

PETRONAS TECHNICAL STANDARDS

MANUAL

Static DC Uninterruptible Power Supply (DC UPS) Units

PTS 33.65.50.31

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This revision of PTS **33.65.50.31 – Static DC Uninterruptible Power Supply (DC UPS) Units (February 2011)** has been reviewed and updated to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. All updates in the document are highlighted in *italic* font (if any).

The previous version of this PTS **33.65.50.31 – Static DC Uninterruptible Power Supply (DC UPS) Units (February 2010)** will be removed from PTS binder / e-repository from herein onwards.

Document Approval

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PREFACE

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They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

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The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

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1. INTRODUCTION

1.1 SCOPE

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

The unit as specified is required to 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.

The DC UPS unit shall comply with this PTS and IEC 60146-2, IEC 60478, IEC 60623 and IEC 60896. In the event of a conflict, the requirements of this PTS shall take precedence.

Additional information relating to a specific installation is given in the requisition sheet PTS 33.65.50.93.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this document is confined to companies forming part of PETRONAS group and to Contractors nominated by them.

This PTS is intended for use in oil refineries, chemical plants, gas plants and in exploration/production and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this PTS the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this PTS 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 with the object of obtaining agreement to follow this PTS 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 **Purchaser** is the party that buys the DC UPS Unit. The Purchaser may be either the Contractor or the Principal.

The word **shall** indicates a 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 rms value of the total periodic waveform
C₁₀	nominal battery capacity based on a 10-hour discharge rate at 20 °C
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)
final (or 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
MTTR	Mean Time to Repair
non-flame-propagating 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
non-toxic substance	substance which causes no harm to the environment nor to a person exposed to it or ingesting it, unless that person is exposed to or ingests it under unusual conditions or in an overwhelming dose.
partially discharged condition	condition reached when the battery has been discharged at the rate specified on the requisition to the final voltage
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 PTS, without exceeding component ratings or going outside any of the specified output tolerances
Switched Mode Power	power supply where the output DC voltage and current are pulse-width controlled by means of switching, at high

Supply (SMPS)	frequency, an unregulated DC voltage converted from the AC mains
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
Modular	Made of 'plug-in units' which can be added together to make the system larger, improve the capabilities, or expand its size.
Redundancy	Duplication of the modular rectifiers and/or controller with the intention of increasing reliability of the system usually in the case of a backup, with typical configuration of N+X, where X=1,2 or 3.
Hot - swappable	The ability to remove, replace or install the rectifier, inverter and controller modules in the system while in operation.
Scalability	The ability to expand further in power capacity to the maximum power rack capacity through addition of modules.

1.4 CROSS REFERENCES

Where cross references to other parts of this PTS are made, the referenced section number is shown in brackets. Other documents referenced in this PTS are listed in (8).

2. GENERAL REQUIREMENTS

2.1 BASIS OF DESIGN

The DC UPS unit shall comply with IEC 60146 and IEC 60478. The static non-modular DC UPS rectifier shall be of either the thyristor controlled type or of the switched mode power supply (SMPS) type. The static modular DC UPS rectifier shall be of the hot swappable switched mode power supply (SMPS) type with the features of modularity, redundancy, scalability and efficiency of minimum 90%. The selection shall be Manufacturer's choice unless specified otherwise in the requisition.

The design of the DC UPS unit shall be such as 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:

- 20 years for the rectifier;
- 4 years continuous operation for rotating equipment, e.g cooling fans;
- 8 years for capacitors of the electrolytic type to retain capacity needed to operate within the specified tolerances;
- 20 years for NiCd and vented lead acid battery cells when operating in an average room temperature of 25 °C;
- 10 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 4 year continuous period. However periodic inspections of the unit including topping up of vented cells and high rate charging are permitted.

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.

For tropical applications, the DC UPS components shall be protected against moisture and fungus.

Capacitor electrolytes shall be non-toxic and free from polychlorinated biphenyls (PCBs).

2.2 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 specified time (3.4) 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). Where rapid 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.