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Energy efficiency, the IET Wiring Regulations and future 'smart' installations

Bill Wright, Head of Energy Solutions at the Electrical Contractors' Association and member of the JPEL/64 committee, writes about what we might expect on energy efficiency in the 18th edition of BS 7671.

A new Standard: IEC 60364-8-1

The IET Wiring Regulations, BS 7671, are primarily concerned with the safety of electrical installations. They do not cover how to design an electrical installation in an energy efficient manner. It is left to the designer and client to define how efficient an installation should be and what energy efficient products could be used in the design. The market for energy efficient products is growing as the cost of energy has increased over the years and energy efficient transformers, motors and other equipment are increasingly specified either by the customer requiring an efficient installation, or by regulation. In the current version of BS 7671, the section that comes nearest to requiring an energy efficient installation is Chapter 33, Compatibility.

The International Electrical Commission decided that a new part to the regulations was required to fill the gap. The result is a new Standard – IEC 60364-8-1*, Low Voltage electrical installations Part 8-1 Energy Efficiency*, which is available now. There is a view that this will become part of the 18th Edition of BS 7671.

The specifics about IEC 60364-8-1

IEC 60364-8-1 is unique in that it allows an installation to be specified as to how electrically efficient it is, not how it is operated. It gives guidance on all aspects of the design, including, for example, the position and type of transformer when supplying a load in a building and the sizing of cables for efficient transmission of power. Other installation equipment, such as PFCs (power factor correction), can also be specified in various formats and an 'Efficiency Code number' can be produced, which indicates the level of efficiency that is specified. A code EM0 would indicate that efficiency has not been taken into account in the design of the installation while a code EM4 would show that the installation is designed with maximum energy efficiency.

For instance, when sizing a cable do you design for the less expensive option of specifying the smallest cable possible to meet the load or would you specify the cable size that would have the smallest losses? If the cable is long and supplying a constant high load it may well be more cost effective to up size the cable to minimise losses. The capital cost may be higher but the long-term running costs could substantially outweigh the capital savings. This brings back the old argument of the cost of building versus the operational cost over the lifetime of the installation. Using IEC 60364-8-1, the client or specifier could specify that they require level EM4 for wiring systems.

IEC 60364-8-1 covers the following areas of an installation and defines the level of efficiency from EM0 (no consideration given) to EM4 (optimised system):

- Load Profile
- Location of main sub station

- Motors
- Lighting
- HVAC equipment
- Transformers
- Wiring system
- Power factor correction
- PF measurement
- Power measurement
- Voltage Measurement
- Harmonic measurement
- Renewable Energy

There are also Energy Efficiency performance levels classified EEPL0 to EEPL4 in in a number of categories, including:

- annual consumption splits between various loads;
- transformer efficiency; and
- power factor.

Each category is marked EM0 to EM4 and given points, so a level EM4 gets 4 points. The total points for the system can then be calculated. The totals of all these are then classified by giving them an Energy Installation Efficiency Class (EIECO) where EIECO is less than 16 points in total (i.e. virtually no energy efficiency measures applied) to EIEC4, which is between 48 and 58 points, showing that many measures have been applied.

This is the first Standard to include efficiency measures applicable to electrical installation and from both a specifier's and an installer's point of view could prove useful in clarifying the measures that should be taken. Applying basic Part L Building Regulation measures will give a degree of efficiency but IEC 60364-8-1 takes this further. It is hoped that IEC 60364-8-1 will be incorporated into the 18th edition of the IET Wiring Regulations (BS 7671) when it is published in a few years' time.

What's next?

There is another Standard following on from this, IEC 60364-8-2, which is nearing completion and which includes the concept of smart electrical installations, the use of control systems such as BEMS (building energy management systems) in the control of loads, the integration of renewable energy sources and storage devices and their associated protective devices into installations. Whether this will be included in the 18th edition of BS 7671 has yet to be decided.

What of the future? Energy efficiency is going to have a higher profile than it has previously had as, despite the current low oil price, the cost of electricity will rise due to the cost of renewable energy and the replacement infrastructure in the UK. The electrical distribution

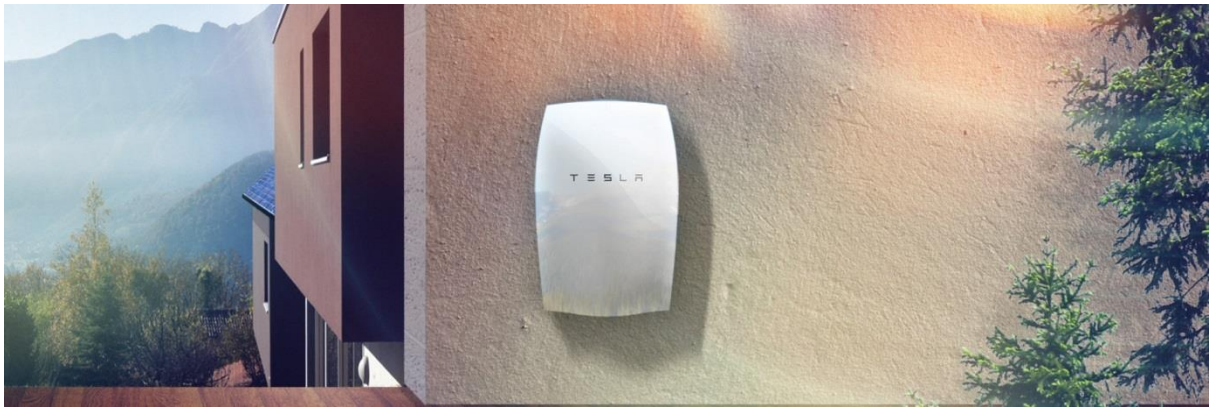
within a building has been sidelined up to now but, going forward, it should be taken into account in the design of a building. If measures to increase the efficiency above the current requirement under Building Regulations are undertaken at construction stage then the cost can be kept to a minimum. It is far more sensible, and cheaper, to reduce power requirements than build new power stations to provide more. There is an EU-wide requirement that countries should not only have a certain proportion of renewable energy by 2020 but also they should reduce their consumption. The recent EU Energy Efficiency Directive, which has brought in the Energy Savings Opportunity Scheme (ESOS) for the UK, is an example of governments being forced down the line of efficiency improvements.

Future challenges to be resolved

One of the problems of renewable energy systems in buildings is that they may produce power (i.e. via Photo Voltaic (PV) and wind) when it cannot be used or the demand exceeds the supply. A degree of smoothing out is required and the recent announcement by Tesla about their home and small business energy storage unit is a welcome initiative to help better use renewable energy. Excess energy produced, say, from PV during the day, is stored and used overnight giving a much smoother load profile for the building and for the incoming supply. Storage is nothing new; it is practised on a large scale in the UK by the 'Energy Mountain', Dinorwic, in Wales. Water is pumped up to a high level reservoir over night when power is cheap and available and then the water is used to produce hydro power during peak periods during the day.

The Tesla storage device is lithium ion battery based and Tesla draw on their electric car experience to package a unit to smooth out power from PV installations. Many advance orders have been placed though we will probably not see the first units in the UK until 2016.

The Tesla energy storage unit is wall mounted.



Shown here for perspective in size, dimensions are 1300 mm x 860 mm x 180 mm

The integration of storage systems into an electrical installation is covered in IEC 60364-8-2.

'Smart meters' will also make a difference in energy consumption if used correctly. Approximately 50 million smart meters are scheduled to be installed in domestic, commercial and industrial premises between 2016 and 2020, although this is to be confirmed by the new government. This will enable users to take advantage of different cost tariffs and, by having external control of connected devices through the meter, will enable management of supplies as well as the consumer having instant access to their consumption figures. If the meters meet expectations then users will be able to decide their own tariffs and have their demand reduced at peak times by data sent to their meter, which can then cut off supplies to appliances such as freezers, tumble driers or any non-critical supplies elsewhere that the consumer has agreed can be included in their supply contract. There is even talk about integrating domestic appliances to the meter by the use of low power radio frequency switching; appliances would be purchased already enabled to take advantage of any communication from the meter. The smart meter, which should not be mistaken for a straight 'AMR' (automatic meter reading) type, can both send and receive data and could transform the way consumers use electricity. It is hoped that wide-scale take up of the capabilities of this meter will enable countrywide grid control and reduce overall demand at peak periods.

The way electrical installations will be designed in the future will change as energy efficiency will have to be taken into account. As energy prices rise clients will realise that long term savings can be made by a small extra capital cost at the beginning of a project.