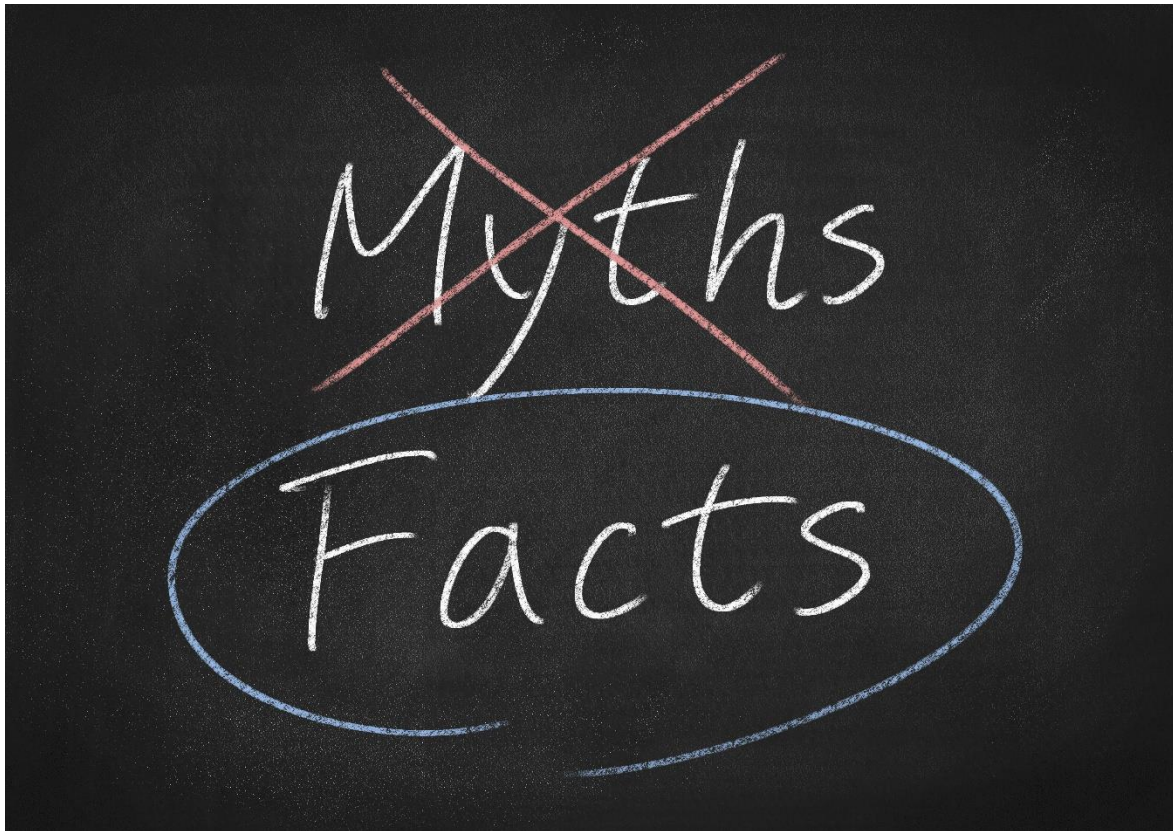




WIRING MATTERS ISSUE 74 MARCH 2019



Mythbusters #3 – All electrical appliances in the workplace should be tested annually

As myths go, this is a well-established one. A cursory glance at any item of electrical equipment in the workplace is very likely to reveal a green sticker indicating that the testing interval is annual, but should it be? As the IET Code of Practice for *In-service Inspection and Testing of Electrical Equipment* undergoes revision in preparation for a 5th Edition, James Eade delves into the archives to look at the rationale for testing and where such established practice comes from.

History

The introduction of the Electricity at Work Regulations in 1989 reinforced the need to make sure that electrical equipment in the workplace was kept safe and unlikely to cause injury or damage, such as by causing a fire. In the early nineties, the (then) IEE was asked to write guidance to help those dutyholders responsible for

electrical equipment to manage it effectively. A committee of interested parties was formed and guidance duly published in 1994, with successive updates in 2001, 2007 and the current 4th Edition published in 2012.

The approach to testing

Many of the tests and associated results in the earlier editions of the Code were inspired by the manufacturers 'type testing' on products, carried out in the final stages of manufacturing. These comprise a range of stringent electrical tests aimed at ensuring protection (such as insulation or electrical separation) is unlikely to breakdown in the variety of conditions that the equipment will typically be exposed to in use.

These tests are broadly the same today. One that some readers may be familiar with is a high-potential (i.e. high voltage) test in the order of 1000 V or more to check insulation. Many readers might remember early appliance test instruments used to have a high voltage probe to allow users to conduct the 'flash-test' for that reason.

It's accepted that exposing equipment to such stringent manufacturing tests repeatedly risks damaging it in the long term, rather than proving safety to a point beyond what can be achieved with basic checks. Over time the focus has been more on ensuring that the safety measures such as insulation or earthed exposed metalwork is in good order; this has led to some of the tests disappearing over time.

The earlier editions also included the range of manufacturers' tests as Appendices. However, the approach to testing changed as noted in the preface to the third Edition, which stated that "Production testing, previously included in this Code of Practice, has been removed as it is not relevant to in-service inspection and testing."

The need for maintenance

One of the key requirements of the law is that electrical equipment does not give rise to the risk of injury or damage. The Electricity at Work Regulations requires in Regulation 4 (2) that, "As may be necessary to prevent danger, all systems shall be maintained to prevent, so far as is reasonably practicable, such danger."

The HSE's publication HSR25 *The Electricity at Work Regulations, 1989. Guidance on Regulations* (free to download from www.hse.gov.uk) states that, "The obligation to maintain arises only if danger would otherwise result. The maintenance should be sufficient to prevent danger so far as is reasonably practicable."

It goes on to note that the, "regular inspection of equipment is an essential part of any preventive maintenance programme", which is in many respects is an obvious statement. If equipment is broken, it's not fulfilling a business need so productivity is likely to suffer accordingly.

'Regular' maintenance

That all sounds perfectly reasonable, but if you are the dutyholder trying to plan such maintenance, you stumble over the 'regular maintenance' statement. What exactly is 'regular'? Every day? Week? Year? For those trying to populate a maintenance plan in a spreadsheet, such grey statements are not helpful.

In order to help address that, the Code has carried initial inspection and testing intervals in Table 7.1 for some time, to try and help dutyholders by giving them an indication of what might be considered a reasonable period. However, these intervals have always been guideline initial intervals; i.e. a period which could be considered reasonable for the first maintenance activity to be carried out, from whence it can made more or less frequent.

In the third Edition, the Code reinforced this position by stating that "No rigid guidelines can be laid down". The fourth Edition went further by saying, "Table 7.1 provides only some guidance on the initial frequencies of inspection and testing. It is not an absolute legal requirement and should not be considered as such." Despite

these statements, the intervals have found themselves being used as ‘prescribed’ intervals and a ‘requirement of the Code of Practice’, which of course they are anything but.

To help address this, the fourth Edition encouraged the reader to consider the risk. In particular, readers were encouraged to think of seven areas ranging from the environment equipment is used in, the skill of the user, the equipment and construction (Class I, II etc.), frequency of use and so on.

In essence, there is no right or wrong answer as to the frequency of maintenance; it’s either suitable or it isn’t. Looking at it another way, if a company suffers with regular equipment downtime or, worse still, people get injured by faulty equipment, then maintenance is not sufficient. Alternatively, it may be that the type of equipment is incorrect for the environment or the application, or the user hasn’t been sufficiently trained. The correct equipment for the job, operated by skilled users and maintained effectively should give largely trouble-free service. If there are no issues then maintenance is either just right, or is possibly being overdone.

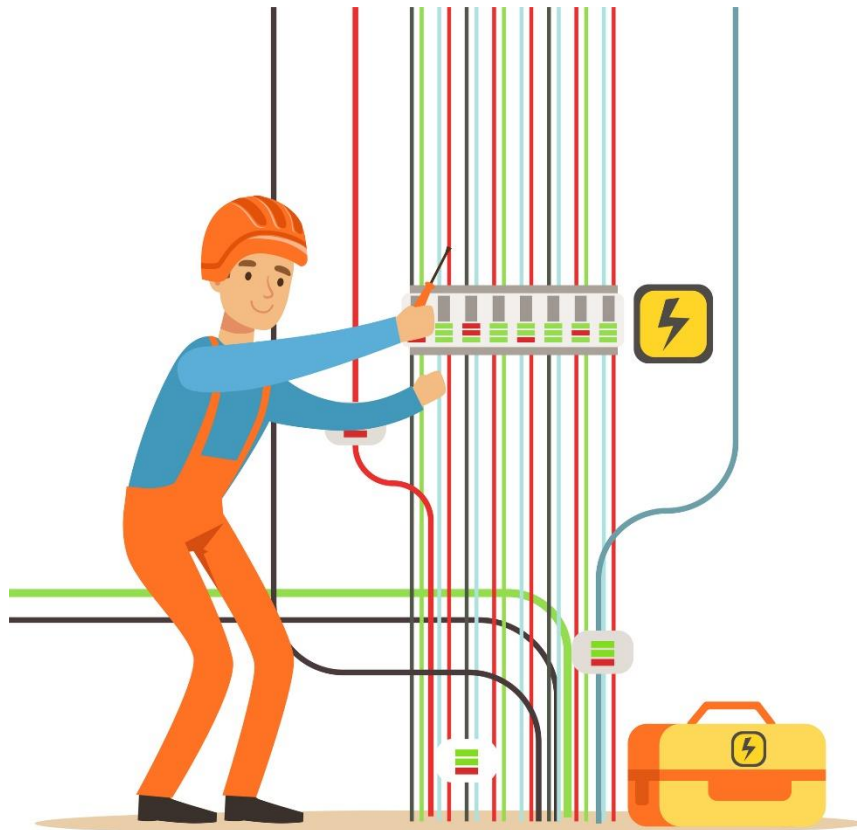
Conclusion

The key message, reinforced in the HSE’s own equipment testing guidance, is that annual testing may well not be the right answer. There is an absolute legal duty of employers to ensure maintenance is carried out and is effective, but dutyholders must decide for themselves what is reasonable and proportional.

Perhaps the final word should go to the HSE’s guidance in HSR25 again: “Practical experience of use may indicate an adjustment to the frequency at which preventive maintenance needs to be carried out. This is a matter for the judgement of the dutyholder who should seek all the information he needs to make this judgement including reference to the equipment manufacturer’s guidance.”

The fifth Edition of the IET Code (due out early 2020) is likely to reinforce the risk assessment requirement. It’ll be a significant revision with a more streamlined approach, greater clarity on what equipment is (and isn’t) in scope and clearer guidance to enable dutyholders to assess the risk and develop a maintenance program. Following the changes, it is also likely that industry training courses will need to be updated, so new or update courses might become available to help practitioners demonstrate competence with the changes introduced in the new Code. As is the case now, these courses won’t be a requirement at all, but a means of demonstrating that candidates have the underpinning knowledge to help them conduct in-service inspection and testing.

There is the usual caveat though: The Code of Practice is work in progress so things may change, so watch this space. For more information on managing electrical risks in the workplace, the IET has two other publications on the subject – the *Code of Practice for Electrical Safety Management* and the *Guide to Electrical Maintenance*.



Working safely with storage: It's not business as usual

by Dr Andrew Crossland CEng and EUR ING Graham Kenyon CEng

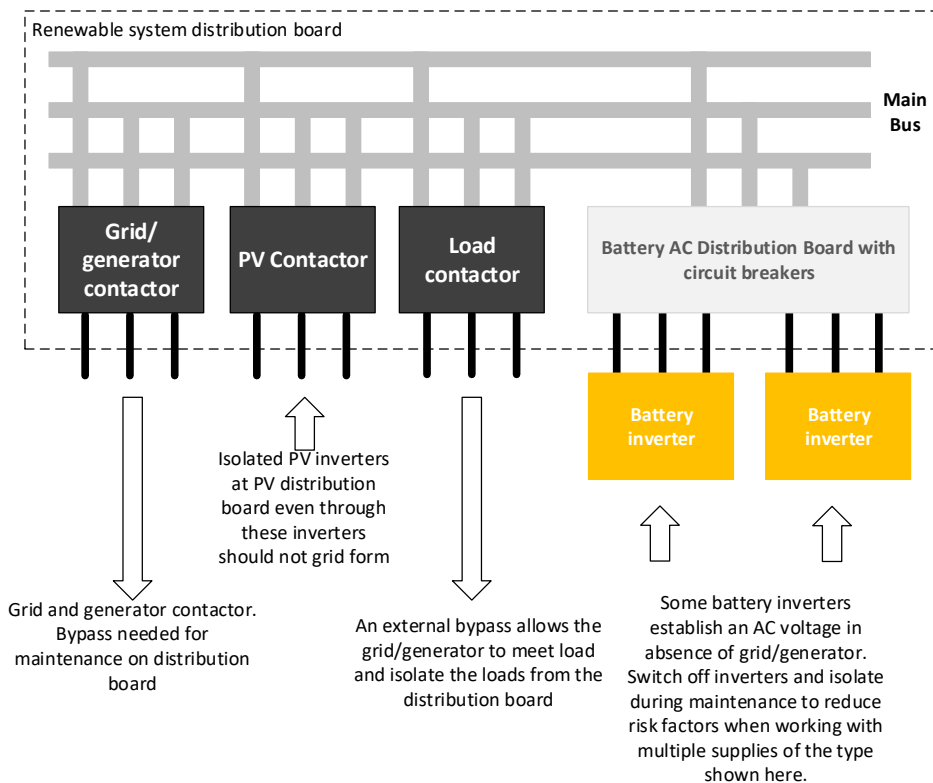
Two near misses within the past 18 months have been a timely reminder of unique safety procedures for electrical energy storage systems.

Working on a project for a remote customer in East Africa, a highly experienced electrical engineer was working on renewable energy system which comprised solar, battery storage, a diesel generator and a grid supply. The operator, who was based in the region and trained in the UK, bypassed the batteries and solar so that the customer's loads were still powered and so that he could work on the distribution board. Reaching into the board, he was quickly called back as his hand was just 75 mm from a bus which was live and had the potential to cause serious harm. So how did a qualified engineer who had worked on the project for six months end up so close to injury?

He had assumed that everything was safe by following standard practices from years of work on regular distribution boards. He had isolated the distribution board at the grid/generator point and disconnected the PV inverters. He had also tested for dead at the part of the board he was due to

work on. Critically however, he forgot that storage introduces new risks to electrical engineers because the battery must always be considered live. This of course applies to the DC terminals of a battery, but also to the AC side of any battery inverter – unless all of the batteries are safely isolated. The grid forming inverters of some battery storage systems will often default to a live state in the absence of an external grid. This means that components that would previously be considered ‘dead’ should always be considered potentially live in a battery storage installation. In the case of this project, as soon as the distribution board had been bypassed, the battery storage inverters became grid forming and re-energised all of the busbars in the system.

Figure 1: Typical arrangement of multiple supplies. Main bus was live because battery inverters established a voltage and were not isolated at the battery AC distribution board



Just nine months later, a similar incident occurred on the same equipment in another location which left an engineer with over twenty years’ experience with slight burns on his hand. He brushed against a busbar he assumed was dead after switching off all the diesel generators at an off-grid site. Although the external grid was disconnected and no loads were being served, the battery still formed a grid and made key elements of the distribution board live.

The risk in these two examples could have easily been mitigated by providing a correct isolation procedure for the engineer to follow. In both cases, this would have involved isolating the PV inverters or PV distribution board, tripping all of the MCCBs to isolate the battery inverters and bypassing to allow the grid and generator to meet the load. The simple procedure could have been written on a single page of paper and embellished with a series of photographs or drawings. We strongly believe that all battery systems, large or small, should be provided with some form of isolation instructions for professionals to follow.

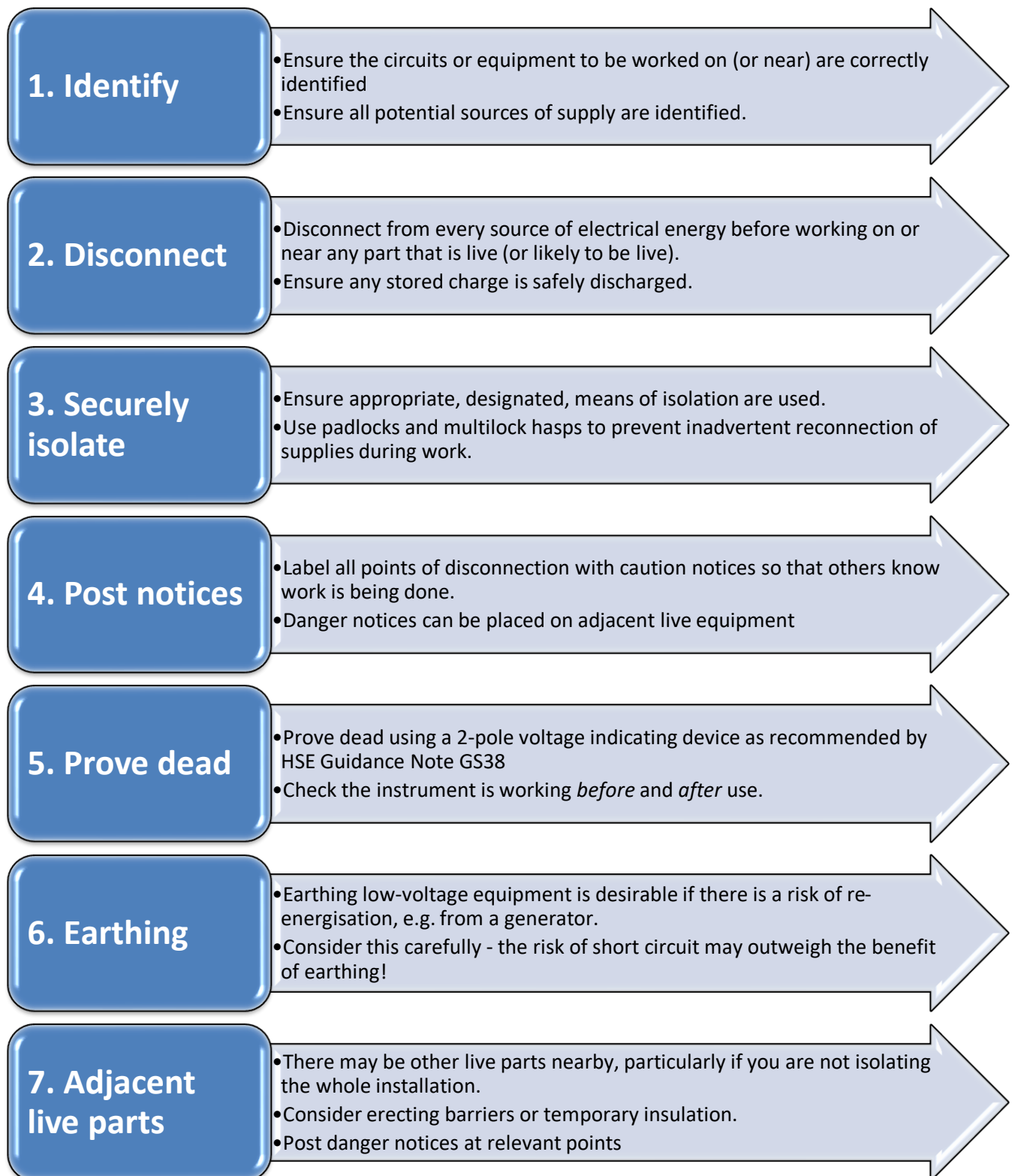
Isolation should not be difficult and must be considered when designing the inclusion of additional sources of generation into an electrical installation. For example, single-phase installations that only have one consumer unit and one inverter could use a clearly marked 4-pole isolator. This would bring the inverter feed into two poles, and the normal supply through the other two and would isolate everything on the AC side in the installation except the feed from the inverter to the consumer unit.

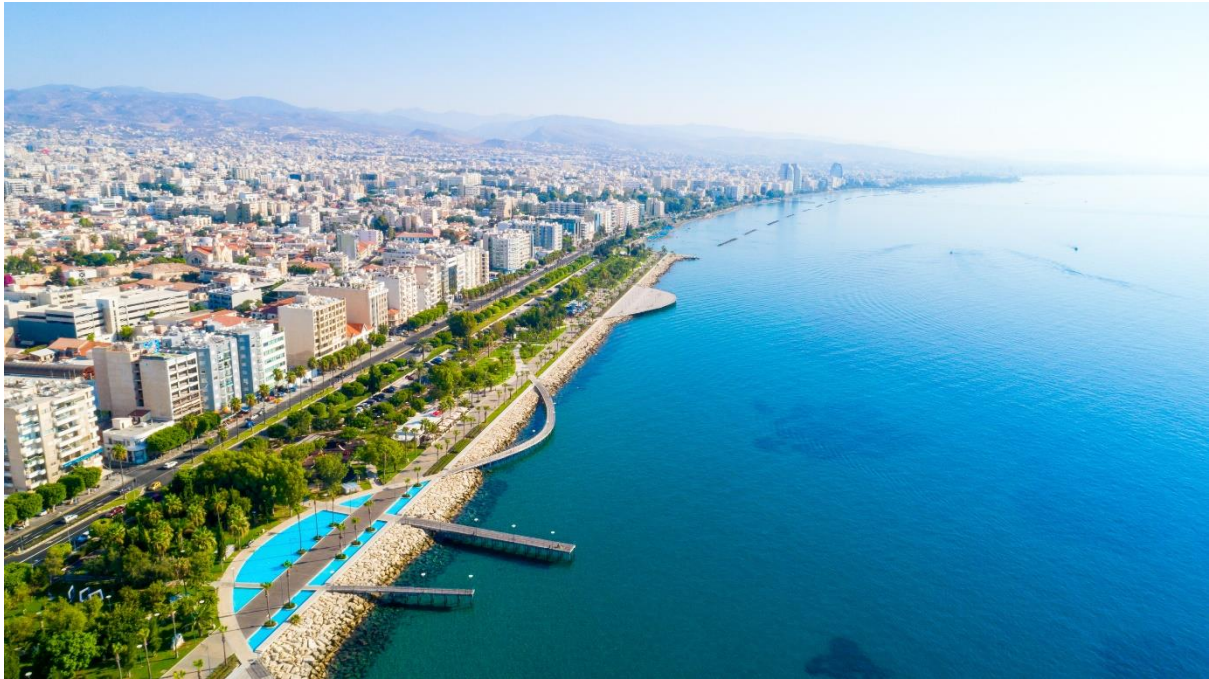
UK requirements for working safely on electrical systems can be found in the HSE publication HSG85 *Electricity at Work: Safe Working Practices* which is free to download from the [HSE website](#). The key points of the working dead procedure outlined in HSG85 are summarised in Figure 2.

In the case of the system in East Africa, a safe isolation procedure would of course involve disconnecting the grid, generator and PV inverters at the respective points of isolation, locking off the points of isolation, and posting relevant signage. It would also involve opening all of the breakers for the battery inverters and/or switching these off.

Isolation is not hard and neither are the adjustments that we need to safely work with battery storage systems. However, these near misses are a stark reminder of the dangers of getting it wrong when working with new technology. The risks can be mitigated through recognising that new energy technologies need to be worked on with slightly different practices. We need to avoid electricians coming to do 'ordinary' electrical work who are unaware of the risks and issues with EV, renewable generation and storage, and consequently putting either themselves or members of the public at risk. Ultimately, it is our aim that knowledge of EV charging equipment, electrical energy storage, Solar PV etc. becomes mainstream. Getting there will require some relatively simple additions to common safety procedures.

Figure 2: Overview of the key principles of the Working Dead procedure in HSG85





Lecturing on the 18th Edition of the IET Wiring Regulations in Cyprus

By Leon Markwell

The publication of the 18th Edition of the IET Wiring Regulations has created a surge in demand for local network events to provide updates and insight into the new and amended requirements. The IET Cyprus network requested a visit from a member of the IET Technical Regulations team to give lectures on the main technical changes and new requirements of the 18th Edition of the Wiring Regulations in Nicosia and Limassol, and I was happy to volunteer to do them. Local network events are a great way for IET Technical Regulations team members to meet with electricians, electrical engineers, designers and many others working in the electrotechnical industry to inform, influence and inspire them, as well as keeping them informed of new requirements. It also provides us with the opportunity to hear from those that the Wiring Regulations matter to the most and we seldom leave an event without a thought provoking question or two. Currently Cyprus uses the 17th Edition of the IET Wiring Regulations but is considering moving to the 18th Edition.

The event was between 25th and 27th October 2018 and organised by the IET Cyprus Network Chairman Dr Alexis Polycarpou, and the IET Cyprus Local Network Events Coordinator Chara Andreou (both pictured below), and they were most hospitable during my visit.



Cyprus is currently having a boom in the construction of high quality residential accommodation, both single dwellings and large high-rise blocks of high class flats, with engineers looking at new techniques and requirements, and the IET Cyprus Network holds a significant number of very relevant events – their next one being on safety in high rise blocks. The Cyprus network is well supported by energetic volunteers and I was pleased to meet several of them, including Dr Frixos Demetriades who several years ago had translated the 16th Edition of the IET Wiring Regulations into Greek, and knew many previous staff of the IEE (as it was then) Technical Regulations department.

The first lecture was in the evening in Nicosia and was attended by fifty engineers, designers and installers. Many of the new requirements and amendments to existing requirements are quite complex and require significant time to discuss in detail. I therefore focused on the most significant changes to the requirements including the recommendation for Arc Fault Detection Devices (AFDDs), and a good question and answer session followed the lecture. The second lecture in Limassol was on a Saturday morning, and it was a surprise to me to have an audience of twenty people, which would not happen in the UK on a Saturday morning! Again, the lecture was followed by a good question and answer session.

Our team of engineers at the IET are:

- Chief Engineer Geoff Cronshaw, Secretary of JPEL/64 National committee,
- Head of Technical Regulations Mark Coles, Secretary of JPEL/64/D (External Influences)
- Senior Engineer Steven Devine, Secretary to JPEL/64/C (Shock Protection)
- Senior Engineer Leon Markwell, Secretary to JPEL/64/ B (Thermal effects) and the Industry EAS Committee
- Senior Engineer Michael Peace, Secretary to JPEL/64/A (Verification)



Latest developments in International Standards for prosumers low-voltage electrical installations

by Geoff Cronshaw

In October 2018, a new standard, IEC 60364-8-2, was published. In this article, we give a brief overview of some of the latest requirements at international level, which may or may not be incorporated in BS 7671 in the future.

IEC 60364-8-2 is a new section within IEC 60364, known as Prosumers Electrical Installations (PEI), which incorporates energy efficiency measures, interface with the smart grid and manages electricity consumption as well as managing renewable sources of electricity and energy storage. This is a complex standard and this article only mentions some of the many requirements concerning prosumers electrical installations.

The concept of PEI has been developed to answer the needs of the end user, for example, where the PEI has a storage capability; the user could take advantage of low demand to store the energy when its price may be lower.

Also, with active energy management the end user should be able to permanently monitor and control his/her own electricity consumption and his/her own electricity production. The concept of PEI has also been developed to take advantage of renewable sources (such as PV and wind turbines) and energy storage.

There are different types of PEI. They consist of Individual Prosumers Electrical Installations, Collective Prosumers Electrical Installations and Shared Prosumers Electrical Installations.

Individual Prosumers Electrical Installations are considered to be an electrical installation (for example a private house or workshop) that can either produce or consume electrical energy. Three operating modes are considered for the Individual Prosumers Installation. These are:

1. direct feeding mode (where the installation is supplied from grid/supply network);
2. the island mode (where the installation is supplied from its own generator); and
3. reverse feeding mode (where the installation supplies electricity back to the grid/supply network).

Collective Prosumers Electrical Installations (Collective PEI) are considered to be several consuming electrical installations connected to the same public distribution network and sharing one common set of local power supplies and energy storage equipment.

Collective Prosumers Electrical Installations (Collective PEI) could be, for example, a group of single private houses, or flats in a building, or small shops in a shopping centre that have a common electrical power supply from one separate unit (generator/energy storage) producing energy and from the grid/supply network.

Three operating modes are considered for the Collective Prosumers Installation. These are:

1. direct feeding mode (where the installation is supplied from grid (supply network));
2. the island mode (where the installation is supplied from its own generator); and
3. reverse feeding mode (where the installation supplies electricity back to the grid (supply network)).

Shared Prosumers Electrical Installations (Shared PEI) could be for example where a group of individual houses may group their interests in accepting to share their supply with their neighbours from their own renewable power sources. Each house owner may have installed private renewable energy power sources which can either supply the private electrical installation or supply the group of private electrical installations.

This is considered to be a Shared Prosumers Electrical Installation. Three operating modes are considered for the Shared Prosumers Electrical Installation. These are:

1. charging mode (where the installation is supplied from grid/supply network);
2. the island mode (where the installation is supplied from its own generator); and
3. and reverse feeding mode (where the installation supplies electricity back to the grid (supply network)).

The prosumers electrical installation (PEI)

A prosumers electrical installation is defined as low-voltage electrical installation connected or not to a public distribution network (the grid) which is able to operate with local power supplies (e.g. photovoltaic panels or wind turbine), and/or with local storage units (e.g. batteries), and that monitors and controls the energy from the connected sources delivering it to current-using equipment (e.g. motors, heating, lighting, appliances such as washing machines etc.), and/or local storage units (for example batteries), and/or the public distribution network.

There are a wide range of micro generation technologies including: solar photovoltaic (PV), wind turbines, small scale hydro and micro CHP (combined heat and power).

One of the key components of the prosumers electrical installation is the Electrical Energy Management System (EEMS). The objectives of the EEMS are to control the connection of the prosumers electrical installation to the smart power grid, and to manage locally the electrical energy production and the electrical consumption as well as managing the energy procurement from the grid (supply network). This is carried out using meters and measuring equipment in order to communicate correct electricity parameters to the EEMS and direction of energy flow.

Technical issues

Technical issues mentioned in IEC 60364-8-2 comprise a whole range of safety issues, including protection against electric shock, system earthing, selection of protective devices, isolation of the installation, protection against overcurrent, outage of the public network, and protection against transient overvoltages.

Further technical issues in this standard include requirements concerning interaction with the public network, energy storage, designing for flexibility of load and generators, electric vehicle charging, and selectivity between current protective devices.

Conclusion

Please note that this article is only intended as a brief overview of a new complex international standard which may or may not be incorporated in BS 7671 in the future. For more information please refer to IEC 60364-8-2.

Crabtree: 1919 to 2019 and beyond

Electrical safety has always been at the heart of everything Crabtree does. It's a philosophy that has seen the brand through periods of depression, a world war, and market uncertainty. It enables them to consistently deliver products and devices that installers can trust, and it all started with a 'dolly'.

One hundred years ago John Ashworth Crabtree designed a quick make and quick break switch, which safely managed electric arcs that can occur in switching devices. Patenting his creation, John went into business for himself opening a factory in Walsall, a market town in the West Midlands.

From humble beginnings, in an old leather works, the company and its product ranges expanded so rapidly that a move to a new, larger factory became necessary and in 1923 the foundation stone of the company's first purpose-built site was laid. Overcoming the world-wide economic difficulties of the time the company not only survived but prospered! Within ten years J. A. Crabtree & Co. Ltd (as it was then called) was employing over 1,000 people.



A century on and Crabtree remains at the forefront of electrical safety, this time with digital technology in Arc Fault Detection Devices. Now 100-years-old Crabtree is still a leading brand in the UK, now part of Electrium, a Siemens company, it has 100 years of innovation from the early inventions that inspired and evolved into the devices electrical installations would be nowhere without.

When Crabtree launched in 1919, it had a motto: "That which is built soundly endures well". It was inscribed into the company plaque and rightly so.



Crabtree was built soundly enough to provide 100 years of electrical safety to its customers. And with a 100-year solid foundation what else can the brand do in the years to come?

For more information go to www.electrium.co.uk/crabtree