

WHITE PAPER

The importance
of a reliable service
partner for data
centre UPS
installations



KOHLER POWER
uninterruptible

Critical data centre ICT loads depend on UPSs to protect them from power issues and blackouts; the UPSs in turn rely on well-managed maintenance plans to ensure they remain available.

This white paper discusses the possible UPS failure scenarios that can arise, and how these can be best mitigated through working with the original UPS supplier's maintenance team.

Introduction

Critical ICT loads within data centres rely on UPSs to protect them from power issues and ensure a continuous uninterrupted power supply at all times. To live up to this expectation, UPSs must not only be reliable and resilient, but also backed by a rigorous and well-executed planned maintenance programme that also includes on-site or fast access to critical spares inventory and a rapid and high-quality response service to cover emergencies.

However, optimising a maintenance programme for a particular data centre calls for consideration of many issues; the failure scenarios that must be allowed for, and the capacity of on-site staff to complement external technicians' maintenance efforts, or alternatively to create maintenance problems through operator error. The UPSs' topology is also a significant factor.

The maintenance programme's ability to handle these issues depends on how well resourced it is, in terms of technician skills and availability, ready availability of suitable and correct-revision components, and documentation and management.

Below, we discuss these maintenance factors, and how to design a maintenance programme to handle them. Among other points, this discussion highlights the benefits of using the original UPS manufacturer (OEM) to provide a professional maintenance solution.



Routine maintenance

Data centres are continuously populated with facilities staff who oversee the mechanical and electrical services, so there are opportunities for those staff to carry out some, but probably not all, of the routine-planned maintenance tasks if – and only if – the power system topology incorporates sufficient ‘concurrent maintenance’ capability. Those tasks include downloading the event logs, set-point monitoring, filter changes, visual inspection of all connections, general cleaning and battery cleaning/torque setting. If the concurrent maintenance capability is dependent upon manual switching of complete systems (including the UPS for example), then the correct levels of system training and familiarity exercises must be regularly carried out.

Non-routine maintenance and failure response

UPSs also require further maintenance tasks, but not so regularly or routinely. These include:

Battery load bank and cell impedance measurements (annual rising to biannual).

DC capacitor changes.

AC capacitor changes (7–9 year intervals)

However, these non-routine PM tasks - and all UPS failure interventions - are very infrequent. Emergency interventions (actual failure of one or more UPS functions) are so infrequent as to be virtually impossible to cover properly, especially by using on-site 24/7 multi-shift staff. The level of documentation and constant training required do not make commercial sense, especially considering natural wastage and turnover in onsite personnel. In contrast, a UPS OEM’s maintenance technicians are highly experienced in fault-finding and repairing UPS failures, as they are engaged in this daily, within a large installed customer UPS base. Their services need to be available under a contracted service level agreement.

Yet, once a first-line response from trained, experienced OEM technicians is contracted to be readily available, there are opportunities to supplement this support with effort from the data centre’s on-site staff. The exact nature of this working relationship depends on which of the four possible modes of UPS failure occurs, as described below:

A single-bus UPS system where one module fails causing a loss of redundancy but uninterrupted power to the critical load is maintained:

In this case, the cause of failure can be handled without pressure for the root cause. Faults due to operator error can usually be rectified by on-site operation staff, but if the cause cannot be identified then a qualified service technician will be required within 24 hours.

In a single-bus system where the entire UPS system (redundant or not) trips offline and successfully transfers the load to the utility supply:

In this case, as Figure 1 shows, the load has not been impacted, but is at immediate risk from utility-borne interference. A manual transfer to emergency generator supply, with controlled load and restart shutdown, would usually be recommended, although this brings additional risk from operator error and it has to have been previously established that the generator can support the ICT load without the UPS in circuit.

In mature urban grids, the MTBF (mean time between failure) of the utility voltage outside of the CBEMA PQ voltage immunity curve (embodied in IEEE466 and 1100, also known as the ITIC curve) is in the order of 250h but a ‘deviation’ from the CBEMA allowable region could occur almost immediately or, alternatively, not occur for several weeks depending upon transmission arrangements for the location, neighbourhood power consumers and climatic season.

Accordingly, getting the UPS rapidly back online is of paramount importance and the rapid intervention of an expert service technician will be vital – usually with a response time of less than four hours. To achieve that level of availability a service contract must be in place.

In a single-bus system where the entire UPS trips offline and does not transfer the critical load to the utility supply and the load is disconnected:

A loss of data centre load is a traumatic event in any business and the operator’s ability to get the UPS bypass connected, probably including manually starting the emergency generator system, will not reduce the impact of the failure but only speed up the process of recovery. A service engineer is almost always required to diagnose, repair and reinstate the UPS system.

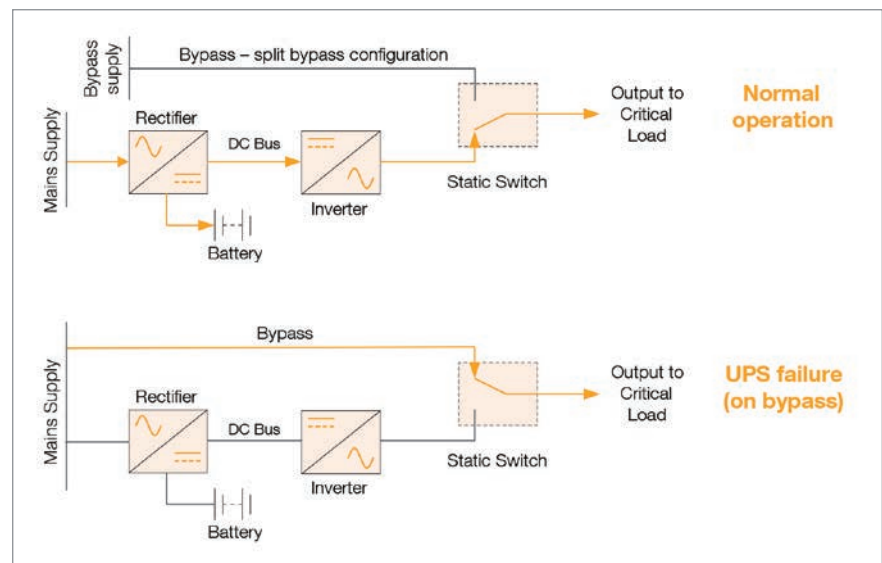


Figure 1: UPS failure mode and transfer to utility mains supply

In a dual-bus UPS system where one system is negatively impacted but the load remains protected either by being dual-corded or being protected by point-of-use static transfer switches: This is where the extra investment in a dual bus power system is rewarded and the provisioned fault tolerance fully utilised.

Clearly the failure in one of the two buses needs to be addressed quickly but the chances of load impact in the intervening period are negligible, if not almost zero. This failure mode is probably the only data centre power event where an immediate service intervention is not required, albeit still being a desirable target.

The human error element

Many published reports attribute as many as 70% of all data centre load-loss incidents to human error, the UPS share is thus reduced to the remaining 30%. In practice, this could be as low as 5% of the total failures for the power system.

Modular UPS topology

In small and medium-sized single-bus data centre power systems up to around 3MW, modular UPS topology can reduce the downtime of any individual UPS system drastically, even where the services of an external on-call service technician are

employed. Even better, if the on-site staff have a spare, pre-commissioned UPS module and have been trained for a module swap-out, then the downtime can be limited to less than one hour under most circumstances.



Figure 2: PowerWAVE 9500DPA modular UPS system

Figure 2 shows KUP's PowerWAVE 9500DPA, which can grow to 3MW capacity with vertical and horizontal scaling.

The failed module must still be repaired, but this can be done in a more relaxed and potentially error-reduced environment. If the end user carries redundant spare modules then the failed unit can be returned to the authorised OEM repair organisation for inspection, report, repair, load testing and return, rather than repaired on site. Such a repair service should be part of a formal support package.

Other benefits of UPS OEM support

Working with the UPS OEM's support team can bring further benefits instrumental to securing UPS safety and reliability. These include management of factory upgrades, remote system monitoring, and spare parts provisioning.

Factory upgrades: The OEM will be the only centralised repository for field operation and failure statistics of their particular UPS models. Where these affect performance and reliability the end user will benefit greatly from the OEM's continuous improvement processes. If the full traceability path of the equipment is intact, equipment upgrades that involve life safety will be initiated by the OEM. However, end users will only be included in such performance-related upgrades through a contract with the OEM or their authorised service agent. There are generally no processes that allow a third-party maintenance organisation to keep up to date with such initiatives.

Remote monitoring: Modern UPS monitoring systems such as KUP's PowerREPORTER (see Figure 3) can constantly monitor UPS systems to automatically detect any error or alarm messages, even on remote locations with no on-site personnel. If an incident is detected, PowerREPORTER automatically connects with KUP's Service Centre network via email, transmitting a status message and providing any available details relating to the fault, as well as a device identification string.

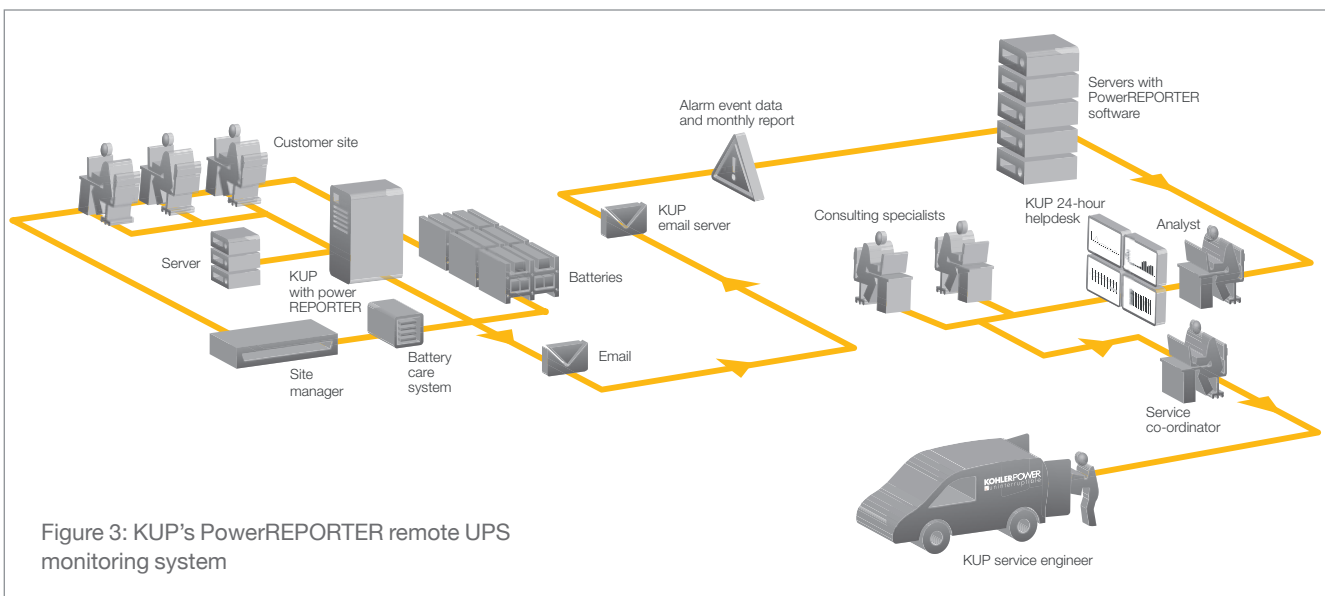


Figure 3: KUP's PowerREPORTER remote UPS monitoring system

KUP's service centre personnel can then liaise with the company's field team, who can integrate and manage the UPS, performing all necessary remote diagnostics before reaching the facility within the contracted service agreement time frame.

Specialised monitoring services for batteries and for generators can also be provided. For batteries, KUP's PowerNSURE checks each cell's internal resistance, temperature and voltage sequentially. The system manages equalisation and charging voltages. The process prevents gassing, dry-out and thermal runaway, and guarantees battery availability at all times.

KUP's Generator Remote Monitoring System provides generator monitoring, management and fault rectification. Once a week, the monitoring system automatically starts the generator and runs it for 10 minutes, checking vital operating parameters such as voltage, frequency, oil and water temperature, battery condition, emergency stop and fuel levels. After the test, it sends a full condition report to the monitoring centre via phone line or GSM upload, as well as optional SMS and voicemail messages to nominated numbers.

Spare parts availability: Access to spare parts is essential for high availability installations, but those spare parts must be of the correct generation, complete with any upgrades, 100% compatible with the installed machine and fully pretested. Only the OEM can guarantee their compatibility and provide local inventory that reflects the installed base. This inventory must support the installed machine for at least 15 years and be accessible within four hours. A rigorously maintained 'crash-kit' system, available to the technician on

a 24/7 basis for each UPS product, is an essential part of a comprehensive service support contract.

Pulling it all together – the service contract

Data centre operators are recommended to set up a service agreement to handle the situations described above, from preventative maintenance to time-guaranteed emergency responses. The agreement can bring together all the elements and resources needed, and package them to suit the facility's particular needs and priorities.

An effective service plan is summarised here. It should comprise annual scheduled preventative maintenance (PM) visits for both the UPS and its batteries, as well as facilities for emergency call-outs on demand. Trained engineers and technicians should be available 24/7, and based close enough to ensure arrival on site within contractually-agreed response times. These personnel should be backed with immediate access to a comprehensive local spare parts inventory, and more in-depth technical support if required.

Interested parties should be able to pre-empt UPS problems as far as possible through remote battery monitoring and impedance testing, generator monitoring, and UPS monitoring with monthly trend reporting and 24/7 alarm notifications.

The service plans must be well-managed, both to ensure their efficacy, and to maintain accurate budgetary control. Tasks include maintaining accurate monthly service records, and replacement planning with time and

budget considerations. Fulfilling recommended part-replacement cycles, once agreed, is important.

Good management also depends on profiling a service contract to each installation's particular circumstances: the type and size of the load, and how business critical it is; whether 24/7 coverage is needed for 365 days a year; and should parts and labour be included or treated as chargeable extras. In practice, battery and capacitor parts and labour are typically excluded.

The ideal number of scheduled preventative maintenance visits per year depends on the power system topology; single-phase installations can be safely supported with a single annual PM visit, while three-phase systems warrant two annual visits. PM visit times – during or outside normal working hours, or at weekends – should be specified, while guaranteed response time frames should be established. Popular choices include 4hr, 6hr, 8hr, end of next working day or next day.

Conclusion

Maintaining a UPS at a high level of availability, and responding fast on the rare occasions when a problem does arise, calls for readily-available, highly-skilled technicians, backed by appropriate spare parts inventory. This level of backup can best be achieved by leveraging the resources of the original UPS supplier, complementing these with support from the facility's on-site operational staff where it makes sense, and managing the overall strategy with a well-tailored maintenance contract.



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