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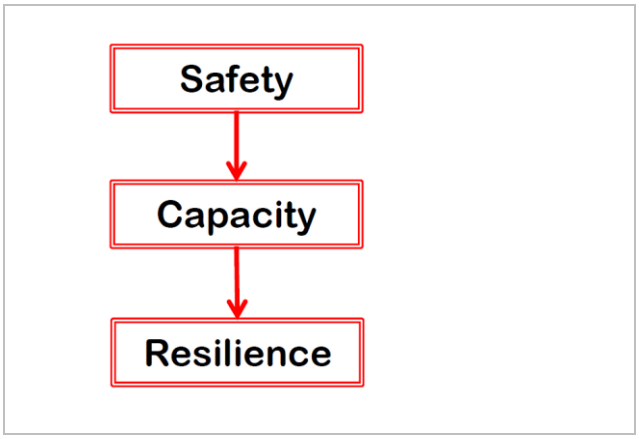
Energy Efficiency in Electrical Installations

A new harmonised document, IEC 60364-8-1 Low Voltage electrical installations – Part 8-1: Energy Efficiency*, considers design and maintenance from the context of reducing inefficiency in electrical installations, whilst adhering to safety and operational control. It is likely that IEC 60364-8-1 will be of interest to users of BS 7671 as energy efficiency is of increasing importance to UK electrical installations.*

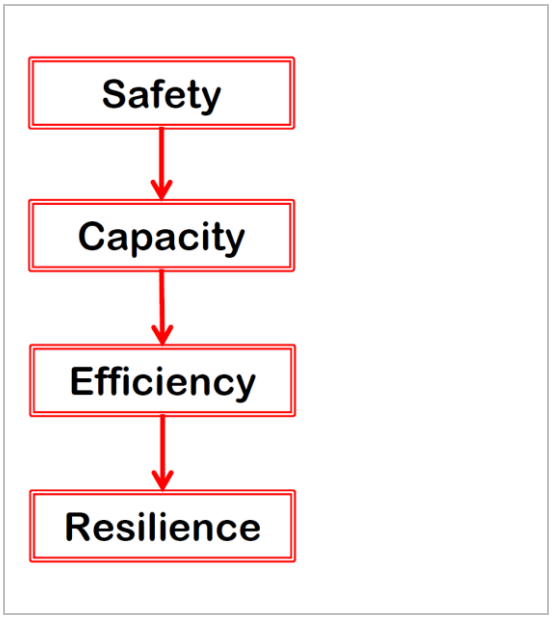
Cameron Steel, author of the recently published Designer's Guide to Energy Efficient Electrical Installations*, explains what IEC 60364-8-1 will require from those working in the electrical industry.*

Design hierarchy

Ensuring that an installation is safe enough to allow satisfactory operations and has sufficient capacity for existing needs has typically been enough for most installations. Some installations, with safety critical operations, may also have considered resilience to avoid single points of failure and provide system continuity. This means that, until relatively recently, the traditional model of an electrical installation design hierarchy would have been:



Energy efficiency updates the hierarchy of design, and that affects the operation of electrical installations. The traditional design hierarchy will change to this:



There is a change of emphasis to incorporate energy efficiency into electrical installation designs as a prerequisite rather than just as an aspiration. An energy efficient electrical installation has many potential benefits:

(a) less impact on the environment generally;
(b) reduces energy losses and hence lowers energy costs;
(c) uses energy when it is required and potentially at a lower (off-peak) tariff;
(d) less reactive maintenance due to the adverse effects of heat loss; and
(e) optimises the electrical system performance throughout its life cycle.

IEC 60364-8-1 considers various factors for electrical efficiency in installations, including:

(a) the efficient placement of the electrical intake;
(b) the efficiency of the electrical distribution wiring system;
(c) the type of controls to avoid wasteful use of loads;
(d) how and where to provide energy measurement;
(e) how and what type of loads can be switched off without affecting user safety, function or comfort;
(f) energy management of electrical systems; and
(g) the impact of maintenance on the efficiency of electrical systems.

Design requirements

The first design requirement is to stress the importance of understanding the energy profile of both the passive and the active measures taken within the building:

(a) active: measures for the optimisation of electrical energy produced, supplied, flowing and consumed.

(b) passive: measures for the choice of parameters of electrical equipment to improve overall electrical energy efficiency of the electrical installation while not affecting the initial construction parameters.

The second design requirement is to reduce energy losses within the electrical installation by two principal methods:

(a) the location of any energy source (conventional high voltage (HV) or low voltage (LV) intake, local generation, and switchboard) should be optimised where possible.
(b) the reduction of losses within the installation wiring system is important. Some design criteria will be understood in terms of voltage drops, maintaining power quality and improving power factors. Other considerations in terms of harmonics, typically caused by end user appliances, can cause operational inefficiencies. The issue of harmonics caused by new equipment on older electrical distribution infrastructure is an increasing cause for concern.

Many new installations seek accreditation from BRE's BREEAM assessment method, Leadership in Energy and Environmental Design (LEED) or similar benchmarks. The IEC standard is a design framework for a more energy efficient electrical installation. A client can stipulate, at the design stage, the required level of energy efficiency measures (EM) that should be applied to an electrical installation with ratings from EM0 to EM4 in each of 13 categories. The design should also influence the operational activities of the electrical installation after the commissioning stage. Three further categories specify the required energy efficiency performance levels (EEPL) rated from EEPL0 to EEPL4.

Most legislative initiatives on energy efficiency relate to new buildings. However, IEC 60364-8-1 recognises that the replacement of existing building stock is relatively low at around 2 % to 5 % per annum and it states that it should be applied to existing as well as new building stock. Applying a standard retrospectively is always difficult, but the standard states "it is in the refurbishment of existing buildings that significant overall improvements in energy efficiency can be achieved."

Other topics addressed by IEC 60364-8-1 include:

(a) supplies and loads, control inputs and outputs;
(b) Barycentres;
(c) load management;
(d) load types; and
(e) installation maintenance.

All topics are explained in full in the *Designer's Guide to Energy Efficient Electrical Installations*.