Overview of EN50600

Information technology—Data centre facilities and

Infrastructures

ارائه دهنده: **سعید قاسمی**

ریاست کمیته تدوین معیارهای ارزیابی نهادهای گواهی کننده (CB)

عضو کمیته تدوین معیارهای ممیزی مراکزداده

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آبان ۱۴۰۰

CEN

- The European Committee for Standardization (CEN) is a public standards organization whose mission is to foster the economy of the European Single Market and the wider European continent in global trading, the welfare of European citizens and the environment by providing an efficient infrastructure to interested parties for the development, maintenance and distribution of coherent sets of standards and specifications.

- The CEN was founded in 1961. Its thirty-four national members work together to develop European Standards (ENs) in various sectors to build a European internal market for goods and services and to position Europe in the global economy.

CENELEC

- European Committee for Electrotechnical Standardization (CENELEC) is responsible for European standardization in the area of electrical engineering.

- CENELEC was founded in 1973.

- CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

EN 50600

EN 50600:

Developed by:

- The CLC/TC 215 “Electrotechnical aspects of telecommunication equipment”

EN 50600 series

Overview
- EN 50600-1-2019 General concepts

Design
- EN 50600-2-1-2014 Building construction
- EN 50600-2-2-2019 Power supply and distribution
- EN 50600-2-3-2019 Environmental control
- EN 50600-2-4-2015 Telecommunications cabling infrastructure
- EN 50600-2-5-2016 Security systems

Operations and Management:
- EN 50600-3-1-2016 Management and operational information

KPIs
- EN 50600-4-1-2016 Overview of and general requirements for KPIs
- EN 50600-4-2-2016 Power Usage Effectiveness
- EN 50600-4-3-2016 A1-2019 Renewable Energy Factor
- EN 50600-4-6-2019-Draft Energy Reuse Factor
- EN 50600-4-7-2019-Draft Cooling Efficiency Ratio (CER)

Best practices
- PD CLC-TR 50600-99-1-2019 Recommended practices for energy management
- PD CLC-TR 50600-99-2-2019 Recommended practices for environmental sustainability
- PD CLC-TR 50600-99-3-2018 Guidance to the application of EN 50600 series

EN 50600

- EN 50600 series is designed as a framework of:

  “standards and technical reports covering the design, the operation and management as well as the key performance indicators for energy efficient operation of the data centre.”

Introduction

This series of European Standards specifies requirements and recommendations to support the various parties:

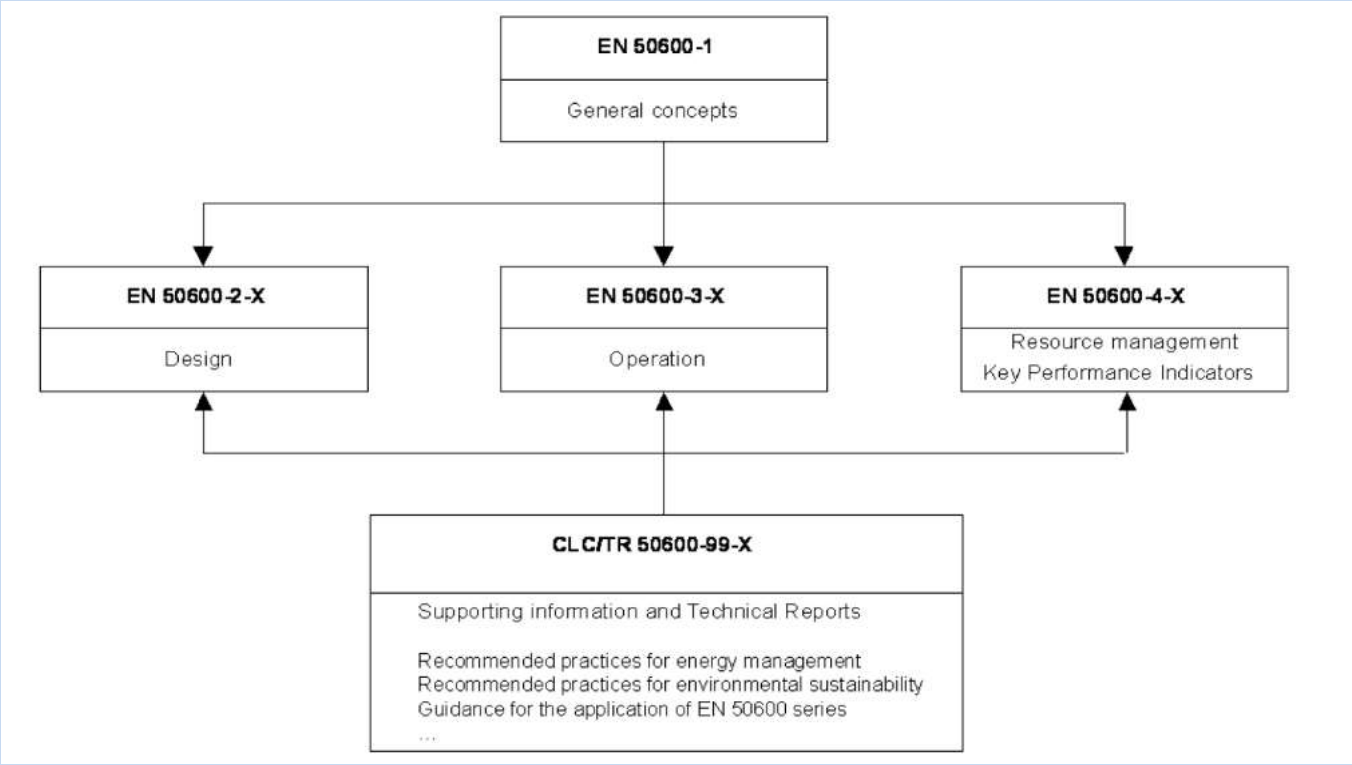
1) owners, operators, facility managers, ICT managers, project managers, main contractors;

2) consulting engineers, architects, building designers and builders, system and installation designers, auditors, test and commissioning agents;

3) facility and infrastructure integrators, suppliers of equipment;

4) installers, maintainers.

EN 50600 series



The inter-relationship of the standards and technical reports within the EN 50600 series

EN 50600-1-2019 General concepts

Scope:

a) general principles for data centres

b) aspects of data centres including terminology, parameters and reference models (functional elements and their accommodation) addressing both the size and complexity of their intended purpose;

c) aspects of the facilities and infrastructures required to support data centres;

d) classification system, based upon the key criteria of “availability”, “security” and “energy efficiency” over the planned lifetime of the data centre, for the provision of effective facilities and infrastructure;

e) details the issues to be addressed in a business risk and operating cost analysis enabling application of the classification of the data centre;

f) provides reference to operation and management of data centres;

g) introduces the concepts of Key Performance Indicators (KPIs) for resource management of data centre facilities and infrastructures.

EN 50600-1-2019 General concepts

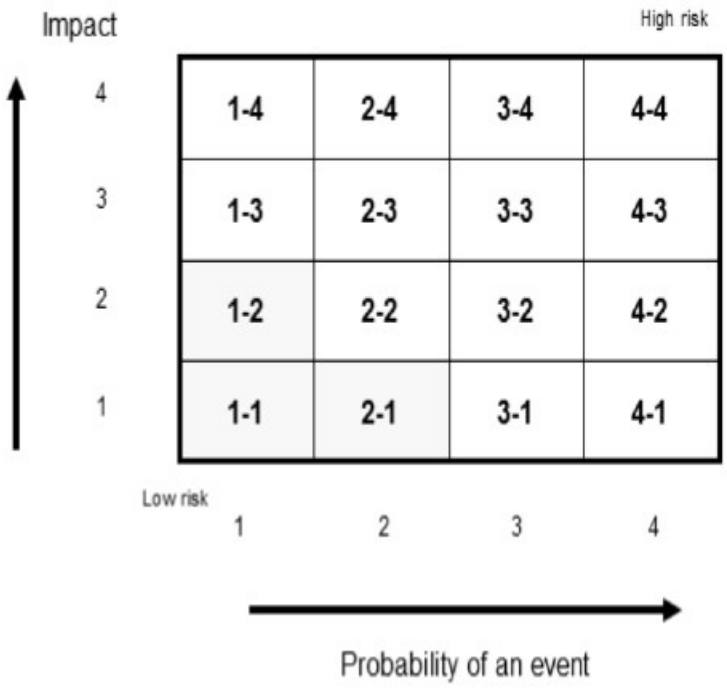
Business risk analysis:

Impact can be categorized as:

1. **low**: Loss of non-critical services;
2. **medium**: Failure of critical system functional elements but no loss of redundancy;
3. **high**: Loss of critical system redundancy but no loss of service;
4. **critical**: Loss of critical service or loss of life (which may be extended to address personal injury).

The probability of an event occurring can be defined in a similar way, that is:

1. very low;
2. low;
3. medium;
4. high.



This standard does not define methods of analysis for the cost of downtime. Standards such as EN 31010, ISO/TS 22317 or EN ISO 22301 provide useful guidance.

EN 50600-1-2019 General concepts

Classification system for the design of data centre facilities and infrastructures:

For the purposes of the EN 50600 series, data centres facilities and infrastructures are designated with respect to:

a) Availability Classes--- 4 classes

b) Protection Classes---- 4 classes

c) Energy efficiency enablement levels---- 3 levels

Availability:

Table 1 – Availability Classes and example implementations

	Availability Class 1	Availability Class 2	Availability Class 3	Availability Class 4
Availability of overall set of infrastructures	low	medium	high	very high
Definition for power supply (see EN 50600-2–2)	Single path to primary distribution equipment - Single source	Single path to primary distribution equipment - Redundant sources	Multiple paths to primary distribution equipment - Redundant sources	Multiple paths to primary distribution equipment - Multiple sources
Definition for power distribution (see EN 50600-2–2)	Single path	Single path with redundancy	Multiple paths - Concurrent repair/operate solution	Multiple paths - Fault tolerant except during maintenance
Definition for environmental control (see EN 50600-2–3)	Single path	Single path with redundancy	Multiple paths - Concurrent repair/operate solution	Multiple paths - Fault tolerant except during maintenance
Definition for telecommunications cabling (see EN 50600-2–4)	Single path - direct connections or fixed infrastructure with single access network connection	Single path - fixed infrastructure with multiple access network connections	Multiple paths - fixed infrastructure with diverse pathways with multiple access network connections	Multiple paths - fixed infrastructure with diverse pathways and redundant distribution zones and multiple access network connections

NOTE 1: Requirements and recommendations for data centre construction that provide the desired Protection Classes to ensure availability of the facilities and infrastructures are addressed in EN 50600-2–1.

NOTE 2: Requirements and recommendations for physical security of data centre spaces and pathways to ensure availability of the facilities and infrastructures are addressed in EN 50600-2–5.

Annex B: Availability description

Table B.1 – Summary of availability classification

item	Availability Class			
	Class 1	Class 2	Class 3	Class 4
EN 50600-2-2 Power Supply				
Availability	Low	Medium	High	Very high
Redundant sources	N	Y	Y	Y
Protected against source failure	N	Y	Y	Y
Redundant path to primary distribution	N	N	Y	Y
Protected against path failure	N	N	Y	Y
Compartmentalization	N	N	N	Y
Protected against single device failure	N	Y	Y	Y
Load operation during maintenance	N	N[1)]	Y	Y
Fault tolerant	N	N	Y[2)]	Y
EN 50600-2-2 Power Distribution				
Availability	Low	Medium	High	Very high
Redundant path	N	N	Y	Y
Protected against path failure	N	N	Y	Y
Compartmentalization	N	N	N	Y
Protected against single device failure	N	Y	Y	Y
Load operation during maintenance	N	N[1)]	Y	Y
Fault tolerant	N	N	N	Y[2)]
EN 50600-2-3 Environmental Control				
Availability	Low	Medium	High	Very high
Redundant source	N	N	Y	Y
Redundant path	N	N	Y	Y
Protected against path failure	N	N	Y	Y
Compartmentalization	N	N	N	Y
Protected against single device failure	N	Y	Y	Y
Load operation during maintenance	N	N[1)]	Y	Y
Fault tolerant	N	N	N	Y[2)]

[1)] Depending on the device being maintained.

[2)] Except during maintenance.

EN 50600-1-2019 General concepts

Physical security:

The physical security provided for the data centre has an influence on both the probability and impact of risk events since the objective of physical security is to protect against:

a) unauthorised access

b) intrusion

c) internal environmental events

d) external environmental events

EN 50600-1-2019 General concepts

Energy efficiency enablement:

The data centre owner/user shall define the appropriate energy efficiency enablement level prior to the data centre design.

The desired energy efficiency enablement level can be determined by:

A. an operating cost analysis;
B. the application of resource and energy management processes according to EN 50600-3-1;
C. the selection and application of one or more appropriate KPIs for resource management according to the EN 50600-4-x series;
D. external regulatory or legislative requirements;
E. user defined rules.

EN 50600-2-1:2014 Building construction

Scope:

This European Standard specifies requirements and recommendations for the following:

a) location and site selection;

b) building construction;

c) building configuration;

d) fire protection;

e) quality construction measures.

Safety and electromagnetic compatibility (EMC) requirements are outside the scope of this European Standard and are covered by other standards and regulations.

EN 50600-2-1:2014 Building construction

Location:

- Assessment of location
- Geographical location
- Natural environment
- Adjacencies
- Infrastructure factors

Site configuration:

- Site selection
- Assessment of existing premises
- Utilities
- Access routes
- Deliveries
- Parking
- Perimeter

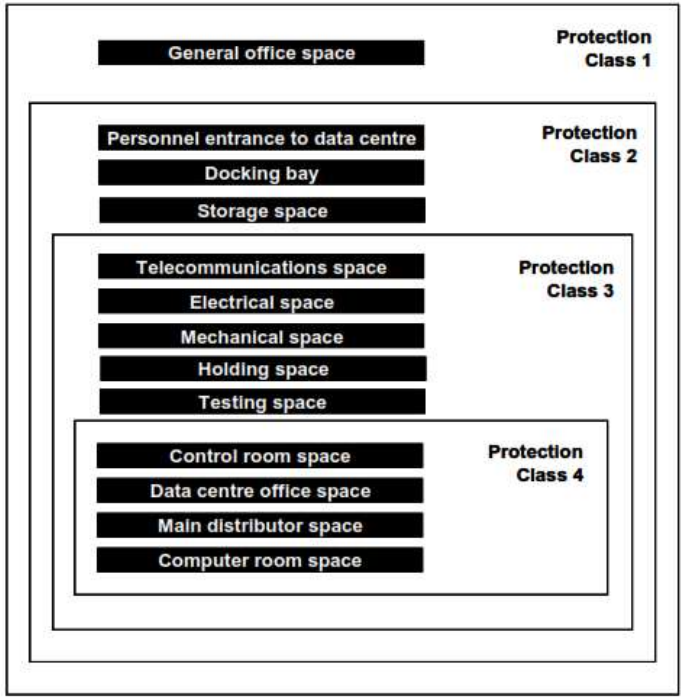


Figure 2 — Site of a Data Centre

EN 50600-2-2:2019 Power supply and distribution

Scope:

This document addresses power supplies to, and power distribution within, data centres based upon the criteria and classifications for “availability”, “physical security” and “energy efficiency enablement” within EN 50600-1.

This document specifies requirements and recommendations for the following:

a) power supplies to data centres;
b) power distribution systems to all equipment within data centres;
c) telecommunications infrastructure bonding;
d) lightning protection;
e) devices for the measurement of the power consumption and power quality characteristics at points along the power distribution system and their integration within management tools.

Power supply and distribution within data centres

The functional elements of power supply and distribution to the data centre are described as:

- sources: e.g. primary, secondary or additional supplies;
- devices: e.g. supply transfer switchgear;
- paths: pathways, spaces and cabling.

Availability Class design options:

Class 1: Single path to primary distribution equipment and with a single source

A Class 1 solution is appropriate where the outcome of the risk assessment deems it acceptable that:

- a single fault in a functional element can result in loss of functional capability;
- planned maintenance can require the load to be shut-down.

Class 2: Single path to primary distribution equipment and with a redundant source

A Class 2 solution is appropriate where the outcome of the risk assessment deems it necessary that:

- a single fault in a source shall not result in loss of functional capability of the path;
- routine planned maintenance of a source shall not require the load to be shut down

Availability Class design options:

Class 3: Multiple paths to primary distribution equipment and with redundant sources

A Class 3 solution is appropriate where the outcome of the risk assessment deems it necessary that:

- a fault of a functional element shall not result in loss of functional capability;
- planned maintenance shall not require the load to be shut-down.

Class 4: Multiple paths to primary distribution equipment and with multiple sources.

A Class 4 solution is appropriate where the outcome of the risk assessment deems it necessary that

- a fault of a functional element shall not result in loss of functional capability;
- any single event impacting a functional element shall not result in load shut-down;
- planned maintenance shall not require the load to be shut-down.

Power supply and distribution within data centres

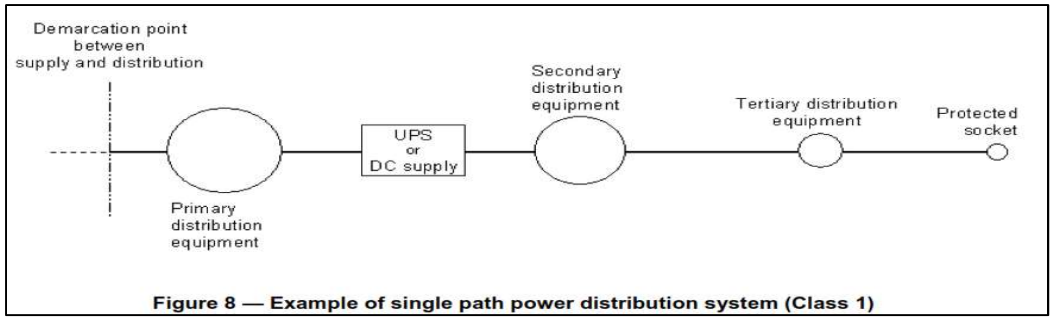


Figure 8 — Example of single path power distribution system (Class 1)

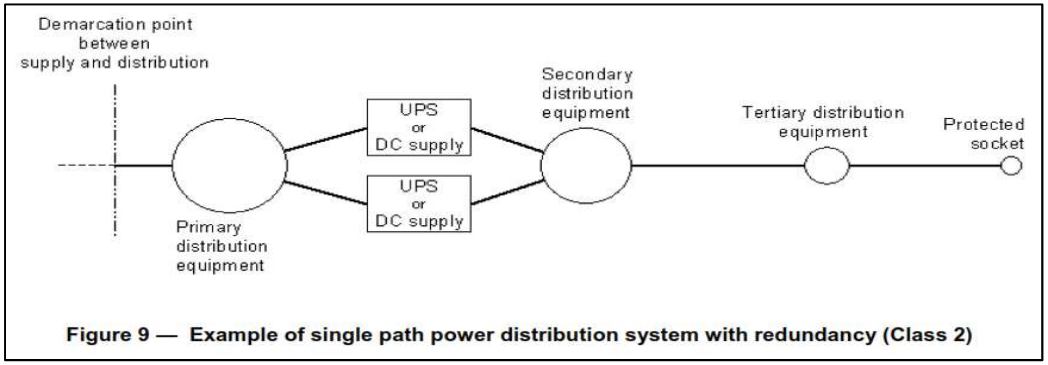


Figure 9 — Example of single path power distribution system with redundancy (Class 2)

EN 50600-2-2:2019 Power supply and distribution

Power supply and distribution within data centres

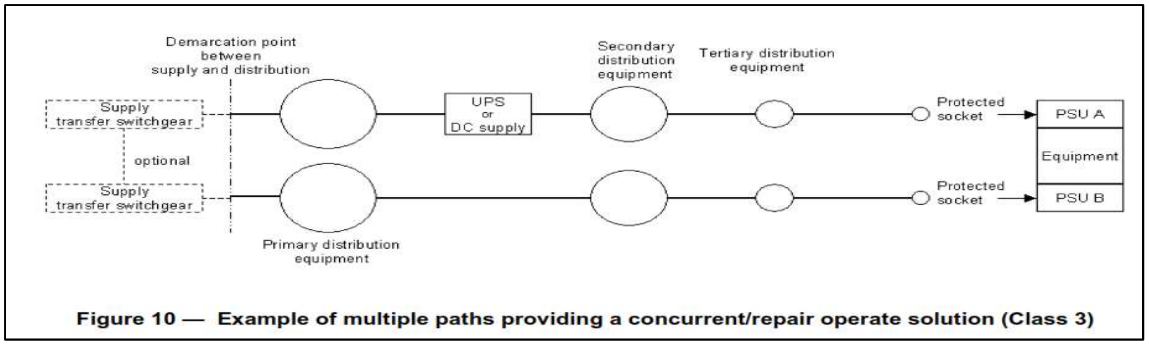


Figure 10 — Example of multiple paths providing a concurrent/repair operate solution (Class 3)

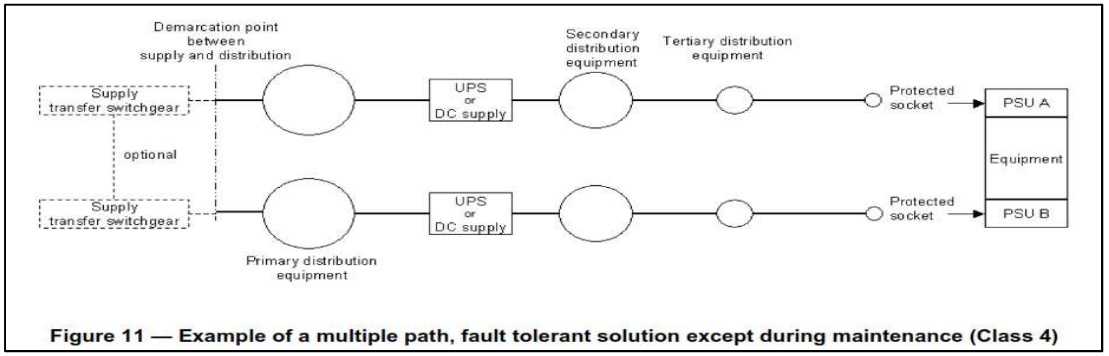


Figure 11 — Example of a multiple path, fault tolerant solution except during maintenance (Class 4)

EN 50600-2-2:2019 Power supply and distribution

Energy efficiency enablement and power distribution:

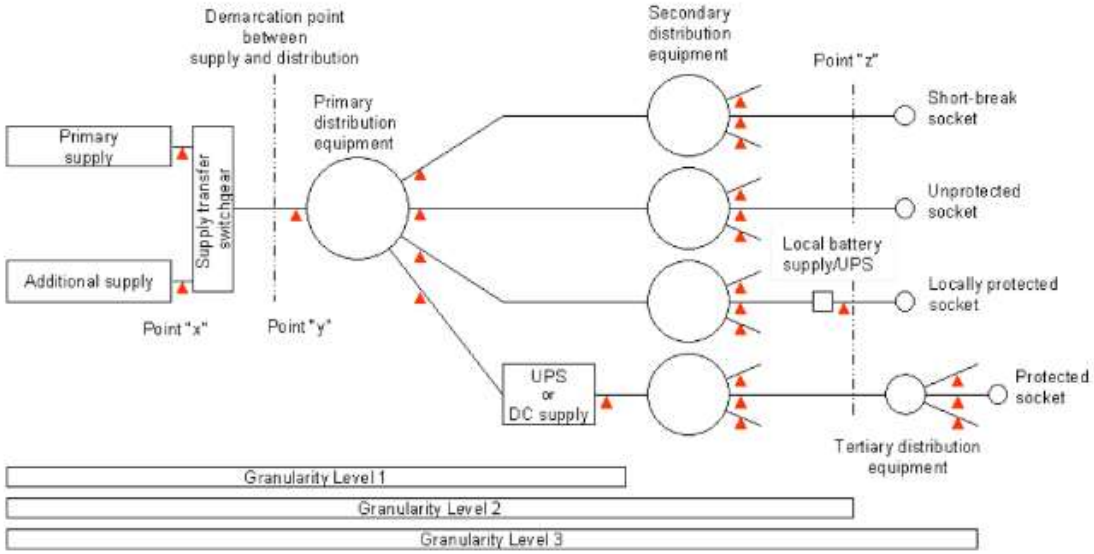


Figure 12 — Possible measurement points

EN 50600-2-3:2019 Environmental control

Scope:

This document addresses environmental control within data centres based upon the criteria and classifications for “availability”, “security” and “energy efficiency enablement” within EN 50600-1.

This document specifies requirements and recommendations for the following:

a) temperature control;

b) fluid movement control;

c) relative humidity control;

d) particulate control;

e) vibration;

f) physical security of environmental control systems.

EN 50600-2-3:2019 Environmental control

Availability Class design options:

Class 1: Single path solution

A Class 1 solution is appropriate where the outcome of the risk assessment deems it acceptable that:

- a single fault in a functional element can result in loss of functional capability;
- planned maintenance can require the load to be shut-down.

Class 2: Single path solution with redundancy

A Class 2 solution is appropriate where the outcome of the risk assessment deems it necessary that:

- a single fault in a device shall not result in loss of functional capability of that path (via redundant devices);
- routine planned maintenance of a redundant device shall not require the load to be shut down.

EN 50600-2-3:2019 Environmental control

Availability Class design options:

Class 3: Multiple paths providing a concurrent repair/operate solution

A Class 3 solution is appropriate where the outcome of the risk assessment deems it necessary that:

- a fault of a functional element shall not result in loss of functional capability;
- planned maintenance shall not require the load to be shut-down;
- although a failure of a path can result in unplanned load shutdown, maintenance routines shall not require planned load shutdown as the passive path serves to act as the concurrent maintenance enabler as well as reducing the recovery of service time (minimizing the mean downtime) after the failure of a path.

Class 4: fault tolerant solution except during maintenance

A Class 4 solution is appropriate where the outcome of the risk assessment deems it necessary that:

- a fault of a functional element shall not result in loss of functional capability;
- a failure of one path shall not result in unplanned load shutdown;
- planned maintenance shall not require the load to be shut-down.

All paths shall be designed to sustain the maximum load.

EN 50600-2-3:2019 Environmental control

Environmental control within data centres:

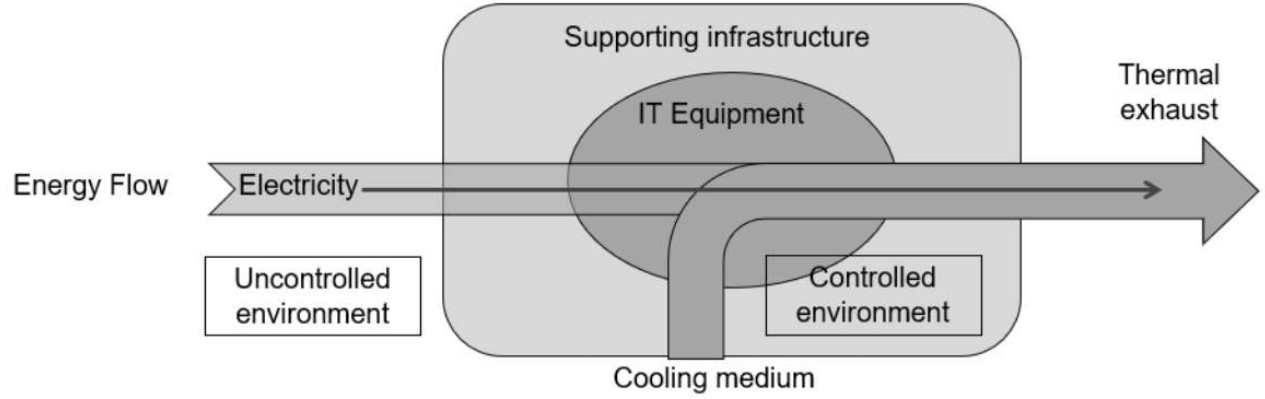


Figure 2 – Logical representation of environmental control of data centre spaces

EN 50600-2-3:2019 Environmental control

Environmental control of data centre spaces:

- Building entrance facilities
- Personnel entrance(s)
- Docking/loading bay(s)
- Generator space(s) including fuel storage
- Electrical distribution space(s)
- Telecommunication spaces(s)
- Main Distributor spaces(s)
- Computer room space(s) and associated testing space(s)
- Electrical space(s)
- Mechanical space(s)
- Control room space(s)
- Office space(s)
- Storage and holding space(s)
- Accommodation of UPS equipment

EN 50600-2-3:2019 Environmental control

Annex A :Overview of the requirements for environmental conditions:

Table A.1 – Summary of environmental conditions by space type

Sub-clause	What	Where	Dp °C	Minimal T °C	Maximal T °C	Type	Condition
5.2.15.3	air	Accommodation Batteries		18	22	M	Where batteries are located away from the UPS equipment that they serve where no information exists or where the equipment manufacturer is not specified
5.2.15.1	air/humidity	Accommodation Static and DRUPS	Anti Condensation	15	35	M	Where the manufacturer is not known
5.2.15.1	air	Accommodation Static and DRUPS		15	35	M	Where no information exists or where the equipment manufacturer is not specified.
5.1.3	humidity	all spaces where there is a risk of damage to static-sensitive	5,5			M	Where no information exists or where the equipment manufacturer is not specified
5.2.9	supply air temperature/ humidity	Computer room space(s) and associated testing space(s)	CLC/TR 50600–99–1	CLC/TR 506 00-99–1	CLC/TR 506 00-99–1	M	
5.2.12	temperature/ humidity	Control room space(s)	Comfort	Comfort	Comfort	M	Comfort environmental

EN 50600-2-3:2019 Environmental control

Availability Class design options:

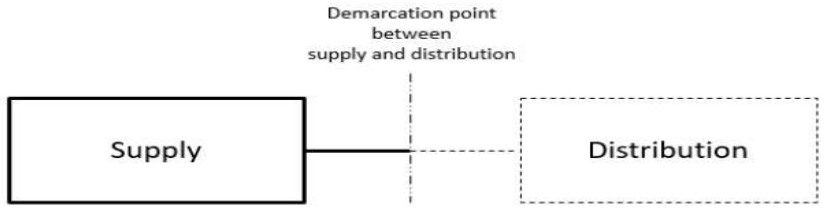


Figure 3 — Class 1 cooling supply sub-system

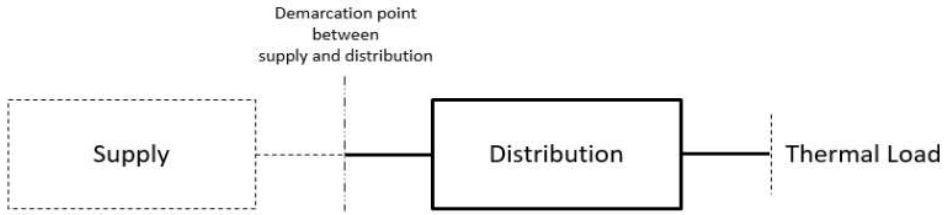


Figure 4 — Class 1 cooling distribution sub-system

EN 50600-2-3:2019 Environmental control

Availability Class design options:

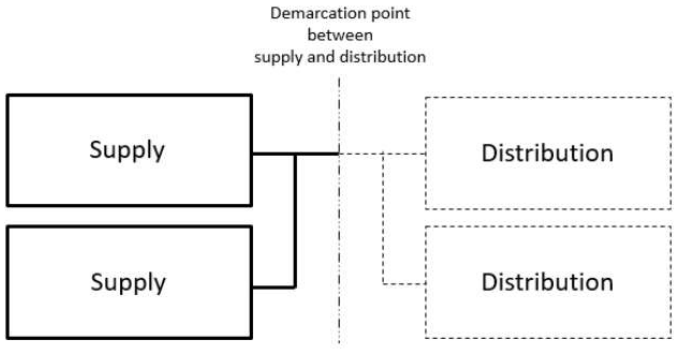


Figure 5 — Class 2 cooling supply sub-system

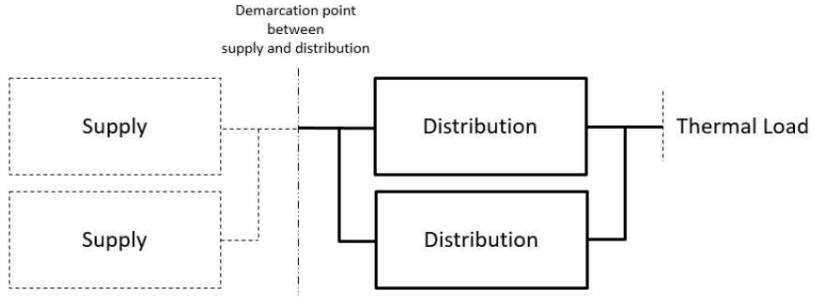


Figure 6 — Class 2 cooling distribution sub-system

EN 50600-2-3:2019 Environmental control

Availability Class design options:

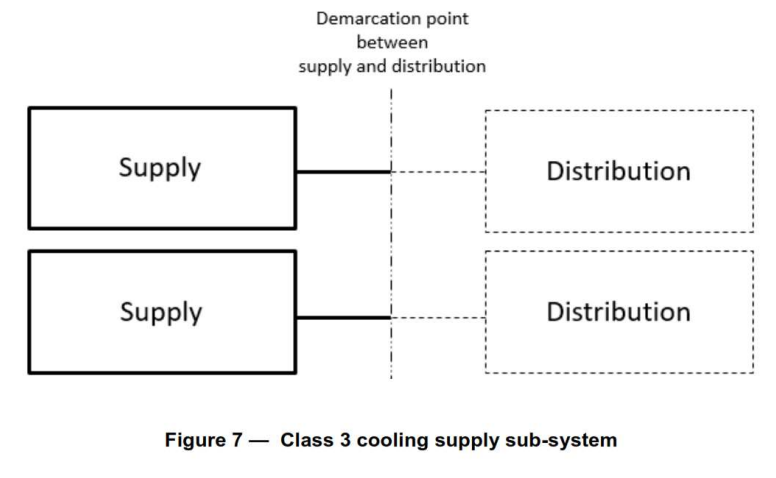


Figure 7 — Class 3 cooling supply sub-system

EN 50600-2-3:2019 Environmental control

Availability Class design options:

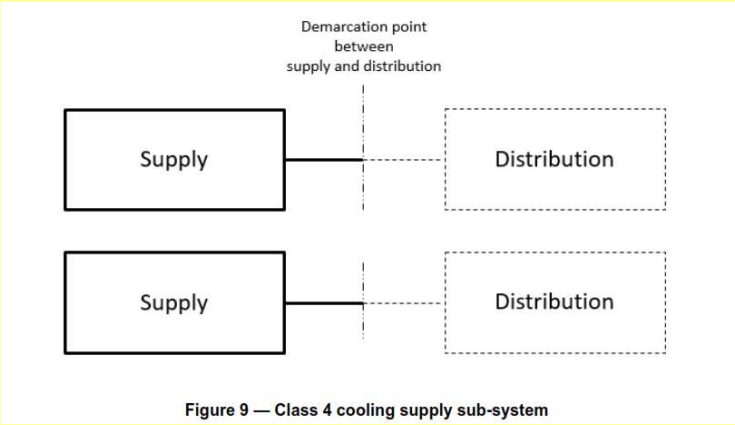


Figure 9 — Class 4 cooling supply sub-system

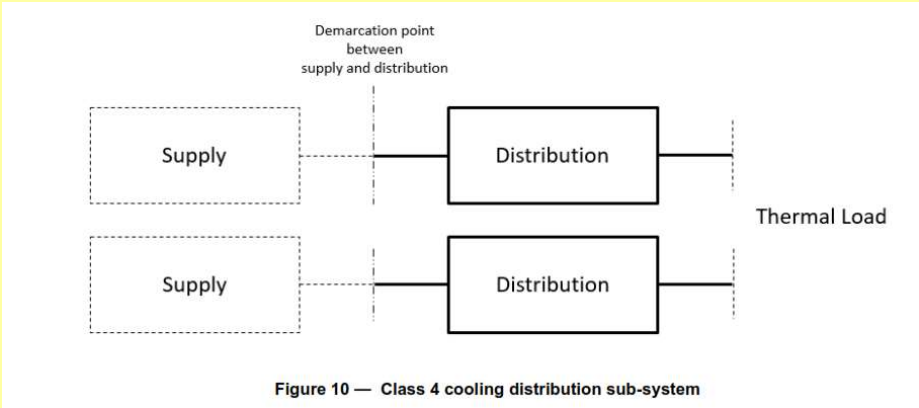


Figure 10 — Class 4 cooling distribution sub-system

EN 50600-2-3:2019 Environmental control

Energy efficiency enablement:

Measurement of temperature:

Table 2 — Measurement requirements by Granularity Level

Requirement	Granularity Level		
	Level 1	Level 2	Level 3
Inlet Air Temperature	Single sensor in proximity to IT equipment	One sensor per cold aisle	One sensor per 10 cabinets or racks (5 on each side of the aisle)
Return Air Temperature	Single sensor in proximity to intake of return air to the cooling equipment	One sensor at the air intake per CRAH	One sensor at the air intake per CRAH

If no air containments are used, the number of sensors can be increased.

EN 50600-2-4-2015 Telecommunications cabling infrastructure

Scope:

This European Standard addresses the wide range of telecommunications cabling infrastructures within data centres based upon the criteria and classifications for “availability” within EN 50600-1.

This European Standard specifies requirements and recommendations for the following:

a) information technology and network telecommunications cabling (e.g. SAN and LAN);

b) general information technology cabling to support the operation of the data centre;

c) telecommunications cabling to monitor and control, as appropriate, power distribution, environmental control and physical security of the data centre;

d) other building automation cabling;

e) pathways, spaces and enclosures for the telecommunications cabling infrastructures.

EN 50600-2-4-2015 Telecommunications cabling infrastructure

Availability design principles for telecommunications cabling infrastructure:

EN 50173

Table 1 – Telecommunication cabling Availability Classes per space architecture and overall data centre Availability Class for facilities and infrastructures

Data centre space	Cabling type	Overall data centre facilities and infrastructure - Availability Class 1	Overall data centre facilities and infrastructure - Availability Class 2	Overall data centre facilities and infrastructure - Availability Class 3	Overall data centre facilities and infrastructure - Availability Class 4
Computer room space	Inter-cabinets	7.2.1 Class 1	7.2.2 Class 2	7.2.3 Class 3	7.2.4 Class 4
	Intra-cabinets	7.2.1 Class 1	7.2.1 Class 1	7.2.1 Class 1	7.2.1 Class 1
	Adjacent cabinets	7.2.1 Class 1	7.2.1 Class 1	7.2.1 Class 1	7.2.1 Class 1
	Monitoring and Control	7.4	7.4	7.4	7.4
	Office style cabling	7.3	7.3	7.3	7.3
Control room space	Office style cabling	7.3	7.3	7.3	7.3
	Monitoring and Control	7.4	7.4	7.4	7.4
Other spaces	Office Style	7.3	7.3	7.3	7.3
	Monitoring and Control	7.4	7.4	7.4	7.4

EN 50600-2-4-2015 Telecommunications cabling infrastructure

Availability design principles for telecommunications cabling infrastructure:

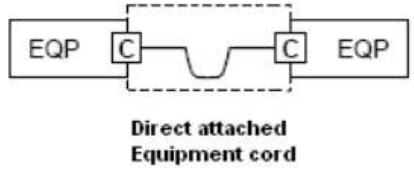


Figure 8 – Telecommunication cabling Class 1 using direct attached cords

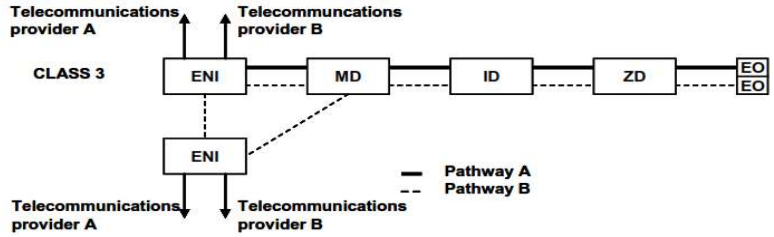


Figure 12 - Redundant multipath telecommunication cabling Class 3

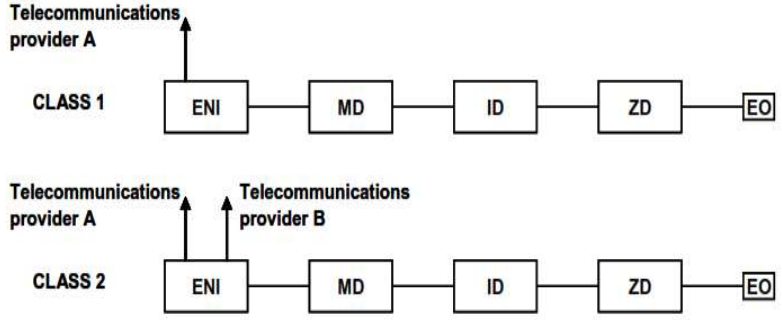


Figure 10 – ENI redundancy for Class 1 and 2

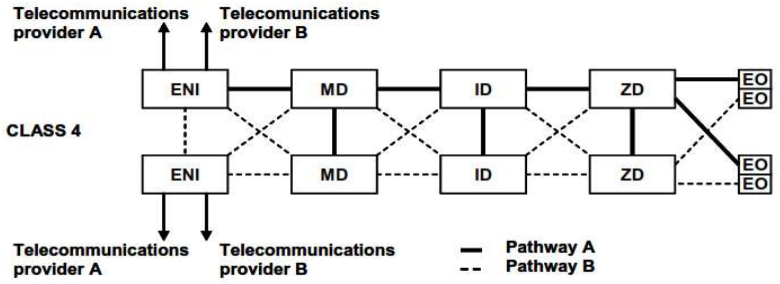


Figure 13 - Redundant multipath telecommunication cabling Class 4

EN 50600-2-5-2016 Security systems

Scope:

This European Standard addresses the physical security of data centres based upon the criteria and classifications for “availability”, “security” and “energy efficiency enablement” within EN 50600-1.

This European Standard provides designations for the data centres spaces defined in EN 50600-1.

This European Standard specifies requirements and recommendations for those data centre spaces, and the systems employed within those spaces, in relation to protection against:

a) unauthorized access addressing constructional, organizational and technological solutions;

b) fire events igniting within data centres spaces;

c) other events within or outside the data centre spaces, which would affect the defined level of protection.

EN 50600-2-5-2016 Security systems

Physical security:

a) Protection against unauthorised access

b) Protection against Intrusion

c) Protection against internal environmental events

d) Protection against external environmental events

EN 50600-2-5-2016 Security systems

Physical security:

Table 2 — Protection Classes against unauthorized access

Type of protection	Class 1	Class 2	Class 3	Class 4
Protection against unauthorized access	Public or semi-public area.	Area that is accessible to all authorized personnel (employees and visitors).	Area restricted to specified employees and visitors (other personnel with access to Class 2 shall be accompanied by personnel authorized to access Class 3 areas).	Area restricted to specified employees who have an identified need to have access (other personnel with access to Class 2 or 3 areas shall be accompanied by personnel authorized to access Class 4 areas).

EN 50600-2-5-2016 Security systems

Physical security:

Table 4 — Protection Classes against internal environmental events

Type of protection	Class 1	Class 2	Class 3	Class 4
Protection against internal environmental events (other than fire)	No special protection applied	Mitigation applied	Mitigation applied	Mitigation applied

EN 50600-2-5-2016 Security systems

Physical security:

Table 5 — Protection Classes against external environmental events

Type of protection	Class 1	Class 2	Class 3	Class 4
Protection against external environmental events	No special protection applied	Mitigation applied	Mitigation applied	Mitigation applied

EN 50600-3-1-2016 Management and operational information

Scope:

This European Standard specifies processes for the management and operation of data centres.

The primary focus of this standard is the operational processes necessary to deliver the expected level of resilience, availability, risk management, risk mitigation, capacity planning, security and energy efficiency.

The secondary focus is on management processes to align the actual and future demands of users. Figure 2 shows an overview of related processes.

EN 50600-3-1-2016 Management and operational information

Scope:

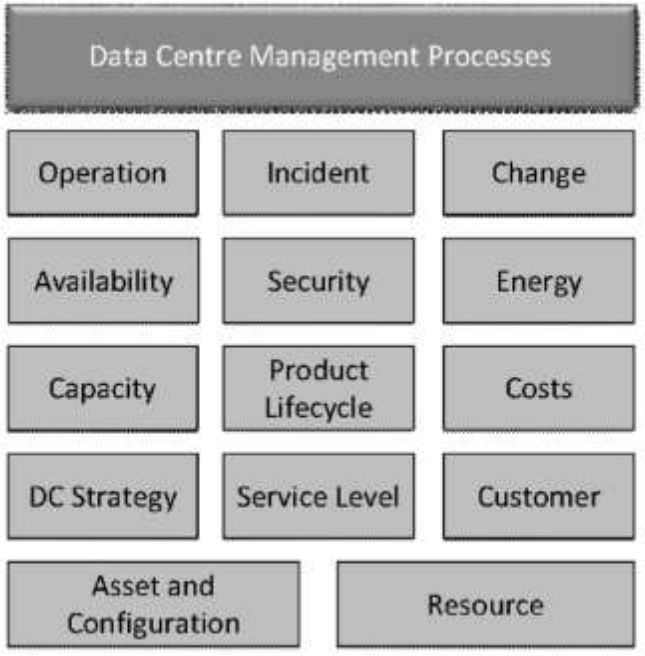


Figure 2 — Data centre management processes overview

EN 50600-3-1-2016 Management and operational information

Operational processes:

The following processes are considered as operational processes:

a) Operations Management – infrastructure maintenance, monitoring and event management;

b) Incident Management – responding to unplanned events, recovery of normal operation state;

c) Change management – logging, coordination, approval and monitoring of all changes;

d) Configuration management – logging and monitoring of configuration items;

e) Capacity management – monitoring, analysis, reporting and improvement of capacity.

EN 50600-3-1-2016 Management and operational information

Operational processes:

Purpose:

The aim of operations management is to keep the data centre at the status of normal operation.

Activities:

Maintenance, Monitoring, Event management

KPIs: The KPI shall be reported for every impact category.

MTBF, Number of incidents, Availability, Unplanned replacement of infrastructure components

EN 50600-4-1:2016 Overview of and general requirements for KPIs

Scope

This European Standard specifies the following for the other standards in the EN 50600-4-X series:

a) a common structure,

b) definitions, terminology and boundary conditions for KPIs of data centre resource usage effectiveness and efficiency,

c) common requirements for KPIs of data centre resource usage effectiveness and efficiency,

d) common objectives for KPIs of the data centre resource effectiveness and efficiency,

e) general information regarding the use of KPIs of data centre resource usage effectiveness and efficiency.

EN 50600-4-1:2016 Overview of and general requirements for KPIs

Key Performance Indicators (KPIs):

- The EN 50600-4 series defines requirements for the KPIs that are used to address aspects of data centre resource usage effectiveness or efficiency.

- Due to the variable nature of type, size, purpose and geographical location of data centres and in order to meet the common objectives defined in common objective, it is not possible to define a single, universally relevant KPI for resource usage effectiveness or efficiency.

EN 50600-4-1:2016 Overview of and general requirements for KPIs

Common Objectives for KPIs:

The common objective of the KPIs of EN 50600-4 series is the efficient or effective use or utilization of resources, for example:

a) minimization of energy and other resource consumption;

b) effectiveness of the IT load (processing, storage and transport) within the data centre, maximizing the IT output with the minimum energy consumption;

c) reuse of unconsumed resources (e.g. energy reuse in the form of waste heat);

d) utilization of renewable energy, both generated on site and off site.

Common Objectives for KPIs:

In order for a KPI to become a candidate for inclusion into the EN 50600-4 series, it shall be:

1) applicable to all types of data centres;
2) technology neutral;
3) geographically neutral.

EN 50600-4-1:2016 Overview of and general requirements for KPIs

Use of KPI:

- KPIs shall be presented as numeric values, and units where applicable, and can be trended against time in graphical form if required.
- Due to the diverse nature of the numerical value of individual KPIs comparison with other data centres, and combinations of KPIs should be approached with caution

EN 50600-4-2:2016+A1:2019 Power Usage Effectiveness

Scope:

This European Standard specifies the Power Usage Effectiveness (PUE) as a Key Performance Indicator (KPI) to quantify the efficient use of energy in the form of electricity.

EN 50600-4-2:2016+A1:2019 Power Usage Effectiveness

This European Standard:

a) defines the Power Usage Effectiveness (PUE) of a data centre;

b) introduces PUE measurement categories;

c) describes the relationship of this KPI to a data centre's infrastructure, information technology equipment and information technology operations;

d) defines the measurement, the calculation and the reporting of the parameter;

e) provides information on the correct interpretation of the PUE.

PUE derivatives are described in Annex C.

EN 50600-4-2:2016+A1:2019 Power Usage Effectiveness

PUE provides a means to determine:

1) opportunities for the improvement of the operational efficiency of a data centre;

2) the improvement of the designs and processes of a data centre over time;

3) a design target or goal for new data centres across the anticipated IT load range.

PUE does not take into account the:

— energy efficiency of the IT load, its utilization or productivity;

— efficiency of on-site electricity generation;

— efficiency of other resources such as human resource, space or water;

— use of renewable energy resources or accounts for re-use of waste by-products (such as heat).

EN 50600-4-2:2016+A1:2019 Power Usage Effectiveness

PUE is not a:

- data centre productivity metric,
- a standalone, comprehensive resource efficiency metric.

- PUE should not be used to compare different data centres.
- Derivatives of PUE which are useful in certain circumstances are described in Annex C.

EN 50600-4-2:2016+A1:2019 Power Usage Effectiveness

Determination of Power Usage Effectiveness:

PUE is defined as:

$$\text{PUE} = \frac{E_{\text{DC}}}{E_{\text{IT}}}$$

where

E_{DC} = total data centre energy consumption (annual) in kWh;

E_{IT} = IT equipment energy consumption (annual) in kWh.

By definition, the calculated PUE is always greater than 1.

EN 50600-4-2:2016+A1:2019 Power Usage Effectiveness

Determination of Power Usage Effectiveness:

E_{IT} includes but is not limited to:

a) IT equipment (e.g. storage, processing and transport equipment);

b) supplemental equipment (e.g. keyboard/video/mouse (KVM) switches, monitors, and workstations/laptops used to monitor, manage, and/or control the data centre).

E_{DC} includes E_{IT} plus all the energy that is consumed to support the following infrastructures:

1) power delivery - including UPS systems, switchgear, generators, power distribution units (PDUs), batteries, and distribution losses external to the IT equipment;

2) cooling system - including chillers, cooling towers, pumps, computer room air handling units (CRAHs), computer room air conditioning units (CRACs), and direct expansion air handler (DX) units;

3) others including data centre lighting, elevator, security system, and fire detection/suppression system.

EN 50600-4-X

Other indicator:

- **Renewable Energy Factor**
- **Draft Energy Reuse Factor**
- **Cooling Efficiency Ratio (CER)**

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