



DPC: 24 / 30491426 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

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Part 8-81: Functional aspects - Energy efficiency

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Responsible Committee Secretary: **Mr Mark Coles (IET) (BSI)**
Direct tel: **01438 767643**
E-mail: mcoles@theiet.org

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



64/2669/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: IEC 60364-8-81 ED1	
DATE OF CIRCULATION: 2024-04-12	CLOSING DATE FOR COMMENTS: 2024-08-02
SUPERSEDES DOCUMENTS: 64/2657A/RR	

IEC TC 64 : ELECTRICAL INSTALLATIONS AND PROTECTION AGAINST ELECTRIC SHOCK	
SECRETARIAT: Germany	SECRETARY: Mr Wolfgang Niedenzu
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 2,SC 22G,TC 23,SC 23E,SC 23K,TC 65,TC 69,TC 82,TC 85,TC 120,TC 121,SC 121A,SC 121B,PC 128	PROPOSED HORIZONTAL STANDARD: ☒ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	

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TITLE:

Low-voltage electrical installations - Part 8-81: Functional aspects - Energy efficiency

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE ELECTRICAL INSTALLATIONS –

Part 8-81: Functional aspects - Energy efficiency

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International Standard IEC 60364-8-81 has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock.

This first edition cancels and replaces the second edition of IEC 60364-8-1 published in 2019. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) ...;
- b)

The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

The optimization of electrical energy usage can be facilitated by appropriate design and installation considerations. An electrical installation can provide the required level of service and safety for the lowest electrical consumption. This is considered by designers as a general requirement of their design procedures in order to establish the best use of electrical energy. In addition to the many parameters taken into account in the design of electrical installations, more importance is nowadays focused on reducing losses within the system and its use. The design of the whole installation has therefore to take into account inputs from users, suppliers and utilities.

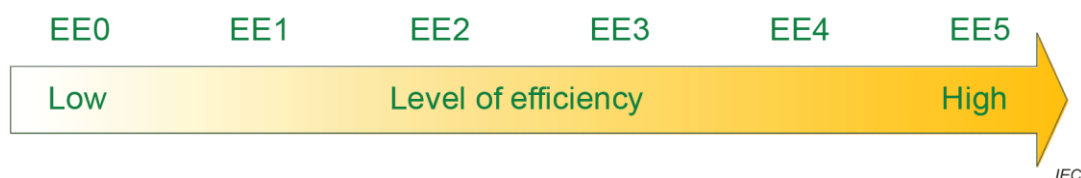
It is important that this document covers existing electrical installations in buildings, in addition to new installations. It is in the refurbishment of existing buildings that significant overall improvements in energy efficiency can be achieved.

The optimization of the use of electricity is based on energy efficiency management which is based on the price of electricity, electrical consumption and real-time adaptation. Efficiency is checked by measurement during the whole life of the electrical installation. This helps identify opportunities for any improvements and corrections. Improvements and corrections may be implemented by redesign or equipment replacement. The aim is to provide a design for an efficient electrical installation which allows an energy management process to suit the user's needs, and in accordance with an acceptable investment. This document first introduces the different measures to ensure an energy efficient installation based on kWh saving. It then provides guidance on giving priority to the measures depending on the return of investment; i.e. the saving of electrical energy and reducing of electrical power costs divided by the amount of investment.

This document is intended to provide requirements and recommendations for the electrical part of the energy management system addressed by ISO 50001.

It introduces requirements, recommendations and methods for the design and the energy efficiency assessment of an electrical installation within the framework of an energy efficiency management approach in order to get the best permanent functionally equivalent service for the lowest electrical energy consumption and the most acceptable energy availability and economic balance.

The assessment method described in Annex B **Error! Reference source not found.** based on the electrical energy efficiency of the installation allows a classification of energy efficiency installation according to the following levels:



NOTE Account can be taken, if appropriate, of induced works (civil works, compartmentalization) and the necessity to expect, or not, the modifiability of the installation.

This document introduces requirements and recommendations to design the adequate installation in order to give the ability to improve the management of the energy performance of the installation by the tenant/user or for example the energy manager.

All requirements and recommendations of this part of IEC 60364 enhance the requirements contained in Parts 1 to 8 of the IEC 60364 series.

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LOW-VOLTAGE ELECTRICAL INSTALLATIONS –

Part 8-81: Functional aspects - Energy efficiency

81 Energy Efficiency

81.1 Scope

This part of IEC 60364 provides additional requirements, measures and recommendations for the design, erection, operation and verification of all types of low voltage electrical installation including local production and storage of energy for optimizing the overall efficient use of electricity.

It introduces requirements, recommendations and methods for the design and the energy efficiency (EE) assessment of an electrical installation within the framework of an energy efficiency management approach in order to get the best permanent functionally equivalent service for the lowest electrical energy consumption and the most acceptable energy availability and economic balance.

These requirements, recommendations and methods apply, within the scope of the IEC 60364 (all parts), for new installations and modification of existing installations.

This document is applicable to the electrical installation of a building or system and does not apply to products. The energy efficiency of products and their operational requirements are covered by the relevant product standards.

Where another standard provides specific requirements for a particular system or installation application (e.g. manufacturing system covered by ISO 20140 (all parts)), those requirements may supersede this document.

This document does not specifically address building automation systems.

This group energy efficiency publication is primarily intended to be used as an energy efficiency standard for the low voltage electrical installations mentioned in Clause 1, but is also intended to be used by technical committees in the preparation of standards, in accordance with the principles laid down in IEC Guide 119 and IEC Guide 118.

81.2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61557-12:2007, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 12: Performance measuring and monitoring devices (PMD)*

IEC 61869-2, *Instrument transformers – Part 2: Additional requirements for current transformers*

IEC 62052-11, *Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 11: Metering equipment*

287 IEC 62053-21, *Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static*
288 *meters for active energy (classes 1 and 2)*

289 IEC 62053-22, *Electricity metering equipment (a.c.) – Particular requirements – Part 22: Static*
290 *meters for active energy (classes 0,2 S and 0,5 S)*

291 IEC 62974-1, *Monitoring and measuring systems used for data collection, gathering and*
292 *analysis – Part 1: Device requirements*

293 IEC Guide 118, *Inclusion of energy efficiency aspects in electrotechnical publications*

294 IEC Guide 119, *Preparation of energy efficiency publications and the use of basic energy*
295 *efficiency publications and group energy efficiency publications*

296 **81.3 Terms and definitions**

297 For the purposes of this document, the following terms and definitions apply.

298 ISO and IEC maintain terminology databases for use in standardization at the following
299 addresses:

- 300 • IEC Electropedia: available at <https://www.electropedia.org/>
- 301 • ISO Online browsing platform: available at <https://www.iso.org/obp>

302 **81.3.1 General**

303 **81.3.1.1**

304 **zone**

305 area (or surface) defining a part of an installation

306 Note 1 to entry: Examples of a zone can be a kitchen of 20 m² or a storage area of 500 m².

307 **81.3.1.2**

308 **current-using equipment**

309 electric equipment intended to convert electric energy into another form of energy, for example
310 light, heat, mechanical energy

311 [SOURCE: IEC 60050-826:2004, 826-16-02]

312 **81.3.1.3**

313 **electrical installation**

314 assembly of associated electric equipment having co-ordinated characteristics to fulfil specific
315 purposes

316 [SOURCE: IEC 60050-826:2004, 826-10-01]

317 **81.3.1.4**

318 **usage**

319 type of application for which electricity is used

320 EXAMPLE Lighting, heating.

321 **81.3.1.5**

322 **load energy profile**

323 figure representing the energy consumption (Y-axis) within a period of time (X-axis) based on
324 measurements for a mesh or a group of meshes

325 EXAMPLE Hourly consumption of energy for a period of a week.

81.3.1.6**power demand profile**

figure representing the power demand (Y-axis) for a given integration period within a period of time (X-axis) based on measurements for a mesh or a group of meshes

81.3.1.7**electrical energy efficiency****EEE**

system approach for optimizing the efficiency of electricity usage

Note 1 to entry: Energy efficiency improvement measures take into account the following considerations:

- both the consumption (kWh) and the price of electricity;
- technology;
- environmental impact.

Note 2 to entry: This note applies to the French language only.

81.3.1.8**mesh**

one or more circuits of the electrical installation for one or more zones including one or more services supplying a group of electrical equipment for the purpose of electrical energy efficiency

81.3.1.9**active electrical energy efficiency measure**

operational measure, either manually or automatically controlled, for optimizing the energy efficiency of the electrical installation

EXAMPLE Thermostat control, occupancy lighting control, building optimization control systems.

81.3.1.10**passive electrical energy efficiency measure**

measure for optimizing the energy efficiency of the electrical installation by selection and erection of electrical equipment other than control equipment

EXAMPLE Selection and location of transformer, cross section of cables, routing of wiring system, sub-division of circuits.

81.3.1.11**electrical installation efficiency class**

defined level of energy efficiency for an electrical installation

Note 1 to entry: See Annex B.

81.3.1.12**driving parameter**

external factors that affect energy efficiency

EXAMPLE Regulation, environmental conditions, occupancy, energy prices and management requirements, mode of operation, duty cycle, load curves, state, operating, parameters, indoor temperature, lighting levels, production volume.

81.3.1.13**barycentre method**

procedure to optimize the position of energy source(s) and loads in consideration of energy efficiency

81.3.1.14**EE assessment**

process to determine the electrical installation efficiency class of an installation

81.3.2 Electrical energy management**81.3.2.1
electrical energy management system
EEMS**

system monitoring, operating, controlling and managing energy resources and loads of the installations

**81.3.2.2
load shedding**

method(s) of optimizing demand by controlling the electrical loads for variable periods of time

**81.3.2.3
demand response**

changes in electric usage by end-user customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized

**81.3.2.4
user interface**

means that allow the user to monitor and/or control the electrical installation, locally or remotely

EXAMPLE Visual or audible signal, local display, remote display, push button.

81.3.3 Energy measurement**81.3.3.1
measurement**

process of obtaining value(s) that can be attributed to a quantity

**81.3.3.2
monitoring**

continuing procedure for the collection and assessment of pertinent information, including measurements, for the purpose of identifying deviations and determining the effectiveness of the plans and procedures

[SOURCE: IEC 60050-881:1983, 881-16-02, modified — Addition of “identifying deviations and” deletion of “for radiation protection”.]

**81.3.3.3
power metering and monitoring device
PMD**

combination in one or more devices of several functional modules dedicated to metering and monitoring electrical parameters in energy distribution systems or electrical installations, used for applications such as energy efficiency, power monitoring and network performance

Note 1 to entry: This note applies to the French language only.

**81.3.3.4
billing**

process that allows energy suppliers or their representatives to invoice their customers according to a defined contract

Note 1 to entry: These applications can be covered by international standards, regulations such as MID in Europe or NMI in Australia, and/or utility specifications.

81.3.3.5**sub-billing**

process that allows the property manager to allocate an energy invoice from the energy supplier and charges as appropriate to specific tenants

81.3.3.6**cost allocation**

process that allows a facility manager to account for energy costs from internal cost centres that consume energy

EXAMPLE Process line, test and inspection, administration.

81.3.3.7**estimation**

process of judging one or more values that can be attributed to a quantity

Note 1 to entry: Estimation by a competent person can provide data of a reasonable accuracy.

81.3.3.8**forecast**

estimate of the expected value of a parameter at a given future date

81.3.3.9**total harmonic distortion of the voltage wave** **THD_U**

ratio of the RMS value of the harmonic content of an alternating quantity (voltage) to the RMS value of the fundamental component of the quantity (voltage)

81.3.3.10**total harmonic distortion of the current wave** **THD_I**

ratio of the RMS value of the harmonic content of an alternating quantity (current) to the RMS value of the fundamental component of the quantity (current)

81.3.3.11**Degree day**

A unit used to determine the heating requirements of buildings, representing a fall of one degree below a specified average outdoor temperature (usually 18°C) for one day

81.3.4 Sectors of activities**81.3.4.1****residential installations**

premises designed and constructed for private habitation and including associated areas

Note 1 to entry: Associated areas include common areas, garages, gardens, pools.

81.3.4.2**commercial installations**

premises designed and constructed for commercial operations

EXAMPLE Offices, retail, distribution centres, public buildings, banks, hotels, hospitals, schools.

81.3.4.3**industrial installations**

premises designed and constructed for manufacturing and processing operations

EXAMPLE Factories, workshops.

81.3.4.4**infrastructure installations**

systems or premises designed and constructed for transport or utility operations

EXAMPLE Airport terminals, port facilities, transport facilities.

81.3.5 Abbreviated terms

BS	bonus
DB	distribution board
DSO	distribution system operator
EEE	Electrical energy efficiency
EM	energy management
HVAC	heating, ventilation and air conditioning
ICT	information and communications technologies
KPI	key performance indicator
MA	performance maintenance
PDS	power drive system
PEI	peak efficiency index
PM	power monitoring
PMD	power metering and monitoring device
PV	photovoltaic
THD	total harmonic distortion
UPS	uninterruptible power supplies

81.4 General**81.4.1 Fundamental principles****81.4.1.1 Safety of the electrical installation**

The requirements and recommendations of this part of IEC 60364 shall not impair requirements included in other parts of the IEC 60364 series.

81.4.1.2 Availability of electrical energy and user decision

Energy efficiency management shall not reduce electrical availability and/or services or operation below the level desired by the user.

The electrical installation shall have provisions for overriding the energy efficiency management settings according to the user's decision.

EXAMPLE 1 If someone is ill, the user can decide to heat the room to a higher temperature, even during peak consumption.

EXAMPLE 2 If a company receives an urgent delivery order, there can be a need for the workshop operate at an unexpected hour.

81.4.1.3 Design principles

The design principles of this document take into account the following aspects:

- load energy profile (active and reactive energy);
- availability of local generation (PV, wind turbine, generator, etc.) and storage;
- reduction of energy losses in the electrical installation;

- the arrangement of the circuits with regard to energy efficiency (meshes, see 81.7.4);
 - the customer's power use distribution over time;
 - the tariff structure offered by the supplier of the electrical energy;
- maintaining the quality of service and the performance of the electrical installation.

In order to verify the achievement of electrical energy efficiency measures, an overall energy efficiency assessment should be made.

81.4.2 Energy efficiency assessment for electrical installations

81.4.2.1 General

Assessment of installations shall be performed according to Annex B. **Error! Reference source not found.** This assessment shall be achieved preferably by measurement. It may be also achieved by calculation

The frequency of periodic inspection of an installation shall be determined having regard to the type of installation and equipment, its use and operation, the frequency and quality of maintenance, factors liable to influence energy efficiency and the external influences to which it is subjected. The results and recommendations of the previous report, if any, shall be taken into account.

The maximum interval for follow-up assessment is recommended to not exceed:

- five years for commercial;
- three years for industrial and infrastructure.

81.4.2.2 Action plan following an assessment according to Annex B

Where assessment is performed on a new installation and the assessment identified an electrical installation efficiency class lower than required, the identified variances shall be corrected or other action shall be taken based on local regulation, if any.

Where periodic assessment identifies the electrical installation efficiency class is lower than the required value performed, an action plan is typically needed to achieve the required or desired electrical installation efficiency class.

81.5 Sectors of activities

For a general approach to electrical energy efficiency (EEE), four sectors may be identified, each having particular characteristics requiring specific methodology of implementation

- residential installations;
- commercial installations;
- industrial installations;
- infrastructure installations.

Categorization is intended to facilitate the comparison between similar installations.

Users of this document, such as local authorities, design institutes, building owners, architects, facility managers, should consider assigning specific installation types (sub-sectors) to one of the above sectors of activity.

81.6 Design requirements and recommendations

81.6.1 General

While designing an electrical installation, the following shall be taken into account:

- the load energy profile (active and reactive energy);
- the minimization of energy losses in the electrical installation by means of:
 - optimal location of the transformers, local production and switchboard (barycentre),
 - location of HV/LV substation,
 - reduction of losses in wiring,
- local production and storage.

81.6.2 Determination of load energy profile

The prospective load energy profile within the installation shall be determined.

Synthetic profiles (typical load energy curves) from loads or load groups may be used from similar applications.

If measurements or synthetic profiles are not available, the main loads (based on equipment rating) including expected duration of operation should be identified. This consumption could then be summed to create a load energy profile.

81.6.3 Determination of the transformer and switchboard location with an optimizing method

Account shall be taken of the building's use, construction and space availability for the best position to be obtained, but this should be determined with the building designers and owners prior to construction. To keep the wiring losses to a minimum, the main distribution transformers and switchboards shall be located, taking into consideration the building constraints, in such a way as to keep distances to main loads to a minimum. The methods used for determining the position can be used to determine the optimal available site for the distribution equipment and transformers.

The barycentre method is an iterative approach that can be used to determine:

- whether the load distribution is uniform, or of localized type;
- whether the loads or other equipment should be relocated; and,
- the total load barycentre location.

See examples of calculations in Annex A.

81.6.4 HV/LV substation

81.6.4.1 General

To find the optimal solution for the transformer, the following shall be considered:

- the optimum number and location of HV/LV substations;
- the working point of the transformer;
- the efficiency of the transformer;
- the load energy profile.

NOTE As a LV consumer, it is important to have an early discussion with the utility on the number and location of the substations, transformers and switchboards.

81.6.4.2 Optimum number and location of HV/LV substations

Depending on several criteria such as the required power, the building surface area and the load distribution, the number of HV/LV substations and the distribution layout will have an influence on the lengths and cross-sectional areas of conductors.

If the barycentre is located in one building side, it is advised to choose one substation close to this barycentre; or if the barycentre is located in the middle of the building layout, it may not be possible to locate the HV/LV substation near the load centre. In such cases, it is recommended to split the electrical distribution into several HV/LV substations located close to their respective barycentres. This facilitates the optimization of LV conductor lengths and sizes.

81.6.4.3 Working point of the transformer

The maximum efficiency of a transformer is when the iron and copper losses are equal.

Transformer manufacturers design the working point of the transformer to align with the specific application of the transformer. For transformers normally loaded at 50% of capacity (e.g. distribution transformers), the working point is designed to be between 30-50%. The working point will be designed to be much higher for transformers designed to normally operate at full load (e.g. LV power transformers).

81.6.4.4 Efficiency of the transformer

The choice of an energy efficient transformer may have a significant impact on the energy efficiency of the whole installation.

Energy efficiency of the transformers is classified on the basis of their load and no-load energy losses.

The choice of the top energy efficiency class results in increased initial cost. However, the payback time can be estimated to be relatively short (a few years) compared to the average lifetime (more than 25 years) of the transformer.

Reference should be made to manufacturers' information for more details on energy efficient transformers with respect to IEC TS 60076-20, including design guidelines, estimated payback time, heat dissipation needs, installation constraints in the presence of other heat-dissipating equipment.

The placement of transformers may be subject to further safety constraints in the case of oil-immersed transformers.

81.6.5 Efficiency of local production and local storage

Renewable energy and associated storage contribute to the overall electrical energy efficiency of the installation.

To achieve high values of energy coverage with local energy generation, adequate local storage and/or reverse feeding into the network of the utility should be considered.

81.6.6 Losses in the wiring

81.6.6.1 Voltage drop

The energy losses in the wiring are reduced by reducing the voltage drop.

Recommendations on the maximum voltage drop in the installation are provided in IEC 60364-5-52:2009, 525.

81.6.6.2 Cross-sectional areas of conductors

Increasing the cross-sectional area of conductors determined according to IEC 60364-5-52 will reduce the losses.

The cross-sectional area of conductors for distribution circuits (feeders) and final circuits supplying loads having a high consumption shall be based on a technical and economical assessment considering the cost of:

- the conductor(s);
- erection and mounting of the conductor(s);
- the energy losses in the conductor(s) over the expected life time.

The expected life time will vary depending on the type of load, installation and the expected use of the installation.

The cross-sectional area of other conductors should be determined assessing the savings within a time scale against the additional cost.

A calculation method can be found in IEC 60287-3-2.

NOTE In some applications (particularly industrial), the most economical cross-sectional area of conductor can be several sizes larger than that required for thermal reasons.

81.6.6.3 Power factor correction

Consideration shall be given to power factor improvement.

Reduction of the reactive energy consumption at the load level reduces the losses in the wiring in the upstream installation.

A possible solution to improve the power factor is the installation of a power factor correction system at the respective load circuits.

NOTE A power factor correction can be made at the load level or centrally, depending on the type of application. The complexity of the issue leads to consideration of each individual application.

81.6.6.4 Reduction of the effects of harmonic currents

Reduction of harmonics at the load level, for example the selection of harmonic-free products, reduces the losses in the wiring.

Possible solutions include:

- reducing harmonics by the installation of harmonic filters at the respective load circuits;
- reducing the effect of harmonics by increasing the cross-sectional area of the conductors;
- using methods that produce less harmonics, like Sinusoidal Pulse Width Modulation (SPWM), in the renewable energy resources' inverters connected to the Point Of Connection (POC).

NOTE A reduction of harmonics can be made at the load level or centrally, depending on the type of application. The complexity of the issue leads to consideration of each individual application.

81.7 Determination of the zones, usages and meshes

81.7.1 Determining the zones

Identification of the zones is needed to enable the correct determination of the meshes (see 81.7.4).

A zone represents an area or a location where electricity is used. It may correspond for example to:

- an industrial workshop;
- a floor in a building;
- an area of a room near windows or an area of a room away from windows;
- a room in a dwelling;
- a private swimming pool;
- a hotel kitchen.

Designers, electrical contractors or the building owner shall agree on the zones within the building.

81.7.2 Determining the usages within the identified zones

Identification of the usage for a particular circuit or zone is needed to enable accurate measurement and analysis of its energy consumption, power flow and other electrical parameters.

Different usages could be the following:

- hot water production;
- HVAC (cooling and heating);
- Electric Vehicle energy transfer;
- electrical energy storage;
- lighting;
- motors;
- appliances.

81.7.3 Demand response

Demand response is the management of the electricity demand in response to supply conditions.

Demand response is intended to adapt the consumption of energy to the generated power, especially when generation with renewable energy (e.g. windpower, photovoltaic) is present, and to guarantee system stability. Demand response programs may include dynamic pricing/tariffs, price-responsive demand bidding, contractually obligated and voluntary curtailment, and direct load control/cycling.

Methods of demand response are:

- time-based rates such as time-of-use pricing (e.g. critical peak pricing, variable peak pricing, real time pricing, critical peak rebates);
- limitation of the supply of energy;
- real-time load energy curves.

The energy efficiency and load management system gives response to the supply conditions from the grid (see Clause 81.8).

NOTE: Real time (pricing) refers to typical time intervals from 5 to 60 minutes, depending on national conditions

81.7.4 Determining the meshes

81.7.4.1 General

A mesh may belong to one or several zones (see 81.7.1).

A more effective solution concerning energy monitoring and controlling is to assign a complete mesh to one zone.

A mesh determines one or several usages (see 81.7.2) in one or several zones.

Meshes shall be designed such that they may be managed to use electrical energy to always fulfil the need, taking into account driving parameters such as the availability of daylight, occupation of a room, availability of energy, outdoor temperature, other aspects linked to the building construction and passive energy efficiency.

One circuit belongs to one mesh or a cluster of meshes.

The determination of the meshes in the installation shall be defined so that they deliver the associated usage, while allowing effective management of the consumption of energy, and considering at least one of the criteria defined in 81.7.4.3.

81.7.4.2 Meshes

Electrical management for energy efficiency is a system approach aiming to optimize the management of energy used for a specific service within a defined “electrical mesh”, taking into account all necessary information concerning the technical and economic approaches.

It is seldom that the optimum of a system equals the sum of the optima of each part of the system. It is therefore necessary to consider the most appropriate meshes of the electrical installation from the electrical energy efficiency point of view.

This shall be considered in order to get the lowest electrical energy consumption and/or cost with regards to a solution for a service which is, and can be, compared to another solution.

It has also to be considered that the installation of a device to introduce modified operation or new functions designed to optimize electrical consumption for that product may result in an increase of electrical consumption for interrelated loads within the same system. It is therefore meaningless to separately consider only one or several devices where the assembly, which includes that device or all of those devices, within the system of a circuit or a mesh may experience optimized consumption, even though the consumption of some individual parts may increase.

Introducing electrical equipment or functions for reducing, measuring, optimizing and monitoring energy consumption or any other use aiming to improve the use of electricity may increase the energy consumption in some parts of a system.

For example, the use of a control device (e.g. a thermostat in an electric heating system, a human presence detector in an electric lighting system) may increase the instant or global consumption of particular equipment for some devices but decrease the total consumption of the whole mesh.

According to this document, the smallest mesh is limited to one electrical device and the largest mesh covers all electrical circuits used in the whole building for all services.

81.7.4.3 Criteria for considering meshes

81.7.4.3.1 General

In addition to criteria depending on the local price of energy, the following criteria are necessary for defining different meshes of an electrical installation from the point of view of energy management and monitoring with regards to efficiency.

81.7.4.3.2 Technical criteria based on driving parameters (time, illuminance, temperature, etc.)

Interruption of some services or applications should be avoided during certain periods of time. The designer, and/or end user should agree on the daily, weekly, monthly or yearly schedule for the periods when some services or applications shall be available or can be reduced or shut off. Identifying these applications and gathering them in a mesh are key from an energy efficiency point of view. For example, defining a mesh for luminaires near windows and a second one for luminaire(s) near the wall allows for switching off those near the windows when daylight is sufficient.

81.7.4.3.3 Technical criteria based on control

A mesh can gather together some loads functionally linked with one or more control devices, for example the thermostat of an electric heating system controlling radiators from several electrical circuits, so that those radiators belong to the same mesh.

81.7.4.3.4 Technical criteria based on critical points for measurement

The accuracy of a measurement is not the same if the objective is to follow a trend or to invoice a service. The purpose of measurement can help to decide on the appropriate mesh.

81.7.4.3.5 Criteria based on meshes

In a location where a group of current using equipment needs to operate all at the same time, creating a large mesh containing all this equipment is beneficial. In cases such as multiple luminaires in a single room, having several small meshes permits more effective use of energy.

81.7.4.3.6 Economic criteria based on the variable cost of electricity

The cost of electricity may vary with the time of use, and with the maximum power allowed by the grid (demand-response may be necessary for monitoring the energy).

Depending on the price variability of the electricity for buying, selling and storage, it can be useful, when possible, to defer or anticipate certain uses or design meshes with this consideration in mind.

81.7.4.3.7 Technical criteria based on energy inertia

It is not possible, or it is at least difficult, to introduce load shedding on a mesh dealing with lighting (no inertia), while it is easier on a mesh including water heating systems (large inertia). Considering inertia of loads is useful to decide how to introduce load shedding between appropriate meshes.

Meshes including recharging of batteries, heating systems, air cooling, a fridge, etc. can be gathered against meshes including lighting, available socket-outlets for the information and communications technologies (ICT) equipment, etc. It will therefore be possible to introduce load shedding and rules for load shedding in meshes having a high inertia. This is an input product standardization, for product design and installation design.

A high inertia is generally associated with easier load shedding due to the fact the status of the load is not really affected by the variation of the electrical supply.

81.7.5 Driving parameters

81.7.5.1 General

Driving parameters having the most influence on energy efficiency shall be identified.

Driving parameters should be assessed to evaluate their relative influence on the overall consumption of the installation.

Dedicated indicators should be analysed to verify the energy efficiency of the installation according to the influence of the driving parameters.

EXAMPLE kWh per m² per degree days.

81.7.5.2 Occupancy

Adapting the usage of energy to the occupancy of the building helps the management of energy.

Occupancy may be determined in the following ways:

- presence of at least one person in a defined zone;
- indication of the number of persons in a defined zone.

81.7.5.3 Operating time

Operating timing may be an effective strategy to set up and reduce the building energy consumption and allows to reduce services which are not needed at certain periods of time. Operating timing may be done:

- at building level;
- at floor level;
- at a zone level depending on the floor;
- at a mesh level.

81.7.5.4 Environmental conditions

Local environmental conditions such as, outside temperature, solar (illuminance and heating), wind, humidity, pollution may be considered as driving parameters.

81.7.5.5 Cost of electricity

As cost of electricity may vary depending on the time and/or period of the year, it shall be taken into account as a driving parameter for optimizing the usage of electrical energy.

81.7.6 Impacts on the design of an electrical installation

The design of an electrical installation shall consider energy efficiency at every stage, including the impact of different load demands, usage, zones and meshes.

The installation of fixed equipment for power metering and monitoring devices, control and energy management shall be considered for new constructions and future modifications.

Main distribution switchboards shall enable the segregation of circuits supplying each zone or each mesh defined in 81.7.4. This requirement shall also apply to other distribution boards where necessary.