DEP SPECIFICATION

LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES (AMENDMENTS/SUPPLEMENTS TO IEC 61439)

DEP 33.67.01.31-Gen.

February 2011

DESIGN AND ENGINEERING PRACTICE

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PART I INTRODUCTION AND GENERAL

1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for low voltage switchgear and controlgear assemblies.

Part II of this DEP amends and supplements IEC 61439-2:2009, referring to the same clause numbers. The additional requirements specified in this DEP are required in order to:

a) Make selections from the options given in IEC 61439-2;
b) Specify additional and more stringent requirements, as necessary, to operate and maintain the switchgear in continuously operating plants;
c) Specify supplementary provisions required to make the gear suitable for operation in the overall process control design.

Integrated Motor Control Systems (IMCS) are covered in Appendix 1.

The requirements specified apply to power switchgear and controlgear assemblies (PSC-ASSEMBLIES). For assemblies used as sub-distribution systems, with incoming feeders protected by short-circuit current limiting devices of a nominal current of maximum 400 A, less rigorous requirements can be accepted; see (Part I, 2).

This is a revision of the DEP of the same number dated November 2006; see (Part I: 1.5) regarding the changes.

1.2 DISTRIBUTION, APPLICABILITY 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.

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 may 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 regard 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 which 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 which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

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The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Integrated Motor Control System (IMCS)	A system comprising control modules, central unit(s), a serial bus connecting the control modules to the central unit and a communication facility enabling connection of the central unit to a distributed control system (DCS) and/or a Supervisory Control and Data Acquisition System (SCADA).
Panel	A constructional unit of a (multi-) cubicle type assembly between two successive vertical delineations.
Requisition	is one of the following: DEP 33.67.01.93-Gen. (requisition for LV switchboard). DEP 33.67.01.94-Gen. (requisition for lighting distribution switchboard). DEP 33.67.01.80-Gen. (schedule for LV switchboard) is normally attached to the requisition.
Restarting relay (RR)	A relay which initiates the re-closure of a motor circuit under predetermined conditions, after a voltage depression or interruption.
Section	A constructional unit consisting of a number of panels connected to a continuous busbar system.
Sectionaliser unit	A mechanical switching device to connect the busbar of two sections.
Skeleton Compartment	A spare compartment for later completion but so equipped that completion can take place safely without the need to de-energise the switchboard or any other panel.
Time delayed restarting relay (TMR)	A time delayed relay which initiates a delayed re-closure of a motor circuit controlled by the process control system, under predetermined conditions, after a voltage depression or interruption.

1.4 CROSS-REFERENCES

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

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated November 2006.

Changes made have been predominately to align numbering and text with that used in the revised IEC 61439-2 and therefore all the paragraph numbering has been changed.

Other substantive changes are listed below.

Old section	New section	Change
2	2	Added general comments explaining use of same numbering of paragraphs as in IEC 61439-1 and IEC 61439-2
4		Reference to 2% frequency variation deleted. Same limits of frequency variation are now given in IEC 61439-1 section 5.4
	5.2.1	Wording revised to make consideration of THD by Principal applicable to all aplications

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8.4.2.3		Section deleted as interlock requirement now covered in IEC standard.
	8.5.3.102	Added option of using auxiliary contact on isolator for breaking neutral pole in motor starter control circuits
	8.5.3.111	Changed text to make use of digital multifunction meters the default provision with analogue as an option
7.6.2.1	8.5.5	Reference to minimum mounting heights for equipment deleted as now covered in IEC standard
7.6.1.1	8.6.1	Reference to sizing of neutral bar deleted as now covered in IEC Standard
	10.1	Defined list of items to be verified by test with numbering and titles as used in IEC Standard. This replicates tests called for in previous DEP.

1.6 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://sww.shell.com/standards and on the main page of the DEPs DVD-ROM.

2. GENERAL

Part II of this DEP amends, supplements and deletes various clauses/paragraphs of IEC 61439-2:2009. Clauses of IEC 61439-2:2009 that are not mentioned shall remain applicable as written.

IEC 61439-2 is based upon requirements of IEC 61439-1, uses the same titles and paragraph numbering scheme as IEC 61439-1 and contains amendments, supplements or new clauses to IEC 60439-1.

Unless modified in this DEP or in IEC 61439-2, all clauses in IEC 61439-1 shall remain applicable as written.

For simplicity, reference is only made to IEC 61439-2 in (Part II), but it shall be understood that text amendment may have been taken from base standard IEC 61439-1 rather than from IEC 61439-2.

The same numbering of clauses is used in this Part II as that used in IEC 61439-1 and IEC 61439-2.

Integrated Motor Control Systems (IMCS), when specified, shall comply with Appendix 1.

The requirements specified apply to power switchgear and controlgear assemblies (PSC-ASSEMBLIES). For assemblies used as sub-distribution systems, with incoming feeders protected by short-circuit current limiting devices of a nominal current of maximum 400 A, less rigorous requirements can be accepted. This is indicated in ***bold italic text*** under the specific headings, and with reference to this clause for the above definition.

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PART II AMENDMENTS/SUPPLEMENTS TO IEC 61439-2

1. SCOPE

Add to this clause:

Although this standard is mainly concerned with fully withdrawable gear of (multi-) cubicle type assemblies for indoor installation, it shall also apply to fixed and semi-withdrawable cubicle type assemblies and combinations thereof, and to multi-box type assemblies and assemblies located outdoors.

5. INTERFACE CHARACTERISTICS

Add to this clause:

5.2.1 Rated voltage (U_n) (of the ASSEMBLY)

During normal system operation and under steady-state conditions, the supply voltage shall not deviate from the rated voltage by more than 5 %

Transient voltage deviations during e.g. motor or group motor starting/reacceleration shall be such as to maintain a minimum of 90 % and shall be not more than 110 % of rated voltage on switchgear busbars.

The assembly shall be suitable to form part of a system with coordinated insulation values in accordance with IEC 60664-1, overvoltage category IV, and shall be type tested accordingly.

The overvoltage category of assemblies with a rated voltage in excess of 600 V shall be as a minimum category III.

Switchgear installed on some installations (typically on mobile and fixed offshore locations) has to be suitable for continuous operation from a supply which is subject to voltage waveform distortions caused by thyristor controlled loads. In the quotation stage, the Principal shall advise the percentage Total Harmonic Distortion that has to be taken into account if this exceeds limits given in IEC 61439-2.

Deviation from the supply characteristics, if any, shall be stated on the requisition.

5.3 RATED CURRENT

Add to this clause:

Unless otherwise specified in the requisition, the assembly shall be arranged for a TN-S power system, i.e. with separate neutral and protective busbars throughout the system.

The main busbars shall be rated for the nominal current over the entire length of the assembly and shall not be rated lower than the incoming and sectionaliser units.

5.3.3 Rated Diversity Factor

Add to this clause:

For temperature rise tests or temperature rise calculations, a diversity factor of 1.0 shall be applied for each switchboard panel containing only one functional unit. If a panel contains two or more functional units, the rated diversity factor applied shall be not less than 0.9 when considering the circuit loads as known at the time of final inspection at the Manufacturer's works. Spare circuits and skeleton compartments shall be considered as being loaded to 90 % of their rated current.

Where IMCS is specified, the equipment shall be included in the temperature test.

This supplement does not apply to assemblies used as sub-distribution systems as defined in (Part I; 1.1), to which the original clause of IEC 61439-1 shall apply.

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6. INFORMATION

6.1 ASSEMBLY DESIGNATION MARKING

Add to this clause:

Nameplates including circuit labels, instruction and warning plates and caution notes shall be made of durable, corrosion resistant material.

Add new clause:

6.1.101 General Equipment Nameplate

The following information shall be given on the general equipment nameplate, which shall be mounted on the front of the assembly, e.g. on the sectionaliser or incoming feeder:

a) Manufacturer's name or trademark;

b) Type designation;

c) Purchase order number;

d) Year of manufacture;

e) Rated voltage;

f) Rated frequency;

g) Rated current of busbar system;

h) Rated voltage of auxiliary circuits (if applicable);

i) Rated peak and short time withstand current and withstand time;

j) Degree of protection;

k) Form of internal separation.

The above information together with the other information of IEC 61439-1 clause 5.1 shall be given in the relevant documents of the Manufacturer.

Where applicable, other markings shall be provided on the assembly (e.g. CE, ATEX)

Add new clause:

6.1.102 Circuit labels

Each circuit of the assembly shall be provided with the following circuit identification labels:

a) Circuit identification tag number in accordance with standard drawing S 67.021. The circuit labels shall be installed on the front of the fixed and the removable part of a withdrawable or removable unit and repeated at the main and auxiliary cable terminations which are not clearly identifiable from the physical layout, e.g. cable compartments at the rear or bottom of the assembly.

b) Identification number of connected equipment or circuit destination as specified in DEP 33.67.01.80-Gen.

Add new clause:

6.1.103 Synoptic diagram

Assemblies shall be provided with a durable one-line synoptic diagram, indicating the busbar circuit and the specific function of the different compartments.

Synoptic diagrams are not required if the busbar system and the branch circuits can be viewed via transparent covers.

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Add new clause:

6.1.104 Instruction plates

If the operating sequence or procedure of certain equipment items in the assembly is not evident, e.g. mechanical interlocking features, instruction plates shall be provided fixed near the point of operation. The instruction shall be given as far as possible in a pictorial manner.

Add new clause:

6.1.105 Warning plates, caution notices

In locations where dangerous situations may inadvertently be created, warning plate(s) or caution notice(s) shall be installed, identifying the danger point(s). This may be either in a compartment or on the outside of an assembly.

6.2.2 Instructions for handling, installation, operation and maintenance

Add to this clause:

The Manufacturer shall supply at least the following drawings/documents in the quantities and at the times stated in form DEP 40.10.01.93-Gen., attached to the requisition:

a) Final single-line diagram *,

b) Schematic diagrams of all different types of circuits,

c) Documentation as specified in Appendix 1 (in case of IMCS only),

d) Final assembly arrangement drawing showing main circuits, main dimensions, panel layout, floor plan and shipping sections *,

e) Minimum clearances around the assemblies for ventilation and safety during operation and maintenance *,

f) Total mass of the assembly and of the individual shipping sections *,

g) Transport, installation, commissioning, operation and maintenance instructions, limited and specific to the assembly and its components,

h) Instructions of measures to be taken, if any, with regard to EMC associated with the installation, operation and maintenance of the assembly,

i) List of recommended spare parts and SPIR forms (see DEP 70.10.90.11-Gen.),

j) List of applicable type test certificates,

k) Test report of the final routine testing.

NOTE*: Items marked * may be combined, provided all information indicated above is included.

All documents shall show the relevant order number, item and Manufacturer's references, and shall be formatted and distributed as specified in the purchasing documents. Documents shall also be provided on a PC readable device (e.g. CD-ROM), unless otherwise specified by the Principal.

Assemblies supplied in transport units shall have these units clearly marked to facilitate assembly at site.

Erection instructions and any special tools required for erection and maintenance shall form an integral part of the order and shall be packed with the equipment.

The Manufacturer shall provide with the quotation preliminary arrangement drawings and details of component ratings, e.g. by filling in the appropriate sections of DEP 33.67.01.80-Gen. (schedule for LV switchboard), and all other information as specified further on in this DEP.

The language used shall be as specified in the requisition.

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7. SERVICE CONDITIONS

7.1 NORMAL SERVICE CONDITIONS

Add to this clause:

The actual service conditions shall be specified in the requisition if they are more onerous than those stated in IEC 61439-1.

The requisition shall specify the location (land or offshore installation) where the assembly will be installed. It also specifies whether the assembly will be installed indoors or outdoors.

7.1.3 Pollution degree

Add to this clause:

Unless otherwise specified in the requisition, the assembly and the components installed therein shall be suitable for use in a pollution degree 3 environment. However, the air will be laden with dust, salt and/or sulphur as encountered in the petrochemical industries or in oil/gas fields.

7.2 SPECIAL SERVICE CONDITIONS

Add to this clause:

Equipment installed on mobile and fixed offshore installations shall be unaffected by vibration and shock. The equipment for these applications shall be tested according to IEC 61892-3:1999, Table 9, Item 9.

Unless otherwise specified, the switchboard shall be suitable for installation in a non-hazardous area as defined in IEC 60079-10.

7.3 CONDITIONS DURING TRANSPORT, STORAGE AND ERECTION

Add to this clause:

Any special conditions that may arise, e.g. shock and vibration and/or extreme temperatures, shall be stated on the requisition.

8. CONSTRUCTIONAL REQUIREMENTS

Add to this clause:

Space heaters shall be included in the quotation as an option, if they are not specified in the requisition but the Manufacturer recommends their installation.

If anti-condensation heating is required inside the assembly, it shall be supplied from a separate source connected between system phase and neutral. The heating system of each section shall be separately protected and switched for isolation purposes by means of a miniature circuit breaker in combination with an earth leakage protecting device of 30 mA sensitivity. When the heating system is live, this shall be indicated by means of a prominently situated red LED. The heating system shall be designed in such a way that the heat is adequately distributed over all functional units.

8.1 STRENGTH OF MATERIALS AND PARTS

8.1.1 General

Add to this clause:

The assemblies shall be designed for continuous operation at full load for at least 90,000 h without maintenance which would require the main busbars and the distribution busbars (dropper system) to b e de-energised. When operating under the specified service conditions, the main and distribution busbars including their connections shall not require maintenance during the lifetime of the assembly.

NOTE: 1) De-energising of the main busbar and distribution busbars after 90,000 h may be required, e.g. to inspect and clean the compartments.

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2) Operation of switching devices may be required within the period of 90,000 h as mentioned above. For non-essential switchgear this may lead to de-energising of the busbar. Assemblies in vital and essential service will normally have dual feeders and bus section switches to cater for continuous operation, even when one of these switches is operated.

The assemblies shall have a design lifetime of at least 25 years, under the service conditions specified and maintained according to the Manufacturer's recommendation. Where IMCS is specified, the lifetime of this system shall be aligned with the lifetime of the assembly (see also Appendix 1).

Switchgear assemblies shall be completely enclosed, self-supporting and suitable for floor or wall mounting, in multi-cubicle or multi-box type structures. The floor shall not be considered as being part of the enclosure.

All structural work shall be adequately protected against corrosion. Frame and partitions may be of galvanised steel without a further paint coating. Those parts/covers requiring painting shall be properly pre-treated before the final coat(s) of oil resistant finishing paint is (are) applied. The Manufacturer's standard colour is acceptable. If a Manufacturer does not have a standard colour, light grey is preferred for the external surface.

Cover bolts or nuts shall be retained in place when undone (captive bolts and nuts).

Assemblies shall comprise one or more sections of busbars to which incoming and outgoing units are connected. Busbar sections shall be linked through sectionaliser units.

In addition to the outgoing units specified in the requisition or schedule, spare skeleton compartments shall be included in each switchboard. The number of skeleton compartments shall be 10 % of each size of outgoing units of which at least three units are installed. They shall be allocated to the switchboard sections in accordance with the actual load distribution and the maximum load that can be accommodated shall be taken into account. A skeleton compartment shall be equipped so that completion at its maximum capacity can take place safely without the need to de-energise the switchboard or any other panel.

8.2 DEGREE OF PROTECTION PROVIDED BY A PSC-ASSEMBLY ENCLOSURE

Add to this clause:

The degree of protection as defined in IEC 60529 for any assembly shall be:

- For indoor use (in enclosed buildings) IP 41
- For outdoor use (protected by e.g. rain canopy) IP 55

NOTE: Outdoor switchgear shall be provided with a rain/sun canopy.

Details of specific installation requirements for e.g. offshore facilities shall be specified by the Principal

8.4 PROTECTION AGAINST ELECTRIC SHOCK

8.4.1 General

Add to this clause:

All switchgear components requiring maintenance shall be easily accessible. All components in wall or back-to-back mounted switchgear shall be accessible from the front only.

Exposed parts within the assemblies that have to be accessible during normal operation, maintenance or equipping of spare compartments, shall either not be live in the opened position or shall be protected to a degree of protection of at least IP 2X.

NOTE: The terminals of the incoming and sectionaliser switching devices can be live when the device is in the off position. Consequently these terminals shall always be protected to a degree of at least IP 2X.

HBC fuses and associated fuse carriers shall only be accessible when they are fully isolated or when they offer a degree of protection to live parts of at least IP 2X when the fuses are inserted, have been withdrawn or are being withdrawn.

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Terminals of equipment installed on a compartment door and which can be live when the door is opened shall be shrouded to a degree of protection of at least IP 2X.

The above IEC requirements for interlocking of doors when isolating switch is in On position do not apply to assemblies used as sub-distribution systems as defined in (Part I; 1.1) provided that all live parts inside the compartment have a degree of protection of at least IP 2X.

8.4.5.2.3 Requirements related to accessibility for maintenance

Add to this clause:

When a withdrawable unit has been removed from the assembly, the live parts inside the fixed compartment shall be protected against touch, with a degree of protection of at least IP 2X. Where shutters are fitted to comply with the above requirement, they shall be mechanically operated by the movement of the withdrawable unit and not be dependent on gravity or springs.

Each set of shutters shall be capable of being individually operated and padlockable in the closed position. Shutters shall be marked as follows:

‘BUSBAR’ on shutters covering busbars,

‘INCOMING SUPPLY’ on shutters covering incoming feeder cables,

‘CIRCUIT’ on shutters covering outgoing feeder cables.

If a test position is provided (partly withdrawn unit), the degree of protection shall be at least IP 2X.

Interlock systems shall be of a mechanical lever type and shall not rely on the operation of springs or gravity.

All practicable measures shall be taken to prevent danger to personnel working on a disconnected functional unit with adjacent units still in operation. Parts likely to be removed for maintenance shall have retainable fastening means (e.g. captive screws).

8.5. INCORPORATION OF SWITCHING DEVICES AND COMPONENTS

8.5.2 Removable parts

Add to this clause:

Withdrawable units which are mechanically identical but electrically have a different function shall be non-interchangeable, e.g. it shall not be possible to install a motor starter unit into a space for a plain feeder unit of the same size.

8.5.3 Selection of switching devices and components

Add to this clause:

All components shall be standardised as far as practical.

The connections of the auxiliary circuits of withdrawable units shall be of the plug-and-socket type, automatically operated by the unit.

Circuits, components, wiring and terminal arrangements shall be installed in accordance with the relevant standard drawings of group S 67.

Add new clause:

8.5.3.101 Incoming and sectionaliser units

Incoming and sectionaliser units shall be mounted in separate compartments and shall be provided with independent manually operated air break switches (fault make, load break) or circuit breakers. When circuit breakers are specified they shall be mounted in separate panels. The utilisation category for the manually operated switches as defined in IEC 60947-3 shall be at least AC 22 for switching devices up to and including 630 A and may be AC 21 for devices with higher current ratings. The utilisation category for circuit breakers as defined in IEC 60947-2 shall be category A, unless otherwise specified.

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