PowerControl

HTM COMPLIANCE

WHITEPAPER

WHAT IS THE HEALTHCARE TECHNICAL MEMORANDUM?

Equipment failure within healthcare facilities must be avoided for patient safety. To assist, the industry has seen the release of The Healthcare Technical Memorandum (HTM). A document prepared by the Department of Health and Social Care (DHSC), a ministerial department of the government responsible for delivering policies and documentation regarding England's health and social care infrastructure.

Comprised of nine core topics ranging from environment and sustainability to electrical services, the HTM provides comprehensive guidance on best practice design, installation and operation of specialised building and engineering technology used in the delivery of healthcare. The entire range of HTM documentation is supported by the initial document, HTM 00 which forms the foundation of operational policies and explores risk management issues.

HTM 06-01 focuses on the supply and distribution of electrical services, highlighting the importance of reducing the probability of equipment failure during a primary mains power outage through secondary and tertiary power backup systems.

From when it was first published in 2007 there has been one update to bring it in line with changes in application, design and statutory requirements. Although adhering to the HTM 06-01 is not a legal requirement, the memorandum provides a point of reference whereby legislation and common law are outlined. The DHSC recommend that it is read it in conjunction with the BS7671 standards.

UK HIERARCHY OF STANDARDS

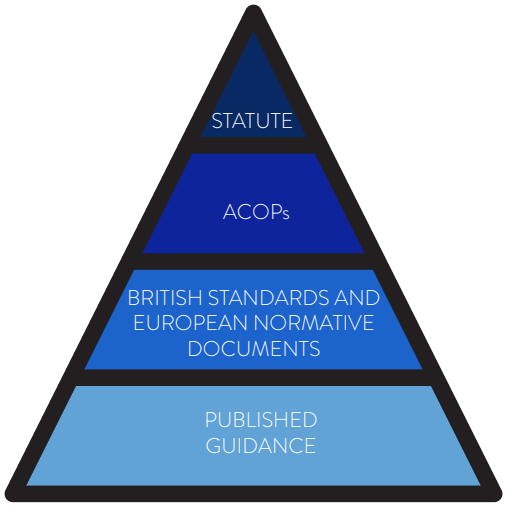

Figure 1

Although it is not a legal requirement to meet all the points set out in the HTM, it does form the foundation of statutory law. Figure 1 shows the hierarchy of standards relating to electrical services within healthcare facilities.

Within the BS7671, if a point refers to the HTM06-01 in relation to location classification, such as that referring to the grading of clinical risk and non-clinical risk by location, then this can be deemed as best practice by UK Law and any harm caused by failure to take specific design steps and measures can be enforced under the HSWA 1974.

GRADING RISK BY LOCATION

When understanding the risks associated with a loss of power, the healthcare technical memorandum divides it into two main elements; clinical risk and non-clinical business continuity risks. Each category is further divided into levels of risk from low to high (figure 2). Specified time periods in which power should be available, for patient and staff safety, also fit into each risk category. These times can be defined as a supply restored within:

- Greater than 15s
- Less than 15s, but greater than 5s
- Less than 5s, but greater than 0.5s
- Less than 0.5s
- No break

Figure 2

CLINICAL RISK

Clinical risk is graded from 'A-E' (figure 3), the group deemed being at the lowest risk of harm if the power was to fail is 'E'. This group may include areas such as patient waiting rooms and pharmacies where an electrical supply loss does not immediately affect the clinical treatment or safety of patients.

Grade 'A' contains those areas where patients are at the highest risk of harm during a power loss and includes patients on life support or undergoing complex surgery. In these areas, an alternative power source must be available within 0.5 seconds or as a no break supply to meet best practice guidelines. A UPS is used as a method of bridging the gap of electricity supply to ensure the alternative power source is available within the time frame advised.

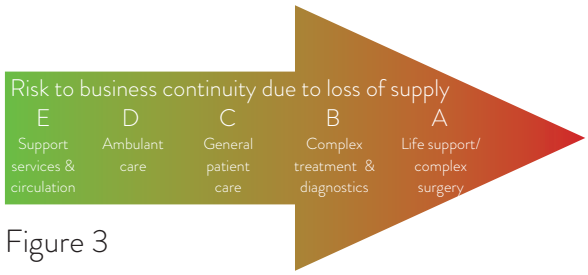

Figure 3

BUINSESS CONTINUITY RISK

While clinical risk is of the highest importance when designing the primary electrical infrastructure (PEI), there are several supporting elements essential to facility continuity. These risks are graded from 'I' to 'IV' (figure 4), 'IV' contains those areas at the lowest risk including finance departments, laundry and workshops, where a power disruption to these areas may not compromise the welfare of patients. To meet best practice guidelines they should have a single-conversion UPS to allow for safe system shut down and avoid data loss in the event of a power failure.

Areas allocated a risk grade of 'I' typically include sterile departments and laboratories. As there is a potential harm to patients if the power went out a UPS should be in place to meet best practice guidelines.

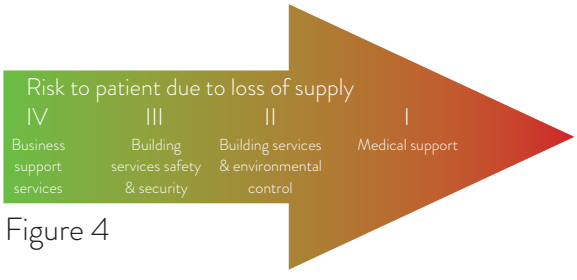

Figure 4

TERTIARY POWER SUPPLIES PER THE HTM

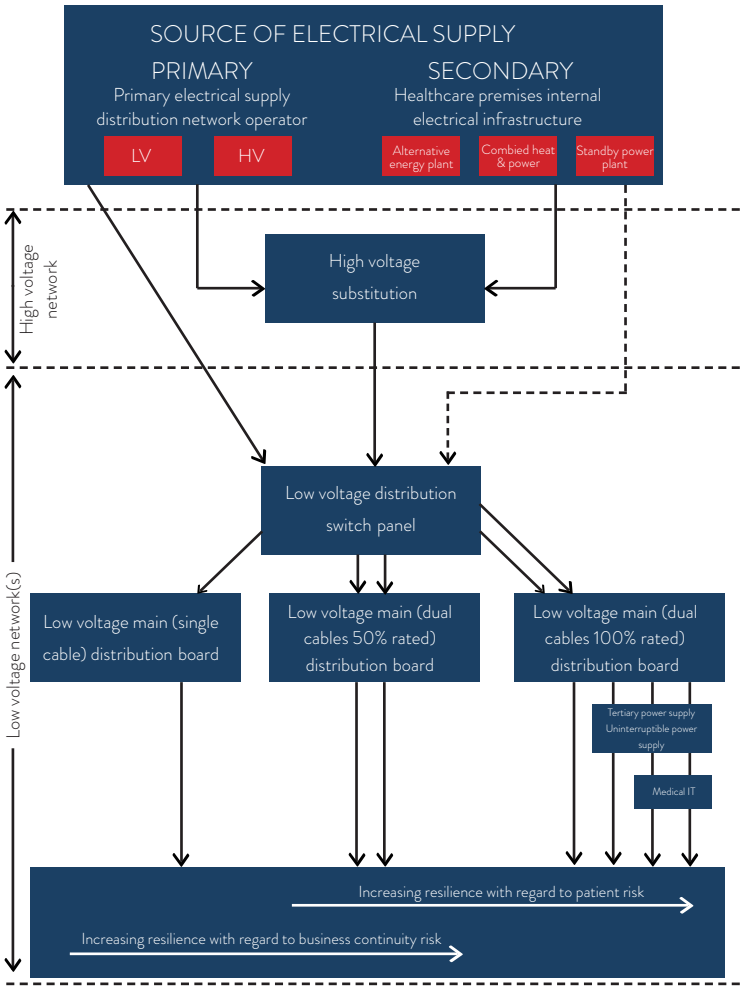

Figure 5

Due to the sensitive nature of healthcare facilities, it is not enough to simply have a secondary source of backup power, a tertiary power supply must also be present (Figure 5)

As defined by the HTM a tertiary power supply is a third supply that supplements the PES (primary energy supply) and the SPS (secondary power supply), usually in the form of a UPS or battery system. Careful consideration must be given to the size, location, configuration and internal component structure of the UPS to meet best practice and guarantee patient safety.

The system should also conform to the following standards:

- BS EN 62040-1
- BS EN 601461-1-1
- BS EN 61439-6
- Energy Networks Association's G514-1

UPS COMPLIANCE BY COMPONENT

Batteries form the fundamental structure of the UPS and determine the level of autonomy. There are certain criteria outlined in the HTM that UPS batteries must meet to comply with best practice guidelines. Firstly, the batteries must be of valve regulated lead acid (VRLA) composition. VRLA batteries are widely recognised for their near-zero gas emission and leaks and so present a lower environmental hazard to the UPS and surrounding area.

Secondly, the battery terminals should be threaded posts. These posts allow for a nut to be threaded down to secure the connection in place.

It is also important to note that the VRLA battery must comply with the BS EN 60896 (21 and 22) standards with threaded insert connection posts and flame retardant case materials.

UPS batteries require a suitable environment which is detailed in the manufacturer's operating manual, a guideline that is echoed in the HTM to fulfil their life expectancy. Typically, the ambient temperature around the UPS should be between 20 - 25°C with adequate ventilation and cooling. Placing a UPS in an environment not conducive to the outlined parameters will cause the electrochemical reaction in the battery to quicken. On average, for every 8.3°C over the recommended temperature, the life expectancy of the battery reduces by 50%. When arranging the batteries, designers should consider the use of split battery banks as this allows the UPS to remain online while half of the battery stings are being serviced.

10 years of battery life expectancy, based on the batteries being in the stable environment outlined above, is recommended to ensure the long term security of function.

Both single-phase and three-phase UPS systems have their place within healthcare facilities. Single phase systems are most commonly found supporting personal computers and IT network hubs ad used for safe shutdown after a mains failure. In reference to figure 2 and 3, a single phase UPS system would be found in clinical risk grade C, D or E areas.

Three phase, online double conversion UPS systems are used to support clinical risk grade A or B areas, protecting equipment such as medical IT systems and life support as these areas require a switchover, from failure to the PES to the tertiary power supply of less than or equal to 0.5s. Moreover, a battery autonomy of 3 hours is required in these areas if an SPS isn't available within 15s otherwise an autonomy of 1 hour is sufficient to give hospital staff, especially those in the operating theatre, enough time to facilitate 'patient closure'.

BYPASS SWITCH

Not to be confused with the internal static or internal maintenance bypass switch that UPS systems have, an external UPS bypass switch is usually a non-essential addition to a UPS. Internal switches only allow for safe maintenance work in electrically isolated parts of the UPS system. The speed at which they operate means they are considered as a no-break supply switch. However, to meet HTM best practice an external, rotary locking bypass switch should be installed in one of the following locations:

- Input supply to the UPS module
- Input supply to static and maintenance bypass
- The output of the UPS system

DC ISOLATORS

Furthermore, external battery DC isolators are required in hospital environments. These are ideally situated on the front of the cabinet or an accessible wall.

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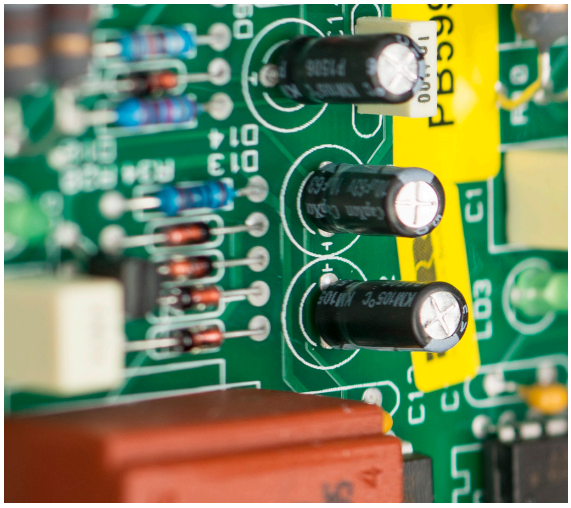
ISOLATION TRANSFORMERS

Although isolation (zero-phase shift) transformers can feature inside a UPS, separate external isolation (zero-phase shift) are essential to the overall infrastructure to prevent problems occurring when the input neutral is switched or broken. While the HTM shows these transformers can be placed on the output, Figure x, it is more beneficial for them to be installed on the UPS input. Consideration needs to be given based on the electrical infrastructure design.



UPS CONFIGURATION

To meet the minimum requirements of redundancy as stipulated in the HTM, a UPS solution must be placed in a parallel redundant configuration, also known as N+1. This configuration consists of one UPS (N) sharing the critical load evenly with another UPS (+1). Both UPS systems are either part of a common output bus, meaning that they are synchronised with one another or they have a function embedded within the module itself.

Furthermore, each UPS must be sized with enough capacity to individually be able to fully support the whole load to alleviate single points of failure within the system. For example, where the critical load is 100kVA, two UPS systems carrying an absolute maximum of 50% load each would be necessary.

With the system overload capacity being doubled, the mean time between failures (MTBF) is greatly increased due to each UPS system only being subjected to half the load compared to a capacity configuration.

UPS TYPE

Up until the HTM was updated in 2017, modular UPS solutions were not considered an option due to true redundancy definitions. As the modules are housed in one casing, with one, fuse, one breaker and one wire coming into it there is always a single point of failure. Using the same example as above of 100kVA, to achieve a true N+1 redundancy in a modular casing a dual bus architecture, with enough modules to cover 100kW per rack would be necessary. Although modular systems are now discussed in the HTM, achieving a true N+1 redundancy is not as cost effective as with a static tower UPS. Further consideration should be given before choosing a modular system.

CONTACT

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