SLOVENSKI STANDARD
oSIST prEN IEC 63376:2022

01-julij-2022

Sistem za energijsko upravljanje industrijskih objektov (FEMS) - Funkcije in informacijski tokovi

INDUSTRIAL FACILITY ENERGY MANAGEMENT SYSTEM (FEMS) - Functions and Information Flows

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Système de gestion d'énergie des installations industrielles (FEMS) - Fonctions et flux d’informations

Ta slovenski standard je istoveten z: **prEN IEC 63376:2022**

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ICS:

25.040.01	Sistemi za avtomatizacijo v industriji na splošno	Industrial automation systems in general

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65/924/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: **IEC 63376 ED1**	
DATE OF CIRCULATION: **2022-05-06**	CLOSING DATE FOR VOTING: **2022-07-29**
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IEC TC 65 : INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION	
SECRETARIAT: France	SECRETARY: Mr Didier GIARRATANO
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

Attention IEC-CENELEC parallel voting

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TITLE:

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CONTENTS

iTeh STANDARD PREVIEW
(standards.iteh.ai)
oSIST prEN IEC 63376:2022
https://standards.iteh.ai/catalog/standards/sist/9114e0bc-92be-496d-bfd2-2373367c70ca/osist-pren-iec-63376-2022

oSIST prEN IEC 63376:2022

iTeh STANDARD PREVIEW
(standards.iteh.ai)
oSIST prEN IEC 63376:2022
https://standards.iteh.ai/catalog/standards/sist/9114e0bc-92be-406d-bfd2-23755b7c70ca/osist-pren-iec-63376-2022

oSIST prEN IEC 63376:2022

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oSIST prEN IEC 63376:2022
https://standards.iteh.ai/catalog/standards/sist/9114e0bc-92be-496d-bfd2-23755b7c70ca/osist-pren-iec-63376-2022

oSIST prEN IEC 63376:2022

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(standards.iteh.ai)
oSIST prEN IEC 63376:2022
https://standards.iteh.ai/catalog/standards/sist/9114e0bc-92be-496d-bfd2-23755b7c70ca/osist-pren-iec-63376-2022

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Industrial Facility Energy Management System (FEMS) –

Functions and Information Flows

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International Standard IEC 63376 has been prepared by IEC technical committee TC 65: Industrial-process measurement, control and automation.

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

Draft	Report on voting
65/XYZ/FDIS	65/XYZ/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

oSIST prEN IEC 63376:2022

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://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.

The National Committees are requested to note that for this document the stability date is 2026.

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oSIST prEN IEC 63376:2022
https://standards.iteh.ai/catalog/standards/sist/9114e0bc-92be-496d-bfd2-23755b7c70ca/osist-pren-iec-63376-2022

oSIST prEN IEC 63376:2022

INTRODUCTION

The world's energy use has been increasing along with economic growth. The energy use by Organization for Economic Co-operation and Development (OECD) countries is no longer increasing. According to World Energy Outlook 2020, energy demand in OECD countries has been on a declining trend since 2007 with continued increase of their gross domestic product. On the other hand, the energy use in developing countries has been increasing in both growth rate and value. The energy use by the industry sector is more than 50% of the total consumption and it is forecast to increase by about 10% between 2018 and 2030. Although the rate of increasing energy demand is lower than the rate in the report published in 2012, this increase causes serious concerns with environmental impact and presents opportunities for energy management. To control global warming, the energy from renewable resources will be increasing globally. It is expected that the share of renewable energy to total demand is increasing from about 30% in 2019 to about 40% in 2030. Outputs of renewable energy resources such as solar photovoltaics and wind etc. require power regulation to manage integration with the overall grid. Industrial facilities are major energy consumers and, also major energy generators. Therefore, the industrial sector is expected to play a significant role to satisfy the power regulations for the smart grid using renewable energy for decarbonization. Consequently, it is quite urgent for the industrial sector to deploy energy management systems to improve the energy efficiency to support the decarbonization of society.

Energy management in the manufacturing industries is linked to production and depending on the industry it can have a very wide range of requirements. To date, energy management systems have been custom developed for/by each company and then enhanced based on practical experiences thus further customizing them. Therefore, there are many different EMSs for each organization. As coordination between related organizations becomes necessary for the optimal operation of each facility, the functions of an industrial Facility Energy Management System (FEMS) require they be standardized to realize the benefits of making better use of the available energy within and across enterprises and organizations.

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Production systems have a hierarchical layered structure such as Enterprise Resource Planning (ERP), Manufacturing Operations Management (MOM) / Manufacturing Execution Systems (MES) and Control. FEMS may have been installed parallel to each layer of the production system to communicate with them. As the production system is integrated for overall optimization, expanding the boundary of FEMS for the horizontal and/or vertical integration of FEMS is also required to have an input to that integrated production system structure.

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For overall optimization, the production system executes under the multiple constraints such as safety, cost, quality of products, production schedule, market requirement, energy, and others particular to the industry and application. These multiple constraints are prioritized according to the business situation and used as the objective functions for optimization. Due to the complexity and continuous variability of practical operation conditions, the objective functions for optimization, in most cases, are set to the production system manually by an experienced engineer or operator who has deep knowledge of the operation. The FEMS has been supporting those people by providing necessary information for their decision-making processes during the operation.

As a FEMS needs to collect energy related information from many kinds of production systems, MOM/MES and ERP, the volume of information has been increasing extensively. It is necessary to clarify the necessary information and functions for energy management. It is also necessary to automate the execution processes of functions of FEMS including the decision-making processes for optimization as possible.

Automation technologies including modelling, simulation, Artificial Intelligence (AI), and others enable automating the process for optimization thus reducing manual operation / intervention. The FEMS provides necessary functions and information for the above-mentioned optimization.

The FEMS functions need to be defined as an international standard to improve interconnectivity between the FEMS and other related systems. This document proposes to

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define the functions, information flows and classes of FEMS based on the level of achievement of FEMS capabilities. The level of automation of the FEMS functions will be one factor to define the class. The class will provide management with a motivation and path for a stepwise progression through the classes. The resulting FEMS standard increases the sophistication of control in industrial complexes and processes so that improved optimization of facility operations can be obtained. Furthermore, the information exchange among FEMS and other systems such as MOM/MES and ERP will be defined for the integration.

International standardization will benefit both end users and suppliers of FEMS.

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INDUSTRIAL FACILITY ENERGY MANAGEMENT SYSTEM (FEMS) –

Functions and Information Flows

1 Scope

This document specifies the functions and the information flows of industrial Facility Energy Management System (FEMS). Generic functions are defined for the FEMS, to enable upgrading traditional Energy Management System (EMS) from visualization of the status of energy consumption to automation of energy management defining a closer relation with other management and control systems. A generic method to classify the FEMS functions will be explained. The information exchange between the FEMS and other systems such as Manufacturing Operations Management (MOM), Manufacturing Execution System (MES) and Enterprise Resource Planning (ERP) will be outlined.

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.

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IEC 62264 (all parts), *Enterprise-control system integration*

IEC/TS 62872-1:2019, “*Industrial-process measurement, control and automation - Part 1: System interface between industrial facilities and the smart grid*”

IEC/TR 62837:2013, “*Energy efficiency through automation systems*”

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ISO 22400-1:2014, “*Automation systems and integration — Key performance indicators (KPIs) for manufacturing operations management — Part 1: Overview, concepts and terminology*”

ISO 22400-2:2014/AMD1:2017, “*Automation systems and integration — Key performance indicators (KPIs) for manufacturing operations management — Part 2: Definitions and descriptions — Amendment 1: Key performance indicators for energy management*”

3 Terms, definitions, and abbreviations

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

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Terms and definitions

3.1.1
device
independent physical entity capable of performing one or more specified functions in a particular context and delimited by its interfaces

Note 1 to entry: A device can form part of a larger device.

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[SOURCE: IEC 61804-2:2017, 3.1.18, Modified add note from IEC 80004-9:2017(en), 3.1.1]

3.1.2
equipment
component or arrangement of components, built for specific function(s)

[SOURCE: ISO 19901-5:2016 (en), 3.17, Modified: Delete notes 1 & 2]

3.1.3
enterprise
one or more organizations sharing a definite mission, goals and objectives which provides an output such as product or service

[SOURCE: IEC 62264-1:2013 clause 3.1.10]

3.1.4
facility
site, or area within a site, that includes the resources within the site or area and includes the activities associated with the use of the resources

[SOURCE: IEC 62264-1:2013, 3.1.20]

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3.1.5
operator
entity responsible for the minute-by-minute execution and safe functioning of a facility

3.1.6
organization
company, corporation, firm, authority or institution, or part or combination thereof, whether incorporated or not, public, or private, that has its own functions and administration

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Note 1 to entry: For organizations with more than one operating unit, a single operating unit may be defined as an organization.

[SOURCE:ISO 14001:2004, 3.16 Modified: reference to enterprise removed.]

3.1.7
plant
physical unit for a comprehensive process including the dedicated functional unit(s) for control

EXAMPLE: Heating plant, ventilating plant, air conditioning plant, chiller plant, sanitary installation, or electrical installation.

Note 1 to entry: A plant can consist of several partial plants that are assembled from equipment, units, or aggregates (e.g., boiler), devices, modules, components, and elements.

[SOURCE: ISO 16484-2:2004 (en), 3.149, Modified: Note 2 deleted. Change unit to unit(s)]

3.1.8
site
identified physical, geographical, and/or logical component grouping of a manufacturing enterprise under a single management

[SOURCE: IEC 62264-1:2013, 3.1.39, Modified: “under a single management” is added after “enterprise”]

oSIST prEN IEC 63376:2022

3.1.9
unit
Lowest level of equipment typically scheduled by the Level 4 or Level 3 functions for continuous manufacturing processes.

3.2 Abbreviations

APO	Advanced Planning and Optimization
BEMS	Building Energy Management System
CMM	Capability Maturity Model
DER	Distributed Energy Resource
EMS	Energy Management System
ERP	Enterprise Resource Planning
FC	Functional Component
FDREM	Facility Demand Response Energy Management
FEMS	Facility Energy Management System
HEMS	Home Energy Management System
IP	Intellectual Property
KPI	Key Performance Indicator
LIMS	Laboratory Information Management System
MES	Manufacturing Execution System
MIMO	Multiple Input Multiple Output
MOM	Manufacturing Operations Management
MPC	Model Predictive Control
OECD	Organisation for Economic Co-operation and Development
MV	Manipulated Variable
PV	Process Variable
PID	Proportional Integral Derivative
SISO	Single Input Single Output
SV	Setpoint Value
WMS	Warehouse Management System

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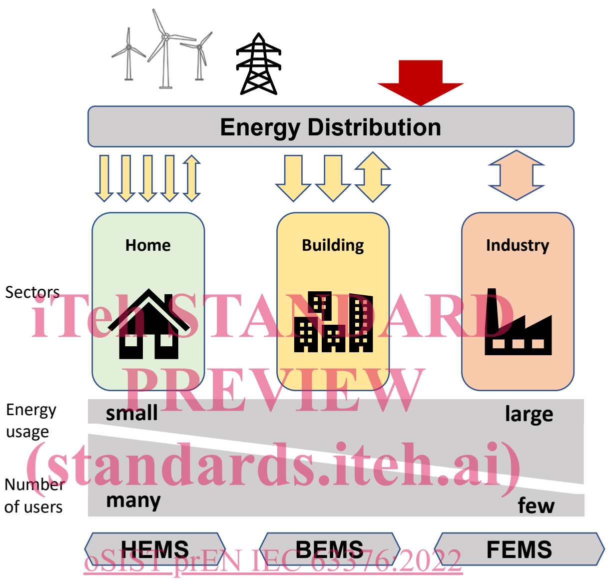
4 General

4.1 Energy management activities in Industrial Facilities

In the customer domains of energy such as Home, Building/Commercial and Industry, energy management systems; Home Energy Management System (HEMS), Building Energy Management System (BEMS) and FEMS respectively have been deployed depending on the characteristics of energy consumption. Figure 1 depicts the characteristic features of FEMS, BEMS, and HEMS. Key factors are the energy usage and number of entities in each domain. Arrows show energy distribution. Up-down-double arrow shows energy trading between Home, building and Industry through the energy distribution.



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oSIST prEN IEC 63376:2022
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Figure 1 – Characteristic feature of HEMS, BEMS, and FEMS

The energy consumption of users of FEMS is generally larger than that of BEMS and HEMS, the effect of a single industrial user's energy efficiency is significant. The profile of energy demand varies among users as a function of the different types of energy sources in a manufacturing facility. Typical energy sources are electricity, fuel, steam, hydro, and distributed energy resources (DER) such as renewable energy, combined heating and power stations, and storage systems to provide useful energy in the form of power, heat, steam, heating or cooling water, compressed air and similar. FEMS is usually provided as a made-to-order product. BEMS has a larger number of target users and is readily available as a ready-made product. HEMS, which deals with a larger number of smaller users, is a readily available mass product. Each system and associated complexity / degree of customization has a corresponding price.

Energy management in a manufacturing enterprise is performed with consideration for harmonizing many conflicting requirements such as productivity, quality, delivery, production scheduling, manufacturing cost, profit, safety, environmental requirements and so on. Those requirements are prioritized depending on the corporate objectives and regulations at the time the energy management decisions are made.

In industrial facilities, the utility facility supplies and manages energy by managing electricity, heat, steam, hot or cooling water and compressed air to demand facilities such as production lines. The utility facility may be designed independently to have the capacity to meet the maximum demands. When the demand decreases, the mismatch between supply and demand