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Information technology — Data centres — Impact on data centre resource metrics of electrical energy storage and export

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 39, *Sustainability for and by Information Technology*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The global economy is now reliant on information and communication technologies and the associated generation, transmission, dissemination, computation and storage of digital data. All markets have experienced exponential growth in that data, for social, educational and business sectors and, while the internet backbone carries the traffic, there are a wide variety of data centres at nodes and hubs within both private enterprise and shared/collocation facilities.

The historical data generation growth rate exceeds the capacity growth rate of the information and communications technology hardware and, with less than half (in 2014) of the world's population having access to an internet connection, that growth in data can only accelerate. In addition, with many governments having digital agendas to provide both citizens and businesses with ever-faster broadband access, the very increase in network speed and capacity will, by itself, generate ever more usage (Jevons Paradox). Data generation and the consequential increase in data manipulation and storage are directly linked to increasing power consumption.

With this background, it is clear that data centre growth, and power consumption in particular, is an inevitable consequence and that growth will demand increasing power consumption despite the most stringent energy efficiency strategies. This makes the need for key performance indicators (KPIs) that cover the effective use of resources (including but not limited to energy) and the reduction of CO_2 emissions essential.

Within the ISO/IEC 30134 series, the term resource usage effectiveness is more generally used for KPIs in preference to resource usage efficiency, which is restricted to situations where the input and output parameters used to define the KPI have the same units.

This document describes the treatment of data centre metrics in circumstances where electrical energy is stored and exported from within the data centres boundaries of other standards in the ISO/IEC 30134 series.

Additionally, this document will provide Excess Electrical Energy Factor (XEEF) as a metric to indicate the weight of this mechanism within the data centre energy balance.

This document deals with the storage and export of electrical energy, whatever form of storage is used; it could eventually serve as a model to handle a similar process of storage and export of non-electrical energy, such as chilled water thermal energy.

In order to determine the overall resource efficiency of a data centre, a holistic suite of metrics is required. This document complements the series of KPIs conforming to ISO/IEC 30134-1, which defines common requirements for a holistic suite of KPIs for data centre resource efficiency. This document does not specify limits or targets for the KPI and does not describe or imply, unless specifically stated, any form of aggregation of this KPI into a combination with other KPIs for data centre resource efficiency.

Information technology — Data centres — Impact on data centre resource metrics of electrical energy storage and export

1 Scope

This document describes the treatment of data centre metrics in circumstances where electrical energy is stored and exported from within the data centre boundaries of other standards in the ISO/IEC 30134 series.

This document specifies the Excess Electrical Energy Factor (XEEF) as a Key Performance Indicator (KPI) to quantify the electrical energy provided back from data centre to the utility.

This document has the structure common to the standards of the ISO/IEC 30134 series.

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.

ISO/IEC 30134-1, *Information technology — Data centres — Key Performance Indicators — Part 1: Overview and general requirements for KPIs*

ISO/IEC 30134-2, *Information technology — Data centres — Key Performance Indicators — Part 2: Power Usage Effectiveness (PUE)*

ISO/IEC 30134-3, *Information technology — Data centres — Key Performance Indicators — Part 3: Renewable Energy Factor (REF)*

ISO/IEC 30134-6[1)], *Information technology — Data centres — Key Performance Indicators — Part 6: Energy Reuse Factor (ERF)*

3 Terms, definitions, abbreviated terms and symbols

For the purposes of this document, the terms and definitions given in ISO/IEC 30134-1, ISO/IEC 30134-2, ISO/IEC 30134-3, ISO/IEC 30134-6 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 Terms and definitions

3.1.1
storage energy
energy stored by any means in order to be recovered later

1) To be published. Current stage:40.60.

3.1.2
data centre excess energy
energy stored in the data centre, from whatever source(s) it comes, and exported from the data centre in the form of electrical energy

3.1.3
data centre gross energy input
energy provided to the data centre from all types of sources, consumed by the data centre as E_{DC}, or exported from the data centre in the form of electrical energy

3.2 Abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO/IEC 30134-1, ISO/IEC 30134-2, ISO/IEC 30134-3, ISO/IEC 30134-6 and the following apply.

XEEF Excess Electrical Energy Factor

3.3 Symbols

For the purposes of this document, the symbols given in ISO/IEC 30134-1, ISO/IEC 30134-2, ISO/IEC 30134-3, ISO/IEC 30134-6 and the following apply.

E_{Excess} data centre excess energy (annual) in kWh

E_{IN} data centre gross energy input (annual) in kWh

4 Objectives

4.1 Energy storage types and dispositioning

Data centre practitioners can find it valuable to store electrical energy within their premises, especially when it is easily available from their local generation, from utilities or other electrical grids outside the data centre. The stored energy can either be used within the data centre when energy is less available or more expensive to obtain or exported to an electrical grid outside the data centre, public or not, when the energy stored exceeds the needs of the data centre.

A large variety of technologies are used to store electrical energy in data centres: thermal energy, in the form of heat or cold, mechanical energy, electrical energy. The recovered energy could be provided in a different form, very often thermal or electrical.

When recovered energy is used within the data centre, whatever form it takes, it is taken into account within the calculation of PUE (specified in ISO/IEC 30134-2).

When recovered energy is exported from the data centre in the form of electrical energy to an electrical grid, be it public or not, this excess electrical energy is represented by XEEF.

NOTE When using energy, data centres create energy losses that could be captured and reused; when this captured energy is reused within the data centre, it is taken into account within the PUE calculation; when this captured energy is reused outside the data centre, it is represented through ERF.

Many data centre KPIs in the ISO/IEC 31034 series (including PUE, REF and ERF) are calculated using the energy consumed by the data centre (E_{DC}).

When a data centre provides energy back to an electrical grid (E_{Excess}), E_{DC} differs from the data centre gross energy input (E_{IN}). As a result calculating PUE or other KPIs using E_{IN}, instead of E_{DC}, would introduce an error since.

$$E_{DC} = E_{IN} - E_{Excess}$$

Using E_{DC}, PUE and other KPIs specified in the ISO/IEC 30134 series properly represent the energy used within the boundaries of the data centre, i.e. all data centre energy usage or losses within its boundary, excluding the energy passing through the data centre to be provided back outside its boundary.

Local generation is to be considered outside the data centre boundary. Energy provided by local generation to an electrical grid is not to be included within E_{Excess}.

E_{Excess} represents the electrical energy that is taken from the energy provided to the data centre boundary as the data centre gross energy input E_{IN} and exported across that boundary.

4.2 Energy flow in data centres

Energy flow in a data centre can be represented by the schematic shown in Annex A.

Energy provided to the data centre, penetrating its boundaries, is used to power IT loads and power the cooling and energy storage systems, if any.

Inefficiencies in IT, cooling, electrical power distribution and energy storage systems result in energy losses which mostly appear in the form of heat. This heat can be partially collected and reused either inside or outside the data centre; ERF (as specified in ISO/IEC 30134-6) is the KPI which indicates energy reused outside the data centre; PUE (as specified in ISO/IEC 30134-2) is improved by heat reused inside the data centre; the rest of these losses is wasted and rejected by the data centre.

Energy storage systems enable part of the energy provided to the data centre to be stored, in order to use it at another time when relevant.

The stored energy increases the energy consumption of the data centre during the storage process but when the stored energy is used within the data centre, it is not considered an additional consumption. The energy used, and associated losses, execute the energy storage and recovery are included within E_{DC}. As a result E_{DC}, and any KPIs that rely on E_{DC}, is correctly accounted with the stored energy being counted only once.

When exported to an electrical grid outside data centre, the stored energy is considered excess energy and is not accounted for within E_{DC} and should be displayed using the XEEF KPI.

In summary, XEEF is a measure which indicates potential improvement of general grid balancing and reduction of associated losses. It can result in an increase of E_{DC} and any KPIs that rely on that parameter.

This excess energy exchange should not impact availability of energy for the critical loads of the data centre such as IT. Therefore, the excess energy considered in this document does not deal with the energy stored in the data centre UPS to provide energy insurance in the event of power failure.

The excess electrical energy exchange with an electrical grid outside the data centre is implemented by a grid connector taking the form of a specific power electronic converter, or an adapted reversible UPS that is

— compliant with local grid requirements,

— capable of orienting the electrical energy towards storage, data centre needs or an external grid,

— capable of measuring the energy flow and to provide the value of E_{Excess}.

The converter orientates the energy according to environmental conditions and policies defined by the manager of the excess energy. This management can be done either by the data centre practitioner or