FINAL DRAFT

INTERNATIONAL STANDARD

ISO/IEC FDIS 30134-6

ISO/IEC JTC **1**/SC **39**

Secretariat: ANSI

Voting begins on:
2020-12-18

Voting terminates on:
2021-02-12

Information technology — Data centres key performance indicators —

Part 6: Energy Reuse Factor (ERF)

Partie 6: Facteur d'énergie renouvelable (ERF)

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

Reference number
ISO/IEC FDIS 30134-6:2020(E)

Contents

Page

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see patents.iec.ch).

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, IT & Data Centres*.

A list of all parts in the ISO/IEC 30134 series can be found on the ISO website.

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 today 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 information and communications technology hardware and, with less than half of the world's population having access to an internet connection (in 2014), 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 processing and storage are directly linked to increasing power consumption.

With this background, data centre growth, and power consumption in particular, is an inevitable consequence; this 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 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.

The energy reuse factor (ERF) provides the data centre practitioner with greater visibility into energy efficiency in data centres that make beneficial use of any reused energy from the data centre.

In order to determine the overall resource efficiency of a data centre, a holistic suite of metrics is required. This document is one of a series of standards for such KPIs and has been produced in accordance with 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. The document presents specific rules on ERF's use, along with its theoretical and mathematical development. The document concludes with several examples of site concepts that can employ the ERF metric.

Information technology — Data centres key performance indicators —

Part 6:
Energy Reuse Factor (ERF)

1 Scope

This document specifies the energy reuse factor (ERF) as a KPI to quantify the reuse of the energy consumed in a data centre. ERF is defined as the ratio of energy being reused divided by the sum of all energy consumed in a data centre. The ERF does reflect the efficiency of the reuse process; the reuse process is not part of a data centre.

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*

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 30134-1 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/

3.1.1
reused energy
reuse of energy
utilization of energy used in the data centre for an alternate purpose outside the data centre boundary

Note 1 to entry: Energy ejected to the environment does not constitute reused energy.

3.1.2
handoff point
point at the boundary of the data centre where energy is measured and is handed off to another party

Note 1 to entry: An example is an energy company which utilizes the energy outside the data centre boundary.

3.2 Abbreviated terms

For the purposes of this document the abbreviated terms of ISO/IEC 30134-1 and the following apply.

AC	alternating current
COP	coefficient of performance
CRAC	computer room air conditioner units
CRAH	computer room air handler units
DX	direct expansion
ERE	energy reuse efficiency
ERF	energy reuse factor
PUE	power usage sffectiveness
IT	information system
UPS	uninterruptible power system
PDU	power distribution unit
r.m.s	root mean square

3.3 Symbols

For the purposes of this document the following symbols apply.

$E_{COOLING}$	energy used by the entire cooling system attributable to the data centre including support spaces (annual)
E_{DC}	total data centre energy consumption (annual)
E_{EXCESS}	data centre excess energy (annual)
E_{IT}	IT equipment energy consumption (annual)
$E_{LIGHTING}$	energy used to light the data centre and support spaces (annual)
E_{POWER}	energy lost in the power distribution system through line-loss and other infrastructure (e.g. UPS or PDU) inefficiencies (annual)
E_{Reuse}	energy from the data centre (annual) that is used outside of the data centre and which substitutes partly or totally energy needed outside the data centre boundary (annual)

4 Applicable area of the data centre

With ERF, the data centre under consideration shall be viewed as a system bounded by interfaces through which energy flows (see Figure 1). The calculation of ERF accounts for energy crossing this boundary. The bounded areas are the same as those used in calculations for PUE and other KPIs from the ISO/IEC 30134 series.

As shown in Figure 1, the data centre boundary is “drawn” around the data centre at the point of handoff from the utility provider. This is a critical distinction when alternate energy types and mixed-use buildings are analysed. It is equally important to ensure all energy types are included in ERF. All energy carriers (such as fuel oil, natural gas, etc.) and energy generated elsewhere (such as electricity, chilled water, etc.) that feed the data centre shall be included in the calculation.

Assuming there is no energy storage, conservation of energy requires that the energy into the data centre equals the energy out. In the simple schematic of Figure 1, that means A + B = F. This is oversimplified, as there are losses and heat generated at the cooling (A minus E), UPS, and PDU (B minus D) points as well, but this waste heat also has to leave the boundary. Once a boundary is defined for a data centre, it can be used to properly understand the ERF concept.

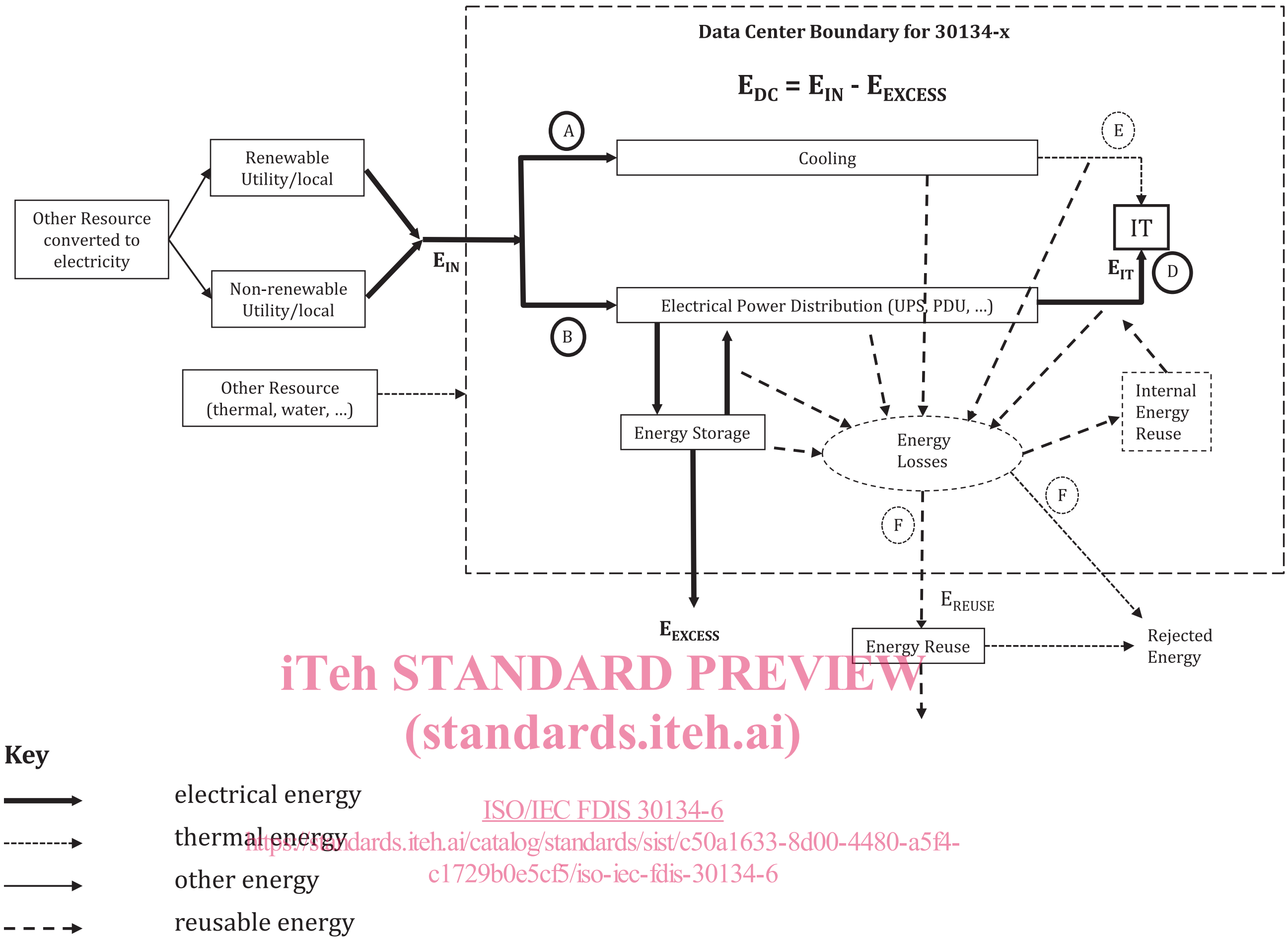

Figure 1 — Simplistic data centre components and boundary

It is critical to include all energy carriers at the point of utility handoff. It is also critical to include all of the data centre's energy consumption in the calculations, which includes but is not limited to generators, inside and outside lighting, fire detection and suppression, associated office/cubicle space strictly intended for data centre personnel, receiving areas, storage areas, etc. For clarity, the diagrams only show the large components to demonstrate the ERF concept.

Only energy being reused outside the boundary of a data centre is considered for ERF as reuse of energy. Any energy reused inside the data centre boundary shall not be counted towards ERF, as it already is accounted for in a lower PUE. Using it to also calculate ERF is essentially double counting and not permitted, as its benefit is already realized in a lower PUE. Examples of this are shown in Annex A.

NOTE The PUE in this subclause is as specified in ISO/IEC 30134-2.

In Figure 1, any portion of (F) that is reused outside the data centre boundary, such as in a mixed-use building or a different building, and not rejected to the atmosphere, is considered reused energy for determining ERF. However, the benefits of that reused energy and the efficiency of that reused energy are outside the scope of ERF. While reuse technologies are important to a data centre's overall energy use, they are too complex to try to define or measure in the context of what ERF is attempting to do, which is primarily based on the energy use and efficiencies of the data centre itself. To determine ERF, the practitioner needs to identify and account for all energy streams crossing the data centre boundary coming in and any energy streams that can have beneficial use going out of the data centre boundary. The energy coming in is typically electricity, but can also be natural gas, diesel fuel, chilled water or conditioned air from another space. The energy leaving the data centre boundary most often takes the form of heated water or heated airflow; these are what this document considers to be potentially reused energy. However, any form of energy that is reused outside of the data centre boundary (such as heated water, heated airflow etc.) shall be accounted for. Whatever the form of the energy, the math and method hold. Annex B provides conversion factor sources and methods, including where regional standards or agreements do not exist. Processes that take advantage of the reused energy for other uses are outside the data centre boundary. The simplest example is some form of chiller being driven by data centre waste heat. The reused energy to be considered for ERF is the waste heat going into the chiller and not the cooling energy delivered by the chiller to another space outside the data centre space. Again, that process is outside of the data centre boundary as it is not a part of the required data centre infrastructure.

A simple test of a specific technology employed in a data centre to determine if the energy reuse should be considered in ERF is if the PUE of the data centre would be different with or without that technology. If the technology causes a lower PUE, then it should not be considered as part of ERF. For example, if warm air from the data centre is used to heat the UPS battery room in the winter, this will result in a lower PUE; therefore, that double-/multi-use of energy shall not be included when calculating ERF. The heat from the data centre, when transferred to the battery room, stays within the data centre boundary and is therefore accounted for in lowering the PUE by reducing electricity demand for heating the battery room. It has no effect on ERF. If it had been used to heat an adjacent, non-data centre space (e.g. an adjacent cafeteria), then the heat crossed the data centre boundary and counts in ERF but not PUE. Examples of ERF usage are described in Annex A.

5 Determination of ERF

ERF provides a way to determine the factor of energy reuse. Heat is the most common example, where some of the heat produced by the data centre is utilized for beneficial purposes outside the data centre boundary and is not regarded as waste heat.

ERF ranges from 0 to 1,0. An ERF of 0,0 means no energy is reused, while a value of 1,0 means that, theoretically, all the energy brought into the data centre is reused. Any equipment outside of the data centre boundary for increasing the temperature delivered, like heat pumps, shall not be included in the calculation.

ERF is defined as:

$$\mathrm{ERF} = \frac{E_{\mathrm{Reuse}}}{E_{\mathrm{DC}}}$$

Where the only energy source is from an electrical utility, E_{DC} is determined by the energy measured at the utility meter. ERF may be applied in mixed-use buildings when measurement of the difference between the energy used for the data centre and that for other functions is possible.

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

a) power delivery — including UPS systems, switchgear, generators, PDUs, batteries, and distribution losses external to the IT equipment;

b) cooling system — including chillers, cooling towers, pumps, CRAHs, CRACs, and DX units;

c) others — including data centre lighting, elevator, security system, and fire suppression system;

d) all the infrastructure needed to transfer or to enhance the reused heat flow to the handoff point at the data centre boundary.

E_{IT} is the energy consumed by IT equipment (annual) that is used to capture, manage, process, store, or transmit data within the compute space, which includes but is not limited to:

1) IT equipment (e.g. compute, storage, and network equipment);

2) supplemental equipment (e.g. Keyboard-Video-Monitor switches, monitors, and workstations/laptops used to monitor, manage and/or control the data centre).

6 Measurement of E_{Reuse} and E_{DC}

The measurement of the E_{DC} shall be carried out at the boundary of the data centre at the handoff point, where the data centre operator measures the power acquired from the energy supplier. If the energy is produced inside the physical boundaries of the data centre, the point of measurement shall be at the logical boundary.

The measurement of the E_{Reuse} shall be carried out at the logical boundary of the data centre at the handoff point, where the energy provided is handed off to be used by the other party. In most cases, the energy transferred is in the form of thermal energy, measured by increase in temperature and flow with reference to incoming provision (see Annex A for reference). The measurements shall be converted to the equivalent units used for E_{DC}, i.e. kWh. The measurement and conversion shall be measured at the hand off point of the data centre boundary.

Measurement of E_{DC} shall be undertaken using either:

a) watt meters with the capability to report energy use, or

b) kilowatt-hour (kWh) meters that report the "true" energy (true r.m.s.), via the simultaneous measurement of the voltage, current, and power factor over time.

In case of E_{Reuse}, where the measurement is often made from the fluid or gaseous flow, where the energy is transferred as heat, the measurement shall be undertaken with meters capable of measuring the energy added to the flow from the data centre boundary.

NOTE Kilovolt-ampere (kVA), the product of voltage and current, is not an acceptable measurement. Though the product of volts and amperes mathematically results in watts, "true" energy is determined by integrating a power factor corrected value of volts and amperes. The frequency, phase variance, and load reaction causes energy calculation difference between apparent energy and "true" energy. The error is inherently significant when power delivery includes AC. Kilovolt-ampere (kVA) measurements can be used for other functions in the data centre, but kVA is insufficient for these measurements.

ERF without any subscripts shall be determined as an annualized value.

7 Application of ERF

ERF can be used by data centre managers to monitor and report reused energy in relation to energy consumption in the data centre.

This KPI can be used independently, but to get a more holistic picture of the resource efficiency of the data centre, other KPIs from the ISO/IEC 30134 series should be considered.

8 Reporting of ERF

8.1 Requirements

8.1.1 Standard construct for communicating ERF data

For a reported ERF to be meaningful, the reporting organization shall provide the following information:

a) the data centre (including the boundaries of the structure) under inspection,

b) the ERF value,

c) the termination date of the period of measurement using the format of ISO 8601-1 (e.g. yyyy-mm-dd).

