

DEP SPECIFICATION

STATIC DC UNINTERRUPTIBLE POWER SUPPLY (DC UPS) UNITS

DEP 33.65.50.31-Gen.

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DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for static (semi-conductor) DC Uninterruptible Power Supply (DC UPS) units comprising rectifier and stand-by battery.

These units serve as a secure (uninterruptible) direct current source of power to vital instrumentation and safeguarding systems that perform a controlling, monitoring and safeguarding function in continuously operating plants.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application of Technical Standards

This is a revision of the DEP of the same number dated January 2010; 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.

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 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 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.

The lower-case word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Autonomy time	Specified time that the battery shall be capable of supplying rated current to the load within the specified voltage limits
Battery design capacity	Battery power required (BDCW) as determined by the battery calculation specified in Appendix 3
Conditioned room	Ventilated room where provisions have been incorporated to minimise dust ingress and maintain an equable temperature
Crest factor	Ratio of the peak value to the r.m.s. value of the total periodic waveform
Discharged condition	Condition reached when the battery has been discharged to the point that the unit can no longer deliver its rated output within the permissible output tolerances
Equalisation charge or commissioning/initial charge	Passing of an electric current through a vented battery by applying a higher voltage to equalise and realign the voltage distribution across the battery string (normally carried out with the battery off-line)
End-of-discharge voltage	Voltage at which the battery discharge is terminated
Float charging	Passing an electric current through a battery by applying a constant voltage from a charger so as to maintain the battery in a state of charge
High-rate charging	Passing a constant electric current through a battery by applying a controlled voltage from a rectifier, so as to restore the battery to a predetermined state of charge in a limited time span, usually applied after a period of deep discharge
Low maintenance nickel cadmium batteries	Valve-regulated type of nickel cadmium batteries designed for ultra-low maintenance and which also require a controlled maximum charging voltage
MTBF (Mean Time Between Failure)	Total operating period divided by number of faults that have resulted in outages (hours)
MTTR (Mean Time to Repair)	Total time to repair and return to service divided by number of faults that have resulted in outages (hours).
Flame retardant material	Material which, without any further admixture, will not, when ignited, continue to burn nor cause other material, in contact with or adjacent to it, to ignite
Partially discharged condition	The condition reached when the battery has been discharged to the point where it is no longer capable of delivering sufficient energy to the load.
Rated output	Power, expressed in kW, which can be continuously delivered by the DC UPS unit over the range of conditions of service and electrical loading specified in this DEP, without exceeding component ratings or going outside any of the specified output tolerances

Relative harmonic content	The ratio of the r.m.s. value of the harmonic content to the r.m.s. value of the total non-sinusoidal periodic waveform, as follows:- Relative harmonic content = $\text{SQRT} (1-(g_1/g)^2)$ Where g_1 = r.m.s. value of fundamental component of current/voltage and g = r.m.s. value of the total wave form of current/voltage
Requisition	Data/requisition sheet DEP 33.65.50.93-Gen.
Switched Mode Power Supply (SMPS)	Power supply where the output DC voltage and current are pulse-width controlled by means of switching, at high frequency, an unregulated DC voltage converted from the AC mains
Total harmonic distortion (THD)	Ratio of the r.m.s. value of harmonics to r.m.s. value of fundamental.
Vented, flooded batteries	Battery cells incorporating free liquid electrolyte in an enclosed container having one or more vents through which gaseous products may freely pass, and which can accept high-rate charging following a discharge (can be lead acid or NiCd)
Vital service	Service which, if failing in operation or when called upon, can cause an unsafe condition of the process and/or electrical installation, jeopardise life, or cause major damage to the installation
VRLA batteries	Valve-regulated lead-acid battery cells in containers which are sealed under normal conditions, and in which the electrolyte is absorbed in plate separator material so that oxygen evolved from the positive plates transfers to the negative plates and 'recombines' to form water. The containers incorporate a pressure relief device to permit the escape of gas if the internal pressure exceeds a certain value. The cell charging voltage on VRLA cells needs to be strictly controlled and high-rate charging is not permitted

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 (8).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated January 2010. The following are the main, non-editorial changes.

Old section	New section	Change
2.1	2.1	SHALL [PS] statement revised to limit applicability of requirement to supplies feeding safety critical systems
2.2	2.2	Lifetime requirement for Plante batteries added Comment on thyristor and SMPS rectifiers deleted
2.3	2.3	"SHALL [PS]" changed to "shall"

Old section	New section	Change
2.5	2.5	Comment on service conditions deleted. All "SHALL [PS]" statements changed to "shall"
3.4	3.4	Comments on use of active devices and switches to regulate output voltages deleted
4.1.1	4.1.4	Comment on gas evolution deleted
4.5	4.5	Comments on factors to be considered when transporting and storing batteries deleted
5.1 & 5.2 & 5.4	5.1 & 5.2 & 5.4	"SHALL [PS]" statements changed to "shall"
6.2.3	6.2.3	Load-duration test period reduced from 24hrs to 8 hours

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

2. GENERAL REQUIREMENTS

2.1 BASIC STANDARDS

The DC UPS unit shall comply with this DEP and IEC 60146-1-1, IEC 60146-1-3 IEC 62040-3, IEC 60623, IEC 60896, IEC 62259 and EN 50272-2. In the event of a conflict, the requirements of this DEP shall take precedence.

Additional information relating to the specific installation requirements of individual UPS systems shall be defined by the Principal on the Requisition DEP 33.65.50.93-Gen. The Manufacturer shall complete the Requisition providing the necessary information to enable the Principal to assess the suitability of the proposed UPS equipment to be evaluated and confirmed during the tendering.

Robust and reliable UPS supply units and distribution systems SHALL [PS] be used to supply safety critical systems e.g. process safeguarding systems.

Robust UPS systems in this context are those with an overall availability of greater than 99.95%, an overall MTBF in excess of 150,000 hrs and a MTTR of 8 hours. These figures exclude outage time for battery discharge testing and assume spare parts are available at site. Refer to section (3.9).

UPS systems which are designed and manufactured in accordance with this specification are deemed to meet these requirements.

In the quotation, the Manufacturer shall confirm compliance with the requirements of this DEP and the Requisition. Any deviations shall be clearly highlighted.

The Manufacturer of the UPS shall be held responsible for all the equipment in the scope of supply, including the battery.

In case of conflict between documents relating to the enquiry/order the following priority of documents shall apply:

1. Purchase order
2. Requisition
3. This DEP

2.2 DESIGN BASIS

The DC UPS rectifier shall be of either the thyristor-controlled type or of the switched mode power supply (SMPS) type. The selection of SMPS type shall be subject to approval by the Principal.

The DC UPS unit SHALL be designed to minimise the risk of short circuits and SHALL ensure personnel and operational safety at all times.

DC UPS units are normally installed in conditioned rooms, unless otherwise specified.

The design and selection of equipment and components shall be based on achieving the following minimum lifetimes:

- a) 20 years for the rectifier and associated auxiliaries;
- b) 6 years continuous operation for rotating equipment, e.g. cooling fans;
- c) 10 years for capacitors of the electrolytic type to retain capacity needed to operate within the specified tolerances;
- d) 20 years for NiCd battery cells when operating in an average room temperature of 25 °C;
- e) 20 years for Lead Acid (Planté) battery cells when operating in an average indoor ambient temperature of 25 °C and 10 years for other vented lead acid battery types
- f) 12 years for VRLA battery cells when operating in an average room temperature of 20 °C.

Additionally, the DC UPS shall be designed to operate totally maintenance free for a 6-year continuous period. However periodic inspections of the unit, including topping up of vented cells and high-rate charging, are permitted.

- NOTES:
1. This is independent of any self-regulation features that the UPS may utilise to optimise battery performance.
 2. The Principal may specify reduced lifetimes and maintenance intervals in the requisition for less onerous applications.

All components shall be of a quality and reliability that satisfies the requirements of a secure DC source of power to vital equipment performing a controlling, monitoring and safeguarding function in continuously operating petrochemical process units, production facilities and utility installations.

Components shall be capable of withstanding the thermal and dynamic stresses resulting from internal and external short circuits and circuit switching operations, etc. Damage arising from component failure should be confined to the component concerned. Component materials shall be non-flame propagating, wherever practicable. For tropical applications, the DC UPS components shall be protected against moisture and fungus.

Capacitor electrolytes shall be not very toxic (see DEP 01.00.01.30-Gen. for definition), e.g. shall not contain polychlorinated biphenyls (PCBs).

2.3 OPERATING PRINCIPLE

The performance requirements as specified in (3) shall be based on the following basic operating principle of the DC UPS unit:

The output of the rectifier shall, during normal operation, continuously supply the power requirements of the load while simultaneously maintaining the battery charge in the float charge mode. In the event of an interruption or depression in the AC mains voltage to the rectifier, the battery shall supply the load requirements for not less than the autonomy time as specified on the Requisition whilst maintaining the output voltage within the permissible limits (3.5). The battery capacity selected by the Manufacturer in order to achieve this will henceforth be referred to as its 100 % nominal capacity.

Upon restoration of the AC mains voltage, the rectifier shall automatically resume supply of the load requirements while simultaneously recharging the battery in a time as specified in (3.1.2). Where high-rate charging is necessary to fulfil this requirement, then this shall only be possible by manual initiation, providing the interlocking provisions of (3.3) are met.

The DC UPS unit shall be suitable for operation in parallel with one or more identical units that may have unsynchronized AC supplies.

2.4 UNIT RATING

The rated output of the DC UPS unit rectifier shall be based on standard duty Class I of IEC 60146-1-3.

Unless otherwise specified on the Requisition, DC UPS units having rated outputs up to and including 1.8 kW shall have single-phase and neutral inputs and units having rated outputs in excess of 1.8 kW shall have 3-phase and neutral inputs.

The nominal DC output voltage shall be as indicated on the Requisition as one of the following standard DC voltages 24 V, 48 V, 110 V and 220 V.