Electrical maintenance: the importance of good practice

Cameron Steel, Electrical Design Engineer and Director of BK Design Associates UK Ltd, writes about the importance of good electrical maintenance.

Good maintenance regimes do not happen by accident: they need careful planning, proactive management and comprehensive reporting. The tone for good maintenance is also established beforehand by considerate design, intelligent construction and satisfactory commissioning.

There are specific legislative and regulatory responsibilities placed on the occupier of a building and associated premises as duty-holders to ensure the safety of the electrical installation. There are also statutory obligations to ensure the successful operation of life safety systems, such as emergency lighting and fire detection and alarm systems, when they are actually needed. Transportation systems such as lifts, escalators and moving walkways also need periodic assessment. Insurance policies may be an additional driver of this – if periodic certification cannot be produced then insurance policies may not be honoured if the need arises. BS 7671 (the IET Wiring Regulations) and the accompanying Guidance Notes discuss the periodic testing and inspection that should be at the heart of any maintenance regime for the premises' electrical installation.

Maintenance activity, especially on life safety systems, needs to be recorded and signed off. To demonstrate compliance of fire alarms, emergency lighting and similar systems with statutory requirements a log book recording periodic tests should be used. This in turn must be left available for auditing purposes. Dates of test, anomalies, and remedial actions should all be noted.

1.1 Instigating a maintenance regime on an existing property

The challenges of instigating a maintenance regime after taking over an existing property that may have been neglected for a few years has probably taxed the undoubted skills of many experienced facilities managers. Satisfactory maintenance of electrical building services and systems should not be left to chance; neither should the responsibility land solely on the contract electrician without any input from the building occupier.

For an existing installation that has been left unattended for a period of time there will be a lot of input required to get it back to a satisfactory operational standard. Often more involved refurbishment activity, rather than just some basic remedial tasks, will be necessary. Sometimes, expired equipment will be obsolete, requiring yet more intrusive work to be carried out as part of what should have been a simple maintenance exercise.

1.2 Creating a maintenance regime for a new property

With a freshly commissioned project that is handed over as a turnkey operation, maintenance of the electrical installation should be easy … shouldn't it? Yet on larger estates, such as universities and hospitals, there is sometimes a breakdown in communication between the capital project teams and the maintenance and facilities teams. Budget drivers mean that expectations of the maintenance teams might be higher than the design team can deliver. Likewise, the design team may consider that maintenance is not their problem as long as regulations and design standards are adhered to. Notwithstanding those constraints any electrical installation design must carefully consider not just for the needs of the end users, but also the needs of those that will be employed to maintain the premises.

Space planning is of paramount importance to allow an installation to be constructed easily and make maintenance more straightforward. Coordination of building services, working at height, safe handling of loads and the simple ergonomics of access and egress with tools and equipment need to be at the forefront of the designer's mind. Checklists, questionnaires and design workshops can aid both the designer and the maintainer.

The maintenance team must be seen as a key stakeholder in consultations during the design and the construction phase of a project. Proper assessment of the connections to the existing infrastructure should also be thought through. This will ensure that the infrastructure can support the new build and

can also deal with seasonal demands. Any residual design risks going forward should be noted to allow for future growth and any planning that needs to be assessed. That information will help inform the next project designers.

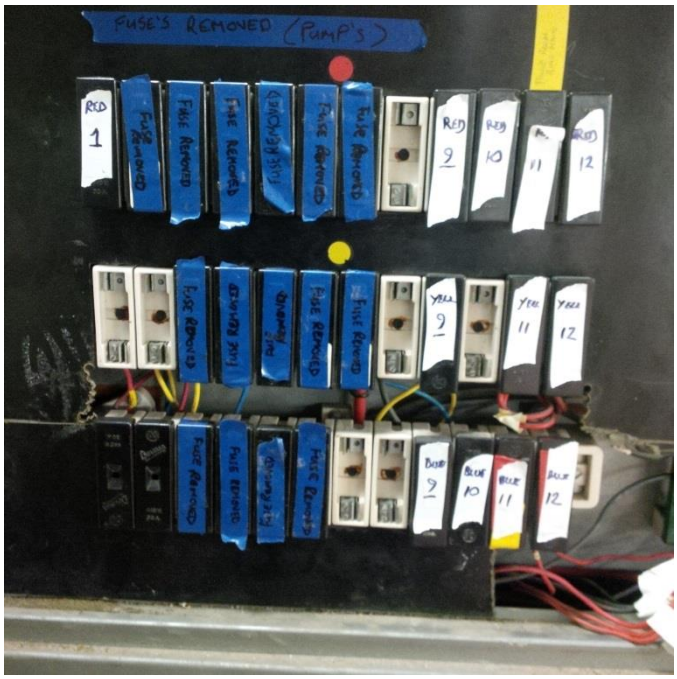
Robust maintenance regimes do not just start with a project handover. They should start far earlier. Project handover, with a comprehensive and site specific Operation and Maintenance (O&M) Manual, should indicate that correctly managed and documented maintenance practices have already commenced. The only maintenance management process left to start should be regular auditing and any consequent replacement of expired equipment.

It is vital for both designers and construction teams to recognise the importance of the O&M Manual that they pass on to the maintenance team when they leave site. This is an integral part of the project completion process. However, it is often left until the last minute and rushed, leading to mistakes. By the time the construction team produce their as-built drawings the design team have moved on to the next job. Drawings and documents do not always get the rigorous review they need to ensure accuracy. The advent of Building Information Modelling (BIM) may improve this situation in terms of up-to-date information being produced as the project develops, but that remains to be seen. In the meantime, most projects will follow traditional patterns with the inevitable gaps in continuity in the flow of information.

1.2.1 Asset management

Asset management tools should also be considered. Adequate labelling of cables, switches, isolators and equipment should all be carefully correlated with schedules, drawings and associated documents. Physically tracing cables can be an onerous task, especially in basement walkways and through walls and risers. Adequate labelling of cables, not just at each end, but at appropriate intervals, can greatly assist, especially during reactive maintenance or disaster recovery situations. Labelling that helps the maintainer to instantly understand where the source of supply is can be beneficial in terms of isolating the right part of the infrastructure in a timely manner.

Example of good labelling



Example of bad labelling

1.2.2 Managing safety

Managing safety for maintenance operators as well as building occupants is a very important consideration. Providing electrical maintenance in a safe and efficient manner is much more than just changing a lamp when it fails or replacing a socket when it is damaged. Correct procedures should be followed to ensure that a system is safely isolated to allow maintenance work to commence.

It should be recognised that maintenance of electrical systems can be intrusive and disruptive. To mitigate these issues safe systems of work should be adopted. Electrical maintenance will often require isolations to normal service. Contingency plans to avoid unnecessary disruption will often involve out-of-hours work. Some electrical systems incorporate back-up or standby supplies to mitigate such interruptions. However, on reinstatement, it is important that the system is returned either to its original design parameters or to an agreed change in those parameters.

Careful management of the electrical maintenance process will include:

(a) safe commencement through the issuing of permits to work, the review of risk assessments and the preparation of method statements; and
(b) safe cessation and satisfactory reinstatement through defined handback procedures, operations checklists and rescinding of the permits.

When the work is completed it must be properly tested and correctly returned to service – this effectively recommissions the electrical system that has been maintained.

1.3 Skills needed for good maintenance

As well as the hard, or direct, electrical engineering skills required for good maintenance philosophies, the soft, or indirect, skills of design, commissioning and documentation of electrical systems need to be understood to ensure a safe and satisfactory maintenance regime. Part of that is the training of staff on the equipment that is to be maintained. Familiarisation, coupled with a safely managed process, will reduce downtime in breakdown periods.

Understanding the strategies for maintenance and knowing when to use them is a responsibility for maintenance mangers and technicians alike. Different responses will be required for preventative,

reactive or predictive maintenance. Regular on-the-job training in particular can help to assist in moments of reactive maintenance to ensure safety and the prompt reinstatement of an electrical service. Having a pre-defined set of standing operating procedures (SOP) to deal with most circumstances can also assist maintenance teams, especially those that are slightly less familiar with the site in the early hours of a Sunday morning.

It is also important to recognise that an urgent breakdown is not a licence to circumvent the normal safety requirements of thinking about risk and methodology. There will be financial drivers or, more importantly, life safety imperatives, to get a system back up and running. Do not cut corners. Prepared electrical maintenance SOPs, which are thoroughly reviewed and updated regularly, can assist greatly in these situations to get the mind in the right space and react safely and promptly.

Another skill for the on-site maintenance crew is customer relations. You have completed the hard work, got the electrical system back up and running and operating successfully when you left the department. Go back half a shift later and make sure it is still working. The end users will be grateful and you will be reassured too. In hospitals, for example, the clinical team has enough to worry about without ringing the estates department – again. Pre-empt that call.

The availability of spare parts is one more maintenance consideration, especially for installations that operate shift patterns outside of normal working hours when wholesalers may be shut and contractors are not available. Can the factory afford not to operate for several hours? Can it afford to carry the overhead of spares within the building? Do these spares have a shelf life, so that just at the moment they are needed they are no longer viable?

1.4 Ongoing maintenance regimes

New installation or existing, fully refurbished or simple remedial works: if some time and effort is put into setting and managing the maintenance process the task becomes easier – does it not? In theory, surely less qualified resources can take over and less time can be allocated? No process can afford the luxury of resting on its laurels. The only constant in life is change. Different components fail at different times; maintenance regimes need to constantly react to different challenges. Proper and regular evaluation of the maintenance process and the performance and knowledge of the maintenance staff are important cornerstones of the maintenance regime.

Different mangers will have different models of operation, but it should be clear that any process should be subject to constant review and improvement where it is required. The advice here is not necessarily to change for change's sake, but the old adages of 'if it works, why fix it?' has no place in the modern electrical maintenance world. Equally, staff turnover and new contractors can add to the complexity of day-to-day management. Each member of the maintenance team will build up a body of knowledge about the site and that will be lost when they move on. This can be a real problem on larger, more complex sites, all of which have their own particular foibles. Making sure qualified and experienced resources are available when required is part of the maintenance challenge.

Electrical equipment has become increasingly more efficient and better controlled but it all has a limited lifespan. Maintenance is a necessity not an inconvenient overhead.

1.5 The future of maintenance

Increasingly we are all urged to use less fossil fuel and hence release less carbon dioxide into the atmosphere. Modern electrical installation designs are using technologies that consume less energy during their lifespan, but only if they are looked after properly. Robust maintenance regimes have an important role in a more sustainable world. There can be no doubt that correctly maintained electrical systems will operate at their maximum energy efficiency for much longer. The trend for energy costs has been upwards for many years. The financial imperative of a well maintained, low energy electrical installation needs to be correctly appreciated by the business manager – otherwise poor maintenance will undermine the bottom line.

As technology develops it is likely that the maintainer will be presented with automated means of monitoring performance and computer systems to plan, manage and report on maintenance activities.

Various electrical systems within buildings are becoming more integrated and complex. An integrated supply chain from concept design to planning and construction to commissioning will be increasingly amalgamated through tools like BIM. This will provide the maintainer with a series of compatible computerised tools to identify replacement parts and ongoing operational analysis of the electrical systems. Linking this into existing practices of monitoring and integrating the status of equipment using Building Management Systems could make life easier for the electrical maintenance manager and on-call duty staff. Going forwards, perhaps in time the 'M' in 'BIM' will become 'Management' to reflect the integrated use of this database over the whole lifecycle of the installation, from design through operation and use and on to decommissioning and disposal.

This new technology also presents a new requirement for the maintainers' skill base – a knowledge and understanding of cyber security. A cost effective cloud based maintenance software solution, with on-site sensors, automated alerts via text or email to on-call staff and off-site diagnostic tools, might be one manager's dream scenario. Equally, it can become another manager's security nightmare through hacking and IT related problems.

The final obligation of the maintainer is to ensure the time-expired equipment is disposed of correctly at the end of their lifecycle. Regulations need to be considered here too as most electrical and electronic equipment at the end of their useful life will be covered by the Waste Electrical and Electronic Equipment Directive.

There is a lot more to electrical maintenance than just turning up with a tool box and pack of light bulbs. You should not run your car without an annual MOT and regular servicing of the vehicle is advisable. Do not neglect your electrical installation either.

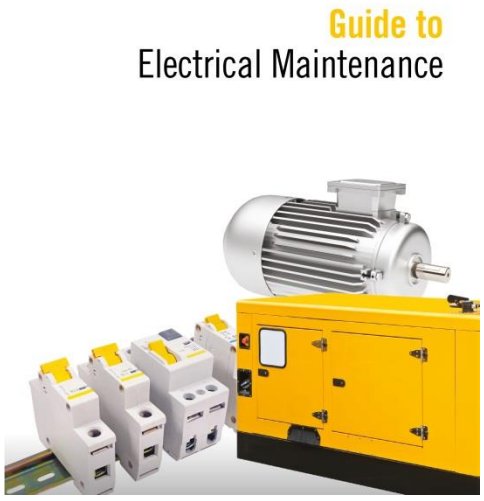
IET work you may be interested in!

The IET is doing a lot of work in the area of electrical maintenance and associated subjects.

Guide to Electrical Maintenance

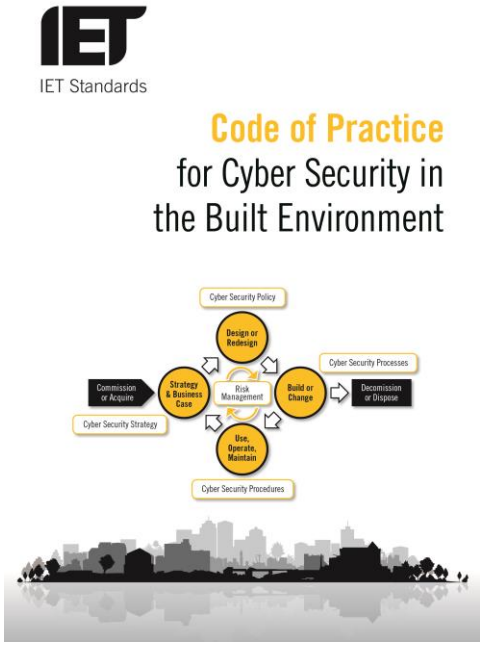
The obvious choice if you're working on anything related to electrical maintenance – from designer to electrical maintainer – the Guide provides clear and informative guidance on carrying out maintenance activities and ensuring good practice.

IET Standards



Code of Practice for Cyber Security in the Built Environment

As Cameron mentioned earlier, advancements in electrical maintenance and the introduction of BIM are likely to lead to integrated electrical systems and a smarter, cloud-based way of monitoring the performance of those systems. Any new technology comes with new challenges, and in this case cyber security is a growing concern. This Code of Practice explains why and how cyber security should be considered throughout a building's lifecycle and explains good practice, focusing on building-related systems and all connections to the wider cyber environment.



Future title: Designers Guide to Energy Efficiency in Electrical Installations

CENELEC HD 60364-8-1 was published in October 2014 and is expected to be included as a new section in the 18th Edition of BS 7671 (the IET Wiring Regulations). We don't expect significant changes to the underlying principles of HD 60364-8-1 so, in the spirit of ensuring that UK designers are prepared and 'ahead of the game' when it comes to designing energy efficient installations in the UK, we're preparing this Guide for publication in early 2016.

The Guide will provide information about designing installations in an energy efficient manner using an internationally agreed standard, and will also provide guidance on the HD.