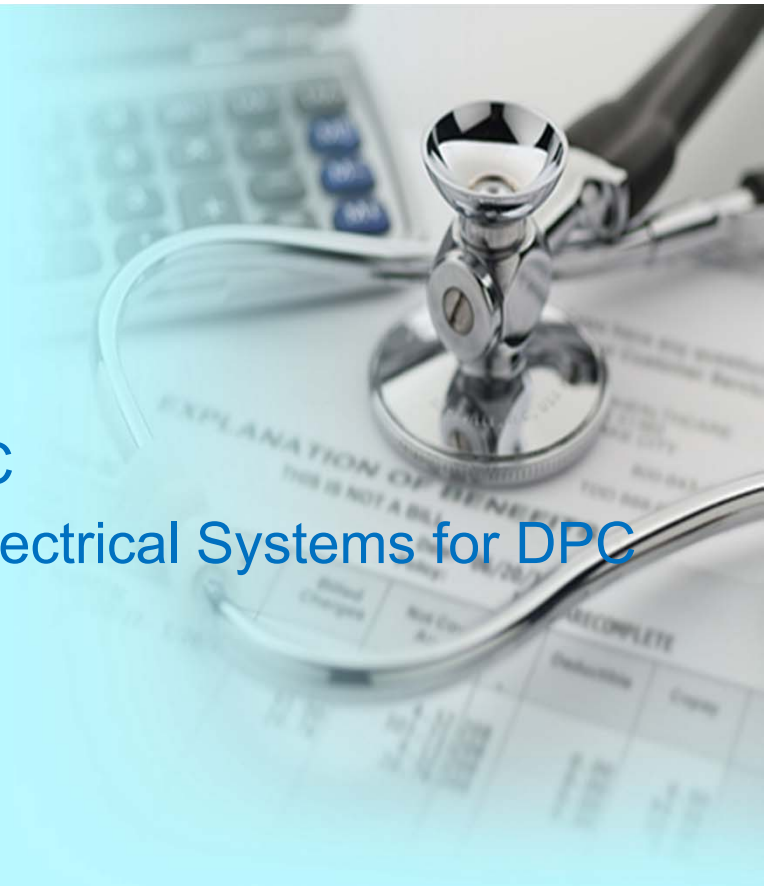
Electrical Installation for Day Procedure Centres

Seminar on Healthcare Engineering Systems of Day Procedure Centers

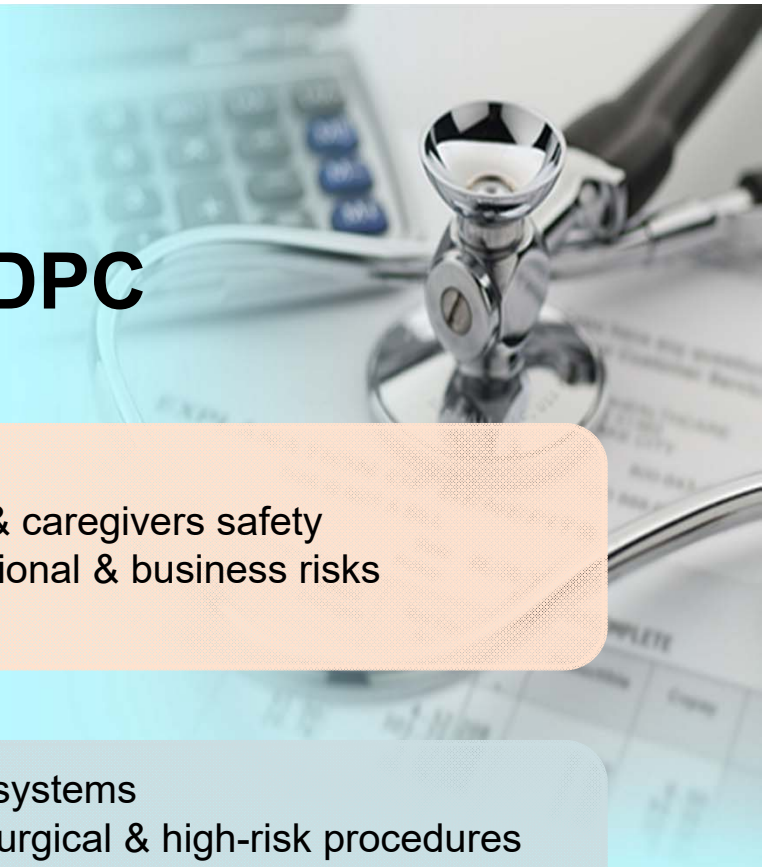
29 November 2019

Outline



- Requirements by CoP for DPC
- Technical Requirements on Electrical Systems for DPC
- Application of UPS in DPC
- Other Requirements

Electrical Systems in DPC



Safety and Reliability

- Ensure patient & caregivers safety
- Minimize operational & business risks

Support Operation of Critical Systems

- Life-supporting systems
- Equipment for surgical & high-risk procedures
- Critical medical devices
- Critical IT systems

Requirements by CoP for DPC

Electrical Installations are designed and installed to meet the electrical demand

International acceptable healthcare standards

Critical care areas – provided with back-up power supplies

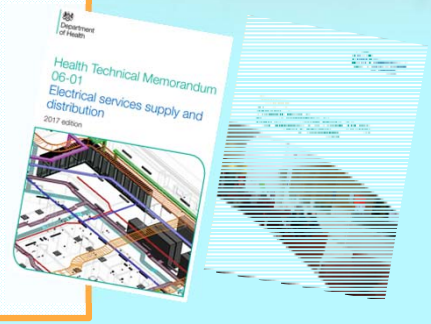
Technical Requirements

Statutory Requirements

- Electricity Ordinance (Cap. 406)
- Buildings Ordinance (Cap. 123)
- Fire Services Ordinance (Cap. 95)
- Dangerous Goods Ordinance (Cap. 295)

International Healthcare Standards

- Health Technical Memorandum (HTM) 06-01 “Electrical Services Supply and Distribution”
- Health Building Notes (HBN) 10-02: Day Surgery Facilities
- Other equivalent standards…



HTM 06-01 – General

- Design electricity distribution based on risk of loss of supply of individual areas

Risk Management Approach

- *N+1* redundancy design should be adopted whenever possible

Resilient Design

- Safe and adequate access for maintenance should be provided

Maintenance Access

HTM 06-01 – Electrical System Infrastructure

Primary Electrical Infrastructure (PEI):	• Supplies from power companies
Secondary Power Supply (SPS)	• Emergency generators
Tertiary Power Supply (TPS):	• Uninterruptible power supplies

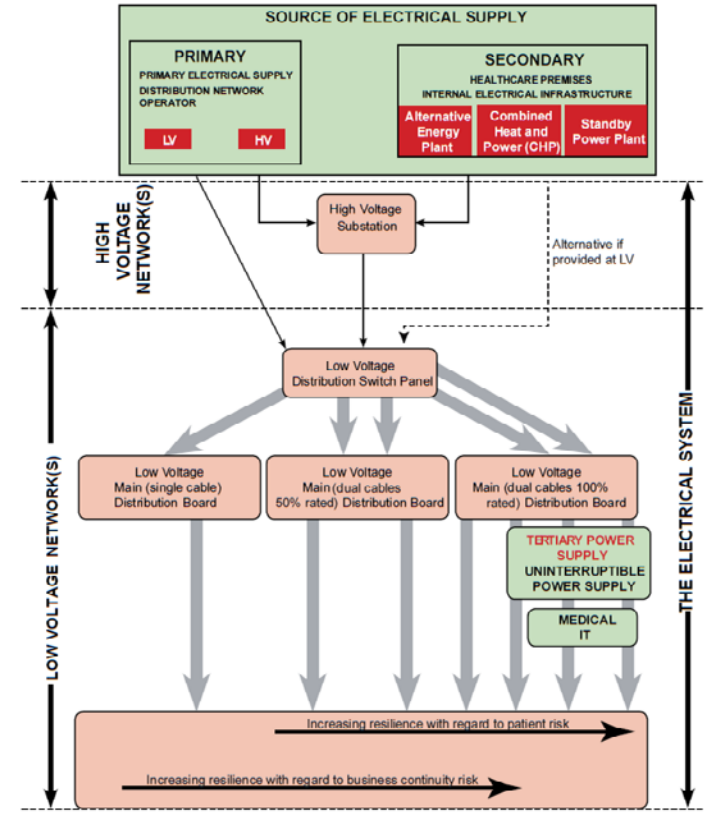


Figure 5 Electrical infrastructure generic flow diagram

Backup Power Supplies

Secondary Power Supplies (SPS)

Emergency Generators

- Automatically available within 15 seconds of loss of normal supply
- Capacity of the emergency generator supply should support the essential services of the DPC according to its contingency plan

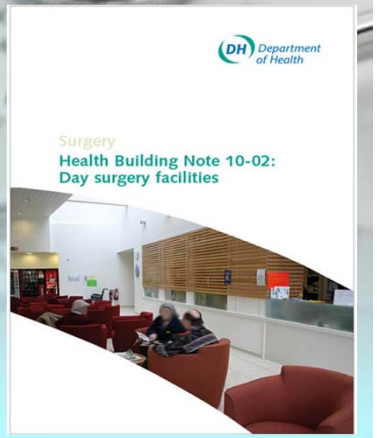
Tertiary Power Supplies (TPS)

Uninterruptible Power Supplies (UPS)

- Should be automatically available without power break upon loss of normal supply
- UPS and associated batteries should be sized with suitable back-up time for the essential services

HBN 10-02 – Small Power Distribution Systems

- Use of interleaved circuits and duplex supply units to ensure the resilience of final sub-circuits.
- Cables and cable containment systems should be concealed behind walls and ceilings.
- Socket-outlets of essential equipment in critical areas, e.g. recovery and critical care, should be prevented from accidentally switched off.
- Equipment requiring a three-phase supply should be permanently connected to a separate sub-circuit.



Electrical Systems for DPC in Existing Buildings

Sufficient Spare Capacity?

Availability of Emergency Generator?

Sufficient Spare Capacity?

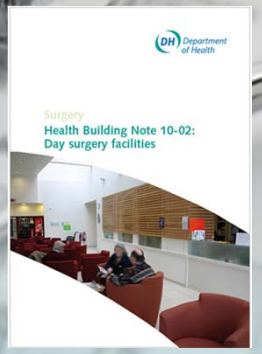
Existing electrical infrastructure may **NOT** have sufficient spare capacity for DPC operation

- ➔Upgrade system components, e.g. transformers, rising mains, sub-main conductors and corresponding protective/switching components
- ➔Protection scheme and protective components settings will require review after major alteration of the system

Availability of Emergency Generator?

HBN 10-02:

- Emergency generator providing electricity … should be capable of providing **full (100%) backup** … to the exclusion of refrigeration plant serving air-conditioning and comfort cooling plant.
- If an existing generator is to be used, …, if minimum requirement cannot be met:
  - Replace existing generator with a larger set;
  - Provide an additional generator that can be run in parallel; or
  - Provide an additional generator dedicated to the surgical procedures facility.



Application of UPS in DPC

DPC may require UPS of large power (VA) rating for medical equipment

➔**Larger battery** size

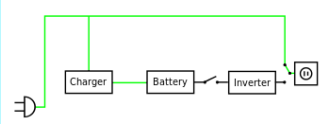
➔**More space** for settling UPS

Centralized UPS **vs** Distributed UPS

Commonly Used UPS

Standby UPS

The load is powered directly by input power.



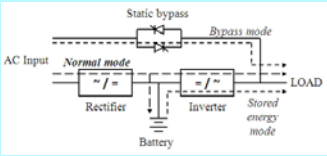
When input voltage falls below or rises above a predetermined level, the UPS turns on internal DC-AC inverter circuitry, which is powered from an internal storage battery.

Applications: Consumer electronics, non-critical computers, security systems, other general electronic equipment, etc.

Double-conversion (Online) UPS

When power loss occurs, the rectifier drops out and batteries keep the power steady without loss of supply

When power is restored, rectifier resumes carrying most of the load and charging batteries



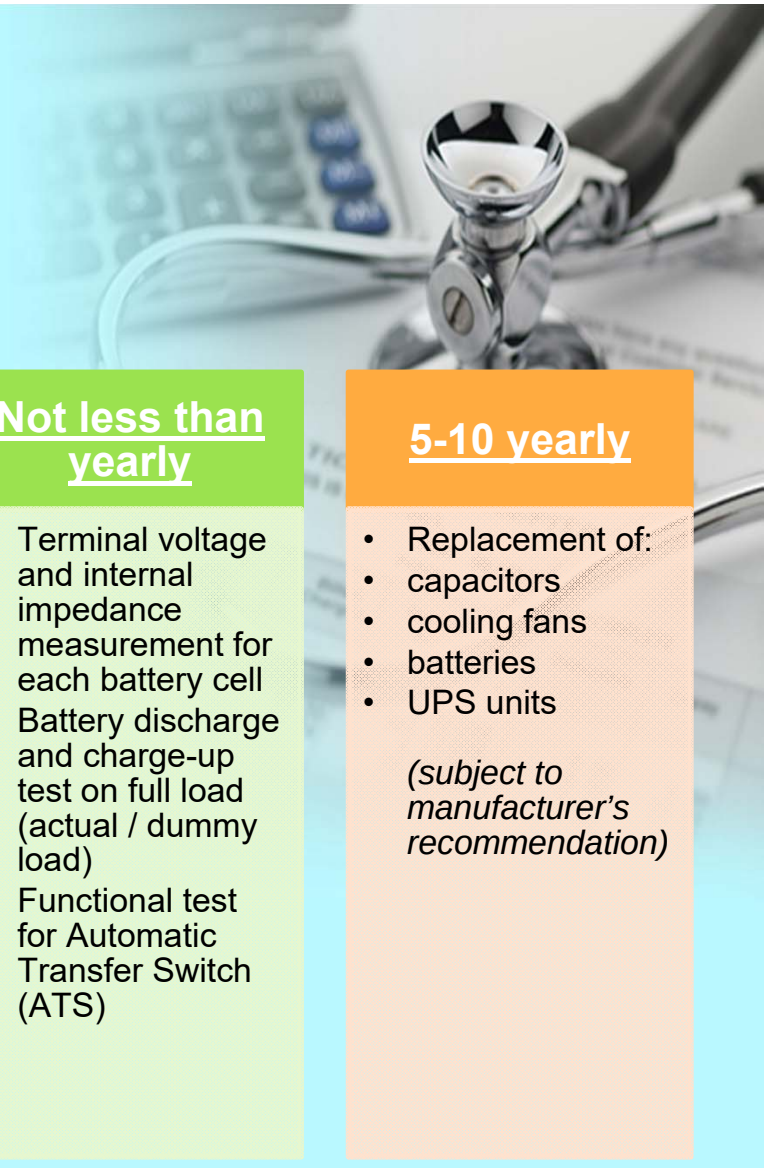
Applications: High-risk clinical areas, life-supporting systems, OT lightings, critical medical equipment, critical medical IT systems, etc.

Maintenance for UPS

Major Components of UPS

- Power electronics modules
- Power cables, circuit breakers, transformers
- Batteries

Maintenance for UPS



Monthly

- System log, alarm signals and status indicators checking
- Visual inspection
- Abnormal noise / heat (using IR scanner)
- Ventilation fans and filters
- Harmonic filter unit
- Static and external maintenance by-pass switches

Quarterly

- Input and Output voltage and current
- Load level (%) and power
- UPS temperature
- Battery surface temperature
- AC / DC capacitors surface temperature

Not less than yearly

- Terminal voltage and internal impedance measurement for each battery cell
- Battery discharge and charge-up test on full load (actual / dummy load)
- Functional test for Automatic Transfer Switch (ATS)

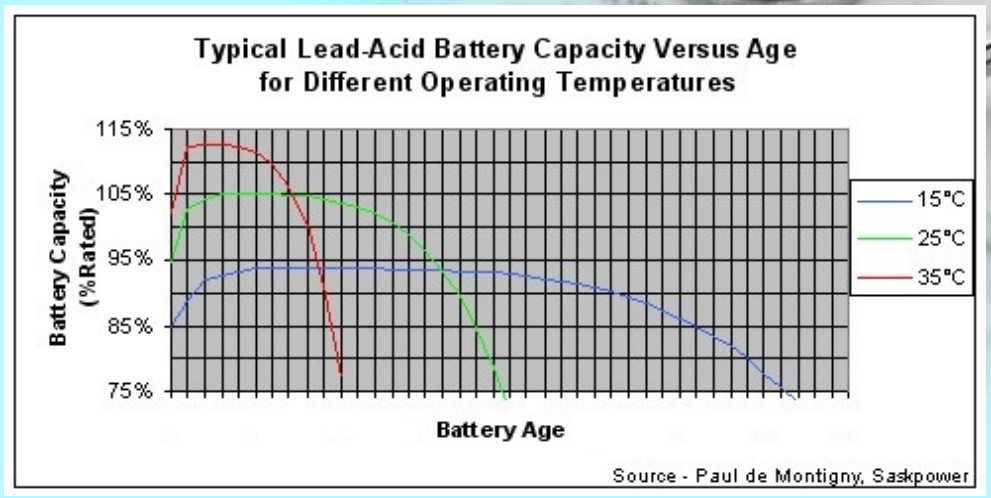
5-10 yearly

- Replacement of:
- capacitors
- cooling fans
- batteries
- UPS units

(subject to manufacturer's recommendation)

UPS Room Condition

- Avoid proximity to wet services (toilets, water pipes, etc.)
- Temperature and RH control (air conditioning)
- Ventilation
- Spatial clearance for battery cells

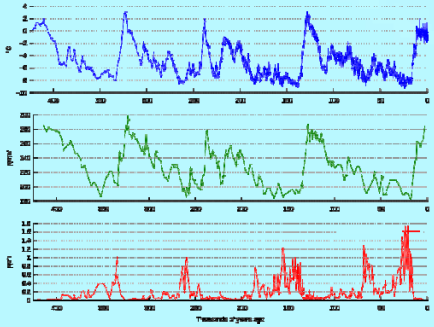


Proper Maintenance Record Keeping

Complete record of past adjustment, inspection and test results

Keep track on equipment conditions

Help refine maintenance schedule and replacement planning

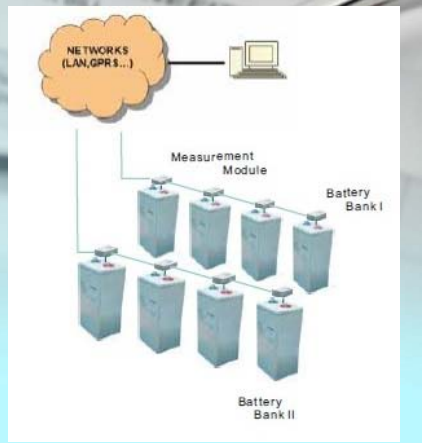


Battery Monitoring System

Continuous and real-time monitoring of battery condition (e.g. charging voltage and current, ambient & battery temperature, battery internal impedance, etc.)

Providing instant alarm to maintenance staff to take necessary corrective action before failure

Facilitating big data analysis based on information collected for achieving predictive maintenance



Other Requirements – Electricity Ordinance (Cap. 406)

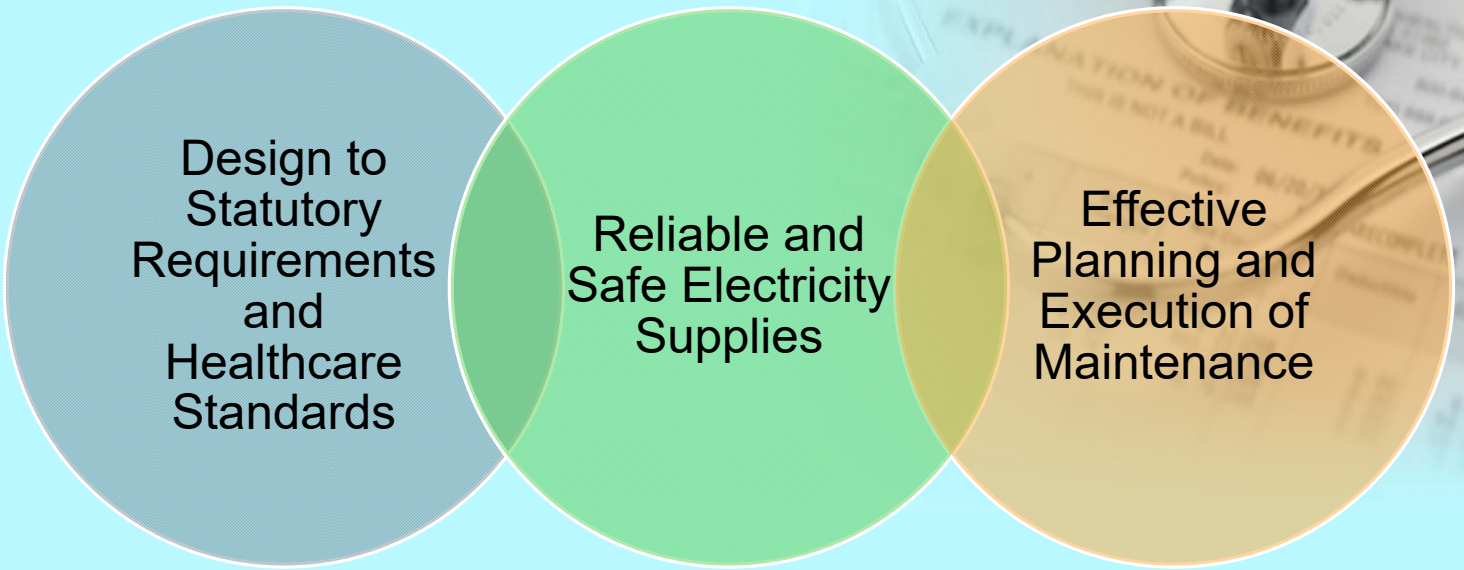
Work Completion Certificate (WR1)

- Fixed Electrical Installations must be certified by a registered electrical worker/contractor to be in safe working order after completion of design and installation and **before being energized for use**

Periodic Inspection, Testing and Certification (WR2)

- Installations with approved loading exceeding 100 A should be inspected, tested and certified by a registered electrical contractor **at least every 5 years**

Summary


Design to Statutory Requirements and Healthcare Standards
Reliable and Safe Electricity Supplies
Effective Planning and Execution of Maintenance

Thank You!!