deletes various clauses of IEC 62271-203:2011. Part III follows the clause numbering of IEC 62271-203 for easy reference.

All clauses of IEC 62271-203 not modified by this DEP remain valid as written.

The amendments to IEC 62271-203 are needed in order to:

- a. Make selections from the options given in IEC 62271-203;
- b. Specify additional and more stringent requirements, as necessary, for operating and maintaining the gear in continuously operating plants;
- c. Specify supplementary provisions required to make the gear suitable for operation in the overall process control design.

The primary reason for issue of this DEP is changes in business needs to accommodate increasing levels of electrical power at facilities. This in turn increases the voltage levels required. The associated DEP 33.67.51.31-Gen. covers voltages up to 52 kV. This DEP extends the voltage range covered to values above 52 kV.

This is a revision of the DEP of the same number dated September 2013; see (1.5) regarding the changes.

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 shall 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 may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

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 word **shall** indicates a requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.4 CROSS-REFERENCES

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

1.5 SUMMARY OF MAIN CHANGES

This DEP is full revision of the DEP of the same number dated September 2013. The following are the main, non-editorial changes.

Section/Clause	Change
All	Restructured and clarified requirements, enforced use of shall/should/may for normative statements.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://www.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 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.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

1.9 REQUISITION/DATA SHEETS

The following are applicable with this DEP.

Requisition/Data Sheet	DEP 33.67.51.93-Gen.
Schedule for HV switchgear and controlgear assemblies	DEP 33.67.51.80-Gen.

PART II GENERAL

Part III of this DEP is written as amendments and supplements to IEC 62271-203:2011. Wherever reference is made to IEC 62271-203, it refers to IEC 62271-203:2011 as amended/supplemented by this DEP.

For ease of reference, the clause numbering of IEC 62271-203 has been used throughout Part III of this DEP.

Clauses in IEC 62271-203, which are not mentioned in this DEP, remain valid as written.

PART III AMENDMENTS/SUPPLEMENTS TO IEC 62271-203:2011

2 Normal and special service conditions

2.1 Normal service conditions

Add the following new clause:

The following applies to Table 1

1. The atmospheric conditions inside the switch houses shall be in accordance with Table 1: Normal Indoor temperature range -5 °C to +30 °C, unless otherwise stated on the Requisition.
2. The atmospheric conditions for outdoor switchgear shall be in accordance with Table 1; Normal Outdoor, temperature range -30 °C to +40 °C and maximum ice loading 20 mm, unless otherwise stated on the Requisition/Data Sheet.

The SF₆ gas density at temperatures below -30 °C falls because the gas condenses and hence insulation capability is affected. For operation below -30 °C switchgear is normally housed inside buildings. External bushings for air terminations can be specified with lower minimum temperature.

3. If allowance has to be made for the entry of dust, salt and sulphur contaminated air when doors are open, or when cable entrances through the floor are uncovered during maintenance and construction periods, then this shall be identified on the Requisition/Data Sheet.
4. The allowances made to militate against more aggressive atmospheric conditions shall be subject to approval by the Principal.
5. If specified on the Requisition/Data Sheet, self limiting or temperature panel heaters shall be installed.

Depending on the area where the switchgear will be installed, condensation inside the non GIS gas filled compartments may occur.

6. For offshore applications the switchgear shall be installed indoors.

2.2 Special service conditions

Add to this clause:

1. The Requisition/Data Sheet shall specify any special service condition that the switchgear may be required to withstand in its operational location and that may arise during transport, storage and erection, e.g., pollution, temperature and humidity, shock and vibration.
2. Unless otherwise specified, the switchgear shall be suitable for installation in a non-hazardous area as defined in IEC 60079-10.

3 Terms and Definitions

Add the following new definitions:

3.122 buscoupler

1. Mechanical switching device used to connect the two busbar systems of a double busbar arrangement.

- 3.123 bay
1. Constructional unit of an assembly between vertical delineations of a three phase circuit.
- 3.124 section
1. Constructional unit consisting of a number of bays connected to a continuous busbar system.
- 3.125 sectionalising switch
1. Mechanical switching device used to connect the busbar systems of two sections.
- 3.126 trip circuit supervision (TCS)
1. Healthy trip indicator provided on all units with electrical tripping. Any loss of trip supply or broken wire in the trip circuit shall operate an alarm relay with contacts wired up for a remote alarm provision.

4 Ratings

Add the following new note:

NOTE: This section of IEC 62271-203 dated 2003-11 has many references to IEC 60694 which has now been superseded by IEC 62271-1. The relevant clauses in IEC 62271-1 apply where IEC 60694 is referred to in IEC 62271-203.

4.1 Rated voltage (U_r)

Add to this clause:

1. The nominal voltage shall be stated on the Requisition/Data Sheet, including information on the system earthing, e.g., earthed via neutral earth transformer.
2. Based on the information on the datasheet, the Manufacturer shall select the applicable rated voltage in accordance with IEC 62271-1.
3. Temporary voltage depressions down to 80% rated system voltage shall not affect switchgear and controlgear operations.

Maximum variations of both voltage and frequency can occur simultaneously.

4. Switchgears to be installed offshore shall be suitable for continuous operation from a supply that is subject to voltage waveform distortion caused by thyristor-controlled loads.
 - a. In the absence of any other data, a figure for total harmonic distortion of 8% shall be used.

4.3 Rated frequency (f_r)

Add to this clause:

1. The rated frequency may be 50 Hz or 60 Hz and shall be stated on the Requisition/Data Sheet.

Frequency variations between plus and minus 2% are acceptable.

4.4 Rated normal current and temperature rise

4.4.1 **Rated normal current (I_r)**

Add to this clause:

1. The rated normal current shall be as indicated on the Requisition/Data Sheet.
2. Ratings shall be quoted on the basis of circuit-breakers and contactors being housed in cubicles under natural ventilation conditions.
3. Cooling fans within the switchgear to allow higher bus bar ratings shall not be used.
4. The current rating of the incoming feeder, sectionaliser and buscoupler switches shall be the same.
5. The main busbar systems shall be fully current rated over the entire length of the switchgear and shall not be rated lower than the current rating of the incoming feeder, sectionaliser and buscoupler switches.
6. The rating of switchgear and controlgear assemblies shall take full account of all heat sources within the compartment including their make-and-break duties.

5 **Design and construction**

Add to this clause:

1. Gas insulated switchgear (GIS) shall be designed for continuous operation at full load for at least 10 years without maintenance, unless the total number of allowed switching operations is exceeded.
2. The design and selection of equipment, components and functions shall be based on a technical lifetime of 25 years.
 - a. The expected lifetime of some of the hardware involved may be less than 25 years. The Manufacturer/Supplier shall state in the quotation the expected technical lifetime of these components. This shall not be less than 10 years. The Manufacturer/Supplier shall also confirm that replacement components will be available and indicate an expected duration of the replacement process.
3. The design of the switchgear shall permit installation, extension, operation and maintenance (preventive and corrective) with a maximum of one circuit (including any circuit requiring intervention) and one section of busbar out of service simultaneously.
4. Equipping and commissioning of spare panels and the connecting of main, control and auxiliary cabling shall be possible whilst the switchgear is energised and in operation.
5. A sectionalising switching device shall electrically interconnect sections for single busbar systems.
 - a. It shall be possible to work on and extend one side of the busbar system safely when the other side of the busbar system is energized.
6. Double busbar systems shall have facilities for each section to be electrically coupled by a buscoupler.
 - a. The busbar systems shall be fully segregated, making it possible to work on and extend one system safely when the other system is energized.

7. The protection relays and initiating controls to operate the switchgear shall be mounted in a separate cabinet, located in a separate room in the switchgear building.
 - a. All necessary switching operations, including application of earths, shall be from the protection and operation cabinet.
8. Interconnecting cabling between the protection and operation cabinet and the main switchgear shall be via pre-manufactured leads using plug and sockets to make connections at each end.
 - a. The plugs and sockets of the leads shall not be interchangeable i.e., it is not possible to incorrectly inter-connect a protection cabinet with its associated switchgear.
 - b. The design and choice of cabling of the leads shall be such that similar circuits use the same leads and that adequate shielding from EMC is provided.
 - c. The Manufacturer shall state in any offer the maximum lead length permitted with the lead design.
9. For applications up to 420 kV the option of mounting both control and protection/operation controls in the LV cabinet mounted on the switchgear may be offered if requested in the Requisition/Data Sheet.
 - a. For mounting of both control and protection/operation controls, the scope of supply shall include an HMI and supporting equipment to allow all switching operations to be performed in separate location to the main switchgear e.g., in a local control room housing the protection and operation cabinets.
 - b. The HMI shall allow full operation of all circuit breakers, three position switches, disconnectors and earthing switches.
 - c. The scope of supply shall include all software licences and programming of the HMI with a single line representation of the switchgear from which switching devices can be selected and operated.
 - d. The HMI shall be in addition to operation controls provided in the protection and operating control cabinets.
10. The layout of the operational front and the location of the components of the assembly shall be arranged in a logical and systematic sequence and standardized throughout.
 - a. Unless otherwise specified, no operational equipment or metering apparatus shall be located at levels below 200 mm and above 2000 mm.

This applies to both LV compartment mounted on the switchgear and any separate protection and operation cabinets
 - b. If the above requirement cannot be met due to space constraints or switchgear size, then details of the equipment to be installed above 2000 mm shall be given in the quotation together with proposals for any platforms or steps needed to provide adequate access to view or operate the equipment.

This is particularly relevant to LV panels with combined control, operation and protection devices.
11. Alphanumeric notation in accordance with IEC 60445 shall be used for identification and marking of phases, conductors and terminals.
12. For panel arrangements and schematics, refer to Standard Drawings series S 67 as listed in (Part IV).

5.2 Requirements for gases in switchgear and controlgear

Add to this clause:

1. In the quotation, the Manufacturer shall provide the criteria for environmentally friendly waste disposal of SF₆ (polluted) waste throughout the design life of the switchgear.

5.3 Earthing

5.3.101 Earthing of the main circuit

Add to this clause:

1. The Manufacturer shall state, at the tender stage:
 - a. the means by which busbars and feeder circuits can be “proved dead” prior to earthing;
 - b. how correct phase rotation between different circuits can be proven;
 - c. how high voltage tests of the switchgear can be undertaken during commissioning, and
 - d. how cable termination high voltage tests can be carried out.

Cable testing is done with AC supplies due to expected use of XLPE insulation for cables

2. The requirement for additional features or equipment (excluding HV test sets) shall be clearly identified in the quotation and whether these have been included in the scope of supply of the switchgear or if they are offered as an option.
3. A capacitive sensor system shall be installed, indicating presence of voltage on all outgoing feeders, incomers and busbars.
 - a. These shall be located such that presence of voltage can be checked before applying any earth switches or opening compartment covers.
4. A circuit or busbar earth shall be applied only via a HV switching device or an earthing switch designed for closing onto an energised busbar/feeder, unless there is certainty that the circuit connected is not live.
5. Earthing switches that can be closed onto an energised busbar/feeder shall have an electrical endurance class E1 according to 4.107 of IEC 62271-102 with respect to their capabilities of making and carrying the prospective short circuit current.
6. With earthing switches of the high speed fault making type, completing a slow close operation shall be prevented.
7. Unless otherwise specified in the Requisition/Data Sheet, the busbar earthing system shall be integrated with the sectionaliser HV switching device.
8. Integrated three-position switches, with busbar (or feeder) connected/ isolated/ earthed position shall be provided for connecting the circuit breaker to a busbar or to an outgoing connection.
9. Circuit and busbar earthing devices should be normally arranged for “local” operation only.

For this application, “local” is deemed to mean operation from controls mounted on the switchgear LV compartment or in a separate room provided at the substation or switchhouse to house the protection/operation control cubicles.

10. Interlocks shall be fitted to prevent accidental earthing of an energised busbar; refer to (5.11).