Wiring Matters

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Fire stopping

By Michael Peace

What is fire stopping?

Fire stopping is part of the passive fire protection for a building and is the practice of reinstating fire compartmentation or barriers which have been penetrated. It is important that suitable products offering the equivalent fire protection are used, an example would be when containment or cables pass through fire rated compartments in a building. The purpose is to prevent or slow down the spread of fire and smoke and keep it within zones or compartments, to prevent escape routes from becoming smoke logged to facilitate escape.

What are the requirements in BS 7671:2018 for fire stopping?

BS 7671:2018 Regulation 527.2 sets out the requirements for the sealing of wiring system penetrations, Regulation 527.2.1 states that:

“Where a wiring system passes through elements of building construction such as floors, walls, roofs, ceilings, partitions or cavity barriers, the openings remaining after passage of the wiring system shall be sealed according to the degree of fire-resistance (if any) prescribed for the respective element of building construction before penetration.”

Whilst BS 7671:2018 states that fire stopping is a requirement, it does not detail how it should be carried out or who should do it. For this, it is important to seek further guidance from specialist contractors and manufacturers.

Are there any statutory requirements to carry out fire stopping?

The Regulatory Reform (Fire Safety) Order 2005 (RFO) is a statutory document which sets out the requirements for fire safety. Prior to 2005, fire safety was covered by approximately 70 separate pieces of fire legislation, but it was decided to simplify the legislation into one document – the RFO – which replaced any previous legislation issued under the Fire Precautions Act 1971. It intends to provide a minimum fire safety standard in all non-domestic premises (with some exceptions) and requires the responsible person to have a risk assessment carried out by a competent person to identify any shortfalls in fire safety requirements which should include fire stopping provisions.

Local fire and rescue services carry out inspections to ensure buildings are compliant and can take action on non-compliant businesses, ranging from providing information and advice to prosecuting the responsible person for the building.

What other requirements are there to carry out fire stopping?

The Building Regulations for use in England only state basic requirements and do not provide technical information on how to specify the correct fire stopping products.

Approved Document B 2019 Volume 1 'Dwellings', Section 9 sets out the requirements for fire stopping and states that openings through a fire resisting element for pipes, ducts, conduits or cable should be all of the following, as few and small as possible and fire stopped.

Section 9.28 states that;

"Best practice guidance on the design, installation and maintenance of measures to contain fires or slow their spread is given in Ensuring Best Practice for Passive Fire Protection in Buildings produced by the Association for Specialist Fire Protection (ASFP)."

Approved Document B 2019 Volume 2 'Buildings other than dwellings', Section 10 states that;

"The performance of a fire-separating element should not be impaired. Every joint, imperfect fit and opening for services should be sealed. Fire-stopping delays the spread of fire and, generally, the spread of smoke as well."

Whose responsibility is it to carry out the fire stopping works?

BS 7671:2018 imposes requirements on the electrical installer to ensure penetrations for wiring systems are sealed to prevent the spread of fire, however, the electrical designer may decide to employ a specialist contractor to carry out the works.

On smaller projects, it is likely that the electrical installer will be the only person involved in the works, so it will be their responsibility to ensure that the fire stopping works are completed adequately.

On larger projects, it can be sometimes assumed that the fire stopping will be carried out by the main contractor, but this is not always the case. It is important to establish where the responsibility lies at an early stage, such as when tendering for a project as it is likely to cost a significant amount of money. The architect will likely be responsible for specifying fire stopping works but this should be clarified with the principal contractor during the tender process. This will require close coordination with the electrical contractor and specialist fire stopping contractor.

Who is competent to carry out fire stopping works?

Fire stopping is a very specialised part of the building works which requires training, experience and a good knowledge of the relevant products. It is important that the product selected has been tested in the relevant scenario and is suitable for the application.

As stated by the HSE, competence can be described as the combination of training, skills, experience and knowledge that a person has and their ability to apply them to perform a task safely. Unless suitable training has been undertaken, it is unlikely that an electrical installer would be able to demonstrate competence in fire stopping works.

What is third party certification?

Third party certification applies to both fire stopping products and installation. Below looks at the different kinds of certification:

First-party certification
An individual or organization providing the goods or service offers assurance that it meets certain claims. (The installer says it's compliant).

Second-party certification
An association to which the individual or organization belongs provides the assurance.
(An association that the installer is a member of, or the supplier of materials says it's compliant).

Third-party certification
Involves an independent assessment declaring that specified requirements pertaining to a product, person, process or management system set out in a scheme document or BS/EN/ISO Standard have been met.

Third party certification should always be provided by a certification body, in the UK they should be accredited by UKAS as this gives further value to their decisions meaning that the certification body themselves are competent to deliver certification and are subject to scrutiny by a national body.

When a product is tested by a UKAS accredited fire test laboratory, it should adequately demonstrate the suitability of a fire stopping product for use within a specific application or range of applications. It is not the job of test laboratories to police the use of claims by manufacturers of fire stopping materials. The third-party schemes which review the test data and carry out factory audits and clearly define the limitations of the product, for example maximum hole size, protection time and application type.

Third-party product certification provides confidence that the product is fit for purpose, is manufactured using a defined quality control system and links factory production with what was actually tested by a fire laboratory and proved under certain conditions.

Some of the third-party accreditation requirements for product manufacturers:

- factory production control via initial factory inspection and routine surveillance visits;
- initial type testing of the product;
- an appraisal of the product test and assessment evidence against a technical schedule to ensure that the certification gives the widest scope of application;
- traceability of the product from raw material to factory to site; and
- labelling of the product to provide confidence to end users and to assist with traceability

A list of UKAS accredited organisations for certification can be found here, Not only is it important that the products are correctly certified, the installation is equally as important. Third-party installer certification provides confidence that the products will be installed professionally and as they were originally tested and certified.

Below are some of the requirements for members of an accredited installer scheme:

- verification of the skills and training of management, designers and estimators;
- the use of materials and products which have been shown by certification, testing or assessment to have the appropriate fire performance;
- operatives and supervisors to be assessed for competence;
- random inspection of sites to monitor the quality of work;
- provision of a certificate of conformity for completed work; and
- provision of an audit trail.

Correctly specifying and installing fire stopping products is fundamental to the fire safety of the building. Therefore, it is important that the products are installed to the same quality as when they were originally tested. It is in the interests of the client that fire stopping work is carried out by a registered third-party installer and certified for compliance. Part of the works will require that each hole or penetration through the fabric of the building is provided with an identifying label and that information is recorded in a register which will include items, such as hole size, fire stopping material and the installers details. In the event of any issues at a later date, this information can be tracked to prove compliance.

Problems and hazards

It is common to see electrical contractors carrying out the fire stopping works themselves. Lack of knowledge of the products is a big issue, for example polyurethane (PU) foam, usually pink in colour, is used in large quantities across building sites, there is a common misconception that it is suitable for carrying out fire stopping of service cables and pipes. This is not the case as it is combustible and therefore should not be subjected to direct flames as toxic black smoke is emitted from the foam when in contact with fire for just a few seconds. It is also important to consider how the chemicals in the foam will affect the cable insulation.

Some manufacturers of PU foam state that their product will provide four-hour fire protection, how can this be true? The fire rating is only applicable to the conditions which it was tested under, this information can be found in the product certification, which will state the exact conditions that it was tested under to achieve this rating.

One example of a test scenario involves the pink PU foam sandwiched between two 200 mm solid concrete walls, and the fire being in the room adjacent to one of the walls, this scenario is quite different to being subjected to direct flames, as it would be if it was used for fire stopping.

Toxic smoke causes more fire related deaths than fire, whilst fire stopping is imperative to maintain the safety of the building, preventing the spread of smoke is equally important. Smoke travels extremely fast, to give an idea, if a 6 m x 6 m room with a ceiling height of 3 m has a hole the size of a pencil between fire compartments, it would take less than four minutes to fill with smoke from a fire in an adjacent room.

Fire stopping should be considered at all stages of a construction project and not just on completion. A construction site can pose significant fire hazards, and with over ten fires a day, they are considered to be high risk in terms of fire. This is due to activities such as hot works and escape routes changing on a regular, sometimes daily basis.

Summary

Whilst it is not forbidden for the electrical installer to carry out fire stopping works, it is unlikely that without the relevant training, skills or knowledge, the fire stopping works would be completed adequately or they would not be deemed competent in a court of law to carry out the works.

Manufacturers can provide information on their products and some can provide training on how to install them.

A specialist third-party accredited installer is best placed to carry out fire stopping works, they would provide the necessary certification for the work and assurance to the client. The responsibility for these works should be established at an early stage of the project.

PVC insulated and sheathed cables in a domestic installation – some possible problems?

By Leon Markwell

There are more than twenty million dwellings in the UK and most would be wired in PVC insulated or PVC insulated and sheathed cables, which have generally provided an economic installation and good service. PVC insulation and sheathing on electrical cables was introduced in the late 1950's and early 1960's to replace rubber insulation and sheathing as it was more practical, and not being a naturally occurring compound could be produced in quantity as required.

Unfortunately, now that we know much more about pollution and environmental concerns PVC is often referred to as the 'poison plastic' due to the toxins it can release during manufacture, when exposed to fire, or decomposed in landfills. These toxins have been linked to health problems, along with the possible release of dioxin and phthalate that are possible contributing factors to the hazards it might pose to human health and the environment. There is mounting environmental pressure to ban PVC, but currently this is not seen as practical due to its excellent properties as an electrical insulator and the need to provide practical alternatives.

However, the thousands of kilometres of PVC insulated and sheathed cables in current use are not without installation and operational problems and this article looks at some that are found in domestic installations.

The ‘green goo’

This problem will be well known to the more mature electrician, but many apprentices and younger operatives may not have had experience of this and the IET Helpline still receives calls on it, as do other organisations.

When PVC insulation was first produced the ‘plasticiser’ chemical added to the PVC mix to allow flexibility (modern waste pipes etc. are unplasticised PVC – uPVC) in some PVC compounds the plasticiser was not chemically bonded into the mix, and thermal cycling of the conductors due to changing load current drew the plasticiser to the surface of the copper conductor, where it dissolved minute traces of copper (hence the green colour) and on vertical cable runs to switches and socket-outlets the force of gravity over the years has drawn it to the lowest point, the switch or outlet. Higher ambient temperatures will accelerate the process and movement down vertical cables.

The main instances arose during the 1960’s and 1970’s, before reformulation of the PVC fixed this problem, although some cases are still seen today.

The goo is only ever present in small quantities, it is messy and of low toxicity but should not be touched with bare hands. The goo is conductive due to the copper in it and when found should be cleaned away to prevent possible tracking. It can be cleaned away with methylated spirits, wearing gloves and paying proper attention to hygiene, and after use the cleaning materials must be properly disposed of.

Figure 1: An example of the 'green goo' (picture reproduced with permission from Goodwin Electrical)

Rewiring the affected final circuits may be considered, but if it is of limited extent regular periodic inspection and insulation resistance testing should be carried out to monitor the problem. It is also suggested by some that the resistance of conductors should be monitored to ascertain that conductors are not being over dissolved with their resistance thereby increasing. There is no specific guidance on the frequency of periodic inspection and testing and this can only be judged by experience of the particular installation.

Expanded polystyrene and PVC sheathed cables

This is a more significant, although less common, problem than the goo, especially in loft spaces of dwellings. Expanded polystyrene is a light, inexpensive and easily handled material with great thermal insulation properties, making it useful for thermal insulation properties. However, if expanded polystyrene is in intimate contact with PVC sheathed cables, over time a chemical reaction can draw out the sheath plasticiser to form a sticky layer on the outside of the cable. In many cases as the plasticiser in the cable soaks into the expanded polystyrene it shrinks back and in the majority of cases no longer remains in contact with the PVC and deplastisation ceases. But in some cases, it has been reported that the plasticiser migrates out of the PVC, absorbing into and softening the polystyrene, which, in one instance, adhered to the PVC sheath, leaving a brittle cable that cracked and split, exposing live conductors, which was reported to have caused a fire in the local timbers within a dwelling. The plasticiser may also be readily flammable and without any fire breaks or seals a fire could spread to other parts of a building space.

It is reported that expanded polystyrene is most affected, but it can also occur with ABS or polycarbonate. It is stated by some manufacturers that modern PVC sheath compounds no longer react with expanded polystyrene, but if PVC sheathed cables are expected to be in contact with expanded polystyrene or other similar materials the advice of the cable manufacturer should be sought for the design.

Bitumen products and PVC sheathed cables

Bitumen and bitumen-based products are widely used in construction for roofing and waterproofing, and not so long ago a bitumen filled cable seal was used as a part of the incoming electricity supply cut-out to terminate a Paper Insulated Lead Covered (PILC) supply cable into a dwelling. Again, the PVC plasticiser can leach out of the cable and soften the bitumen, and in some severe cases it can leak out of the cut-out chamber or make any waterproofing application useless.

Conclusions

Over the many years of use of PVC cable manufacturers have identified most compatibility problems and resolved them, however there are always new building products coming onto the market. It is wise to check with a cable manufacturer when installing PVC insulated and sheathed cables in any new or unusual situation, or when it is proposed to use chemicals such as wood preservative on timber they are fixed to or perhaps paint over the cables.

This article has considered some of the possible physical installation risks to PVC insulated and sheathed cables, but of course the general thermal risks of cable operation due to current carrying, installation in thermal insulation and operating temperature and environment will also always be present.

Vehicles as storage: Why the Industry needs to prepare

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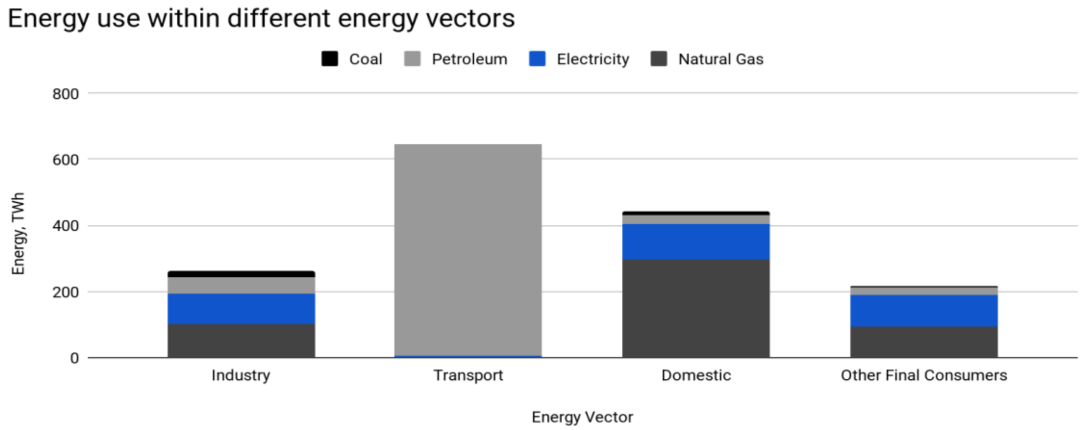
Following on from the draft for public comment stage for the forthcoming *Code of Practice for Electric Vehicle Charging Equipment Installation*, this article looks at the role of vehicles in the electricity grid and why future proofing charging infrastructure according to the new guidance could be important.

Introduction

The decarbonisation of British electricity has been remarkable. Coal power plants used to provide over 40 % of our electricity, today they supply to less than 7 %. Electricity demand has fallen with consequent declines in fossil fuel use and there has been a staggering growth in wind and solar technologies which, in 2018, provided more electrical energy than Britain's nuclear power stations[1]. As a result, the annual average carbon intensity of British electricity has almost halved in just a few years.

Decarbonisation of transport and heat is now rightly entering the British consciousness. At present, transportation represents the largest sector for final energy consumption in the UK with almost all of this energy coming from fossil fuels (Figure 1). The future of decarbonised transport is projected to be a combination of battery and hydrogen technologies, the former placing new demands and presenting new opportunities to the grid as this article explores. But what could a fleet of millions of vehicle batteries mean for the grid?

Figure 1: Final energy consumption of different energy vectors



Vehicles as storage: EVs present challenges and opportunities for the power system

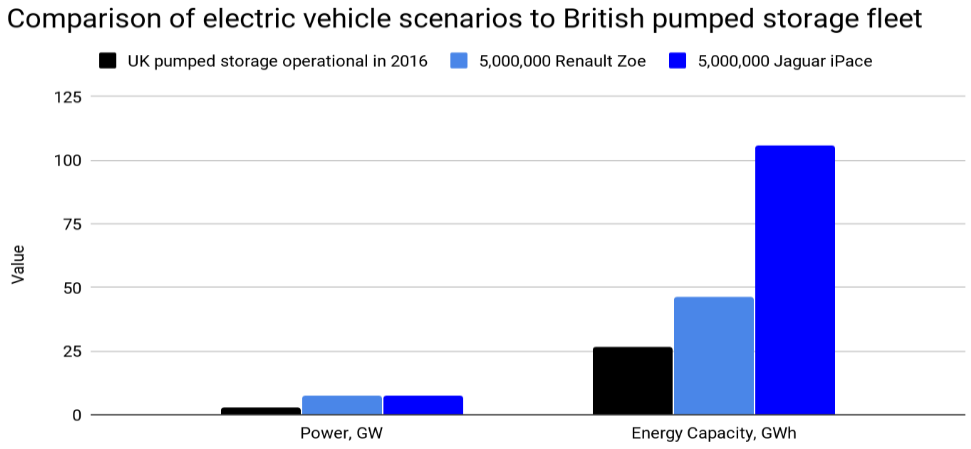
Today's electricity grid is designed to run our homes, services and businesses. In this traditional power system, everything from washing machines to computer servers have a demand for electricity which is very difficult to change – appliances are used when people need them to be used. It's intuitive that battery vehicles will increase demand for electricity and electricity generation

For operators of the electricity system, vehicle batteries are intuitively attractive. Storage facilities were shown to add value in the summer of 2019 in reducing the scale of a major power outage, but they are expensive and only serve the power system. What if vehicle batteries could also contribute to our power system?

Vehicle batteries are a potentially massive storage resource which, service vehicle owners and could also serve the grid. A conservative estimate of the flexibility in five million electric vehicle batteries (Figure 2) shows that these would almost quadruple British electricity storage capacity. This is flexibility that opens up opportunities for vehicles to support the decarbonisation of electricity such as encouraging vehicles to be charged when low carbon generators are operating or to stop charging when there are high conventional electricity demands, such as in the evening peak.

The scale of battery storage in vehicles shows unprecedented scale of this flexibility and the case impact they could have on power. One could imagine a scenario whereby vehicles are predominantly plugged in in the early to late evening. A worst case might be all these vehicles charging at the same time and potentially overloading the grid. If just 2.5 m electric vehicles were all charged using a slow charger at the same time, it would add 7.5 GW of power demand to the grid. For comparison, the midday system demand for electricity in April 2019 was below 40 GW. That's a large ramp up in power and makes vehicle services an essential consideration for the electricity system.

Figure 2: Comparison of power and capacity in electric vehicles relative to pumped storage plants operational in 2016. (Pumped storage data from the British Hydro Association. Vehicle data assumes 5 million vehicles 50 % of battery available to grid and 50 % of vehicles plugged in at a time)



It's right to start thinking about EV charging infrastructure

With approximately 202,000 registered EV vehicles (Dec 2018) EVs still represent only 0.5 % of vehicles on the UK's roads. However, influences related to political, economic, social, technological, legal and environmental changes will all play a role in shaping how fast EVs are adopted and the rate of adoption is increasing every day. The decarbonisation of transport is certainly expected to, excuse the pun, accelerate in the coming years. Vehicle manufacturers are chasing aggressive emission compliance targets against a backdrop of an increasingly competitive marketplace and a changing mobility landscape (with autonomous cars and fleet growth). As shown in Table 1, the batteries in cars are only going to get larger as manufacturers move from batteries in hybrid cars, to plug in hybrids to full electric vehicles – and emissions targets from the EU being driven by the number of vehicles sold.

Figure 3 shows the advancing scenarios by National Grid showing that EV's use will see exponential growth from the mid-2020's, by which time legislative, infrastructure and commercial influences will make EV's the default choice for the masses. It's important for us all to get ready for this challenge with appropriate charging infrastructure.

Figure 3: Number of electric vehicles as predicted by National Grid Future Energy Scenarios (Data is for two degrees or gone green scenarios which are amongst the most green scenarios)

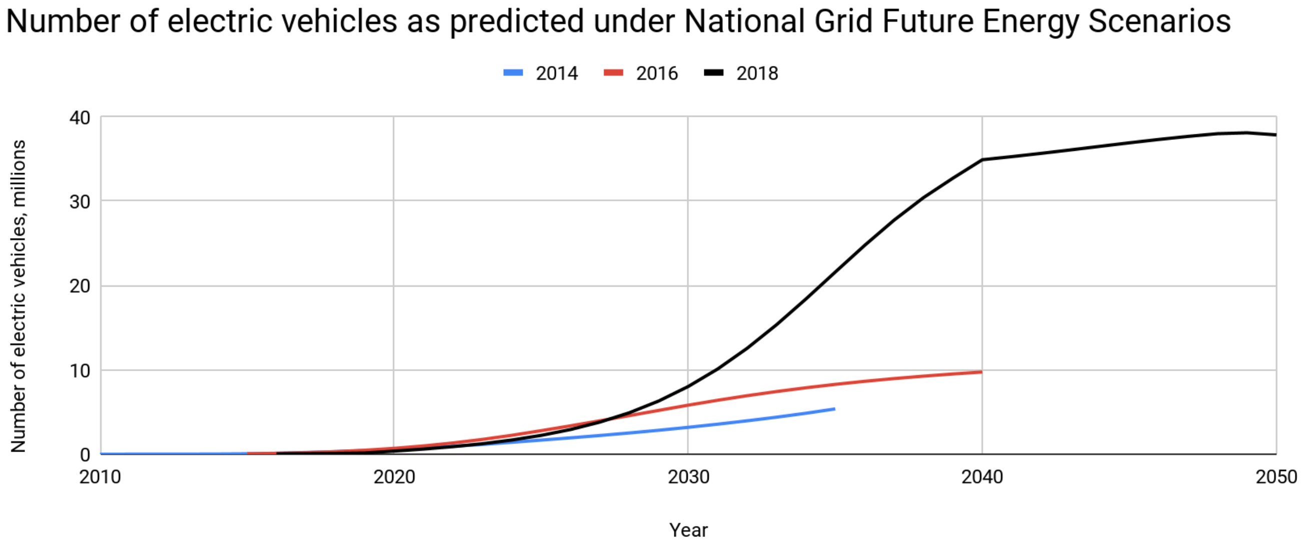


Table 1: Types of vehicles with some form of electric traction

EV Type	Fully electric	Charged from grid	Vehicle as storage opportunity	Typical battery capacity
Mild Hybrid Electric Vehicles (MHEV)	No	No	Zero	48V battery system
Hybrid Electric Vehicles (HEV)	No	No	Very Low	<2kWh
Plug-in Hybrid Electric Vehicle (PHEV)	No	Yes	Low	7-12kWh
Battery Electric Vehicle (BEV)	Yes	Yes	Highest	35-100kWh

How and why you might use a car battery to support the power system

In this article, we are not arguing that all of a vehicle battery is used to support the grid. We are suggesting the strategic use of some of the battery capability and smart charging to provide services to support the power system – and accordingly reduce the costs of managing electricity networks, renewables, generators. For vehicle owners, that might mean strategically changing the rate of charge, different tariff structures or allowing say up to 10 miles range to be sold back to the grid when needed. The interaction of vehicles and the grid work best when they have an unnoticed impact on the vehicle but a very positive impact in maintaining the electricity system.

Potential uses for vehicles as storage fall into a number of categories, and in this article they are broadly split into ancillary services, decarbonized energy matching services (those which help ensure the provision of low cost, low carbon electricity), consumer services and network services (those which help protect networks).

Ancillary services are those services which help to keep the power system stable and provide high quality power. As of 2019, these are largely procured via the national electricity system operator, National Grid, although regional ancillary service markets also exist that are focused on networks. Two easy to understand national ancillary services are reserve and frequency response.

Reserve is the calling upon of sustained load or generation to ensure balancing of supply and demand. For example, when a major power station trips, it is necessary to either reduce demand or increase supply in order to ensure that major loads can be met. To provide this, a fleet of electric car batteries can in theory be called upon to either reduce load (by stopping charging) or supply the grid (by discharging the battery into the grid) in the event of the power station tripping.

'Frequency response' is similar in the requirements of the battery. The frequency of the electricity grid in Great Britain, 50Hz, is a reflection of the instantaneous balance of supply and demand for power across the grid; frequency falls during undersupply and rises during oversupply. The provision of an automated frequency response by EVs plugged into the grid could, in theory, provide a frequency response mechanism. Indeed, it is felt that EVs could provide this to the grid at a much lower cost than stationary storage and so reduce the need to procure large stationary grid batteries altogether – or become a mandatory requirement for grid connected storage.

Energy matching enables EVs to be charged more fully using lower cost and lower carbon electricity or at times which suit the electricity system. For example, during high summer solar generation EVs might be encouraged to charge to allow enough demand to consume excess low carbon generation. Similarly, EVs could be charged at night to raise baseload and provide enough demand to keep nuclear power stations online. These services are likely to manifest through time of use/differential pricing from suppliers, allowing customers to choose how fast or how much to charge or discharge vehicles contingent on the price (or forecast price) of electricity.

Consumer services are those which use the vehicle as storage to directly assist consumers. This might include charging of EVs from distributed generation (such as domestic solar PV or solar carports). It might also be scheduling the EV to charge when electricity is cheap. Automatic chargers already exist and are widely installed in UK homes to achieve both of these services.

Alternatively, the vehicle(s) might be used to provide backup to a home or business when there is a power outage.

Network services are the use of EVs to support or prevent failure of cables and substations. There are a complex variety of network services, and the simplest to explain is slowing down or restriction of EV charging at peak times where the power consumption of EV charging risks overloading network cables. As a result of the regionalised and time dependant nature of network issues, these are likely to be localised, available at different times of the day, and procured/regulated by network companies trying to ensure the lowest cost of running their systems.

Getting ready for flexibility

It is valid to recognise that not all of the services that EVs can offer to the grid are available to vehicle owners today. Similarly, there is no agreement between vehicle manufactures on whether their vehicles can or should provide such services: some manufactures actively promote vehicle services whilst others take a hard line against them. However, over the life of charging infrastructure a range of vehicles and services could be connected and as such electrical requirements for the charger must be considered to provide safe use throughout the charger's life. In addition, charge point infrastructure owners might use smart charging to take advantage of lower cost electricity or to maintain charging rates within the power constraints of their grid connections.

To provide these services requires charging infrastructure, which is designed for vehicle services and not just as dumb electrical supplies. That is because utilising vehicle batteries to support the grid means changing when the battery is charged and also discharging that electricity back into the grid when needed. The following examples show why the differences are so acute and why the updated code of practice is so important:

- Vehicle charging infrastructure is not just a plug to take power from the grid, but also becomes a potential point of generation supplying electricity at times of need. This places particular requirements on notifications to network operators and the design of protection.
- Control and communication access needs to be considered, particularly for infrastructure where an external organisation such as an aggregator or vehicle fleet manager wishes to manage when their vehicles charge. It is important not to underestimate how much vehicle manufacturers are looking at changing their operating models with many considering leasing a fleet of vehicles to a pool of customers and accordingly wanting to manage how their vehicle batteries are used.
- In the most extreme example, infrastructure developers may need to consider providing backup power, with grid forming inverters keeping on essential loads in our homes. This places unique requirements on infrastructure, such as provision of safe earthing in the event of a lost network earth, updated protection under reduced fault currents and safe isolation.
- Operating charging in parallel with solar and battery storage requires communication and control that is coordinated. For example, the charging infrastructure needs to measure the solar generation and coordinate charging with any on site battery storage.

Summary

Should there be wide adoption of battery electric vehicles, Britain can expect a large increase in consumption of electricity as well as a huge increase in the amount of energy storage on the grid. As we have seen, there are a number of means by which this storage can be used to help the grid.

The likelihood of EV batteries operating in this role remains controversial, with different viewpoints from different vehicle manufacturers. The rate of adoption of different grid services is likely to be a result of a combination of the views of the vehicle owner, the economic/technical value of grid services, the economic incentives available such as time of use tariffs, the ownership models, the impact on vehicle battery life and the physical need for services (which is contingent on the national electricity supply mix).

However, as installers of vehicle charging infrastructure, it is our role to provide equipment which is ready for all eventualities. The IET *Code of Practice for Electric Vehicle Charging Equipment*

Installation, 3rd Edition provides a simple guide to the safety, electrical and practical considerations. That, and other publications, are key to helping vehicles play their role in the future grid.

Proposed Amendment to BS 7671:2018

By Geoff Cronshaw

A proposed Amendment 1 of BS 7671:2018 is available as a Draft for Public Comment (DPC) to access from the BSI website. The proposed Amendment concerns Section 722 of BS 7671:2018 (electric vehicle charging installations). In this article, we give a brief overview of some of the proposed changes to Section 722.

The DPC process is your opportunity to comment on the content of the proposed Section 722. The closing date for comments is the 30th November 2019.

Protection against electric shock

Regulation 722.411.4.1 concerning the use of protective multiple earthing (PME) supply has been redrafted. Indent (iii) has been revised and now refers to a three-phase installation. In addition, Regulation 722.411.4.1 now includes an additional new indent (iv) to cover a single-phase installation. Regulation 722.411.4.1 does not allow PME to be used to supply an EV charging point unless you meet (i), or (ii), or (iii), or (iv) of 722.411.4.1. A summary of the requirements of the indents to Regulation 722.411.4.1 are as follows:

Regulation 722.411.4.1(i) refers to a situation where a connecting point is supplied from a three-phase installation used to supply loads other than charging points and where the load is sufficiently well balanced.

Regulation 722.411.4.1(ii) requires a very low resistance earth electrode to mitigate the effects of an open circuit PEN conductor fault on the supply.

As mentioned, Regulation 722.411.4.1 (iii) has been revised and now refers to a three-phase installation. The proposed new informative Annex to 722 describes that suitable arrangements include measurement of the voltage between:

- The circuit protective conductor and a suitable measurement earth electrode.
- The circuit protective conductor and a reference point derived from the line conductors of three-phase system, provided that suitable precautions are also taken to disconnect the device when the supply to one or more line conductors is interrupted.

Also as mentioned, Regulation 722.411.4.1 now includes an additional new indent (iv) to cover protection by a device (or functionality within the charging equipment) for a single-phase installation.

The touch voltage threshold of 70 V mentioned in Regulation 722.411.4.1 is on the basis that Table 2c (Ventricular fibrillation for alternating current 50/60 Hz) of IEC 60479-5{ed1.0} gives a value of 71 V for both-hands-to-feet, in water-wet conditions with medium contact area (12.5 cm2).

What is PME?

The Electricity Safety, Quality and Continuity Regulations 2002 (ESQCR) (as amended) permit the distributor to combine neutral and protective functions in a single conductor provided that (in addition to the neutral to Earth connection at the supply transformer) there are one or more other connections with Earth. The supply neutral may then be used to connect circuit protective conductors of the customer's installation with Earth if the customer's installation meets the requirements of BS 7671. This PME has been almost universally adopted by distributors in the UK as an effective and reliable method of providing their customers with an earth connection. Such a supply system is described in BS 7671 as TN-C-S. Whilst a protective multiple earthing terminal provides an effective and reliable facility for the majority of installations, under certain supply system fault conditions (external to the

installation) a potential can develop between the conductive parts connected to the PME earth terminal and the general mass of Earth.
The potential difference between true Earth and the PME earth terminal is of importance when:
(a) body contact resistance is low (little clothing, damp/wet conditions); and/or
(b) there is relatively good contact with true Earth.

Contact with Earth is always possible outside a building and, if exposed-conductive-parts and/or extraneous-conductive-parts connected to the PME earth terminal are accessible outside the building, people may be subjected to a voltage difference appearing between these parts and Earth.

RCD protection

The proposed requirements for RCD protection have been redrafted. The regulation now contains further requirements for Type B and Type A or Type F RCDs to take account of DC fault current as follows (extract below):

"Except where provided by the EV charging equipment, protection against DC fault currents shall be provided by:
(i) an RCD Type B; or
(ii) an RCD Type A or Type F in conjunction with a residual direct current detecting device (RDC-DD) complying with BS IEC 62955 as appropriate to the nature of the residual and superimposed currents and recommendation of the manufacturer of the charging equipment."

ANNEX A722 (Informative)

The proposed new Annex A722 has been redrafted. The Annex now includes guidance on the voltage monitoring device described in Regulation 722.411.4.1 (iii). Also, the Annex now includes an example arrangement of a separated system described in Regulation 722.413.

Conclusion.

It is important to note that this article only gives a brief overview of the proposed Amendment to BS 7671:2018. For more information please refer to the DPC. It is important to highlight that at this stage these are draft proposals only. The DPC is your opportunity to offer your insight into the proposed changes. The DPC is available here on BSI's website and everyone is invited to view the draft and submit comments by the deadline of 30th November 2019.

Is your BS 7671:2018 and associated guidance genuine? And what are the dangers if it's not?

The IET has become aware that there are a number of fake copies of both BS 7671:2018 and the *On-Site Guide* in circulation.

Fake versions of BS 7671:2018, the *On-Site Guide*, along with the *Electrician's Guide to the Building Regulations* and other books that have been identified aren't just exact copies of the originals. They often contain mistakes that can potentially have catastrophic consequences if the fake guidance is followed.

If pages are missing or information has been corrupted, following the guidance in these books could lead to unsafe work – potentially resulting in fire, electric shock or even death.

If an electrician were to use a fake IET publication bought from an unknown seller on a market place to design and install an electrical installation and something went wrong, it would be the responsibility of the installer even though they had followed what they thought was genuine information. This is why it is really important to make sure that you purchase from recognised sellers who can guarantee that you are purchasing a genuine copy.

About the fake version of the On-Site Guide

The fake copies of the *On-Site Guide* to BS 7671:2018 that we've seen so far have been quite easy to spot when compared to a genuine copy as the blue of the cover is different and there is information missing from some of the tables. Although there is a hologram inside the front cover which initially looks accurate, the vast number of other differences are extremely worrying.

About the fake version of the *Electrician's Guide to the Building Regulations*

The fake copies of the Electrician's Guide to the Building Regulations that we've seen so far have also been quite easy to spot when compared to a genuine copy as not only is the colour of the cover different, but the colour and quality of the paper is poor quality and more importantly information contained within some of the diagrams is incorrect.

How to ensure you buy a genuine copy

There are easy ways to make sure that you buy genuine copies of IET books. A list of verified sellers can be found on the IET website at www.theiet.org/fake-regs along with more information about the dangers of counterfeit books.

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More information can be found at www.theiet.org/fake-regs

The Institution of Engineering and Technology

Code of Practice for Building Automation and Control Systems

By Cameron Steel

Building services typically need controls so that they can operate when required and be switched off when not required. Using automated controls reduces the need for manual intervention. At their most basic this might be a standalone thermostat to control space or water heating. Early forms of building services controls may have had rudimentary fault alerts to indicate operational status and these would have required on-site expertise to check and manage. Technology has evolved to provide building management systems that monitor faults more centrally through automated links. The introduction of communications systems provides opportunities for remote controls to switch systems on and off. The use of computers enables a schematic version of the system to be used to visualise operational status and highlight faults. Advances in technology in the last few decades, particularly in energy metering, enables monitoring of the energy performance of building services as well.

But, as technologies become more complex, how do you design such systems? And how can they be managed to be an effective operational tool. How can you improve the energy performance of a building installation? Do you understand your whole installation and the other services that might be integrated into a more holistic building automation and control system? How do you identify stakeholders during the design stage and when do you engage them? How do you integrate seemingly disparate building services systems to ensure that the needs of the end users are met and energy consumption is reduced as much as possible?

The design requirements of Building Automation and Control Systems (BACS) should explore why, when and how. Is it a new build? Is it a refurbishment? What are the limitations of legacy equipment and infrastructures? Has the design considered how the system will be commissioned and the ongoing maintenance requirements? Working through BS EN ISO 16484-1 provides parallels with the RIBA stage milestones for BACS design development. BS EN 16247-2 demonstrates energy flow through a building and how BACS influences the implementation of controls and monitoring the use of energy.

The operational requirements of BACS should consider safe operation. With constant monitoring and alerts, systems can be optimised and managed to ensure economical operations and energy efficiency. BS EN 15232 gives guidance on BACS energy performance for a certain number of building services that use most of the energy in a building, but the full scope of services in your installation may well include other systems that might have some direct or indirect impact on energy performance. How do you rationalise those changes? Have the appropriate stakeholders provided the correct input at the design or operational stage? Can iterations be clearly defined to improve energy consumption in the next reporting period?

Increasing integration of a wide range of other building services and access via on-site and off-site data networks may mean that cyber security becomes an issue. Digitalisation of designs and commissioning data requires new platforms for building information to be shared amongst staff. Are the appropriate resources in place for these advances in technology? Have the correct training programmes and level of qualifications been identified for all personnel that will interact with BACS in your installation?

The *Code of Practice for Building Automation and Control Systems* is now available to pre-order from the IET.
https://shop.theiet.org/code-of-practice-for-building-automation-and-control-systems.

The publication provides comprehensive advice on specifying and implementing building automation and control systems. It also shows how BACS is an important tool for energy management, can be used to improve an installation's energy performance and the benefits of integration of multiple building services system.

The reader will be able to evaluate the design of a building automation and control system, from concept to commissioning and beyond, against national and international standards and communicate with a client about that level of energy efficiency it may achieve. As a design tool it will improve consulting engineers' knowledge about building controls, and help them to specify systems more effectively. As an operational tool it will develop facilities management engineers' knowledge and provide guidance on the language of building controls and energy efficiency. The document is also on-site reference manual that can be applied to projects on a regular basis and used to optimise energy performance.