



SLOVENSKI STANDARD oSIST prEN IEC 63376:2022

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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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PREVIEW

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

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ICS:

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

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

PROPOSED STABILITY DATE: 2026

NOTE FROM TC/SC OFFICERS:

CONTENTS

1		
2		
3	FOREWORD.....	6
4	INTRODUCTION.....	8
5	1 Scope.....	10
6	2 Normative references	10
7	3 Terms, definitions, and abbreviations	10
8	3.1 Terms and definitions.....	10
9	3.2 Abbreviations.....	12
10	4 General	13
11	4.1 Energy management activities in Industrial Facilities	13
12	4.2 Hierarchical structure of enterprise manufacturing system	14
13	4.2.1 Levels of manufacturing enterprises and the activities	14
14	4.3 Energy management system in a manufacturing enterprise.....	15
15	4.4 Role of FEMS and its expansion	16
16	4.4.1 Role of FEMS	16
17	4.4.2 Expansion of the role of FEMS.....	16
18	4.4.3 International standardization.....	17
19	4.5 Relation between FEMS and other systems	18
20	4.5.1 Relation between FEMS and other systems.....	18
21	4.5.2 FEMS and production system.....	18
22	4.5.3 Management and optimization	21
23	4.6 Information exchange	21
24	4.6.1 System boundary	21
25	4.6.2 Inside and outside of the facility.....	22
26	4.7 Data confidentiality	23
27	4.7.1 General	23
28	4.7.2 Information security	24
29	5 Description of Functions of FEMS.....	25
30	5.1 Category of Functions of FEMS	25
31	5.2 Monitoring Data Flows	28
32	5.2.1 General	28
33	5.2.2 Collecting actual and reference data.....	28
34	5.2.3 Collection of manufacturing planning information and facility	29
35	5.3 Analysis Data Flows.....	30
36	5.3.1 General	30
37	5.3.2 Assumption for unmeasured parameters.....	31
38	5.3.3 Change detection in energy performance.....	31
39	5.3.4 Estimation of causality.....	32
40	5.3.5 Analysis of potential energy recovery	32
41	5.4 Optimization Data Flows	33
42	5.4.1 General	33
43	5.4.2 Derivation of operation strategy	34
44	5.4.3 Validation of operation strategy and constraints.....	35
45	5.5 Instruction data flows	35
46	5.5.1 General	35
47	5.5.2 Output operation strategies to other systems.....	36

48	5.5.3	Report optimisation results to operator/energy manager	36
49	6	Classification of FEMS	37
50	7	FEMS Demand Response.....	41
51	7.1	Demand Response.....	41
52	7.2	FEMS and Incentive-based Demand Response.....	42
53	7.3	FEMS and Price-based Demand Response	42
54	Annex A (informative)	FEMS Use Cases	45
55	A.1	FEMS Actors.....	45
56	A.2	Use cases of FEMS	47
57	A.2.1	General	47
58	A.2.2	Selection of Use cases	47
59	A.2.3	Measurement and analysis of energy data (Visualization)	48
60	A.2.4	Optimization of each unit	49
61	A.2.5	Optimization of each facility	51
62	A.2.6	Optimization of energy supply facility	53
63	A.2.7	Overall optimization	56
64	A.2.8	Energy Source optimization – economics/renewables	58
65	A.2.9	Energy Profile.....	60
66	Annex B (informative)	Interface to exchange information for FEMS	64
67	B.1	Energy Storage System (ESS)	64
68	B.2	Peak Shift	65
69	B.3	Peak Shaving.....	66
70	B.4	Other Functions	67
71	B.4.1	General	67
72	B.4.2	Battery operating time forecast	67
73	B.4.3	Battery life monitoring	67
74	B.4.4	Function update	67
75	Bibliography.....		68
76			
77	Figure 1 – Characteristic feature of HEMS, BEMS, and FEMS		13
78	Figure 2 – Functional Hierarchy		14
79	Figure 3 – Extension to the role-based equipment hierarchy model.....		15
80	Figure 4 – System configuration of integration of multiple FEMSs		16
81	Figure 5 – Expansion of Role of FEMS		17
82	Figure 6 – Relationship between FEMS and other systems		18
83	Figure 7 – Hierarchical model of production system		20
84	Figure 8 – Multiple-input, Multiple-output Controller		20
85	Figure 9 – Hierarchical structure of integrated enterprise-production system.....		22
86	Figure 10 – Example of Information exchange with inside and outside of the facility		23
87	Figure 11 – IEC 62443 Security for industrial automation and control systems		
88	standards.....		24
89	Figure 12 – Categories of FEMS functions and improvement cycle of energy		
90	performance		25
91	Figure 13 – Relationship among functions of FEMS and other systems.....		27
92	Figure 14 – Functions categorized under “Monitoring” and FEMS related Data Flow		28
93	Figure 15 – Functions categorized under “Analysis” and FEMS related Data Flow		30

94	Figure 16 – Functions categorized under “Optimization” and FEMS related data flow.....	34
95	Figure 17 – Functions categorized under “Instruction” and FEMS related data flow.....	36
96	Figure 18 – Three-dimensional map of FEMS	39
97	Figure 19 – General approach common today for grid management of demand	
98	response.....	42
99	Figure 20 – Correspondence relationship among these seven FCs and FEMS functions	43
100	Figure A.1 – Generic communication diagram between the smart grid and the FEMS	45
101	Figure A.2 – Use Case representation on three-dimensional FEMS model	47
102	Figure A.4 – Measurement and analysis of energy data	48
103	Figure A.5 – Sequence diagram of measurement and analysis of energy data	49
104	Figure A.6 – Optimization of each unit (inverter control of compressor).....	50
105	Figure A.7 – Sequence diagram of Optimization of each unit (inverter control of	
106	compressor).....	51
107	Figure A.8 – Optimization of each facility (quantity control of compressor).....	52
108	Figure A.9 – Sequence diagram of optimization of each facility (quantity control of	
109	compressor).....	53
110	Figure A.10 – Optimization of energy supply facility (supply-side RENKEI)	54
111	Figure A.11 – Sequence diagram of optimization of energy supply facility (supply-side	
112	RENKEI).....	55
113	Figure A.12 – Overall optimization (demand and supply RENKEI).....	56
114	Figure A.13 – Sequence diagram of overall optimization (demand and supply RENKEI).....	57
115	Figure A.14 – Alternative Energy Sources.....	59
116	Figure A.15 – Sequence diagram for energy source optimization	60
117	Figure A.16 Alternative Energy Profiles.....	61
118	Figure A.17 Sequence diagram for Energy Profile optimization.....	62
119	Figure B.1 – Signal exchange diagram of the ESS and FEMS.....	65
120	Figure B.2 – Energy flow during peak shift.....	66
121	Figure B.3 – Peak Shaving Energy Flow	67
122		
123	Table 1 – Description for FEMS function categories.....	25
124	Table 2 – Data input and output of FEMS functions categorized into “Monitoring”	28
125	Table 3 – Data input and output of FEMS functions categorized into “Analysis”	30
126	Table 4 – Data input and output of FEMS functions categorized into “Optimization”	33
127	Table 5 – Data input and output of FEMS functions categorized into “Instruction”	35
128	Table 6 – Description of “Automation levels”	37
129	Table 7 – Relation between the level of automation and function	39
130	Table 8 – Relationship between the FCs in IEC62872-2 and the functions of FEMS.....	44
131	Table A.1 – Actors and roles.....	45
132	Table A.2 – Functions included in a Process (Measurement and analysis of energy	
133	data).....	49
134	Table A.3 – Functions included in a Process (optimization of each unit (inverter control	
135	of compressor).....	51
136	Table A.4 – Functions included in a process (optimization of each facility (quantity	
137	control of compressor)	53
138	Table A.5 – Functions included in a process (optimization of energy supply facility	
139	(Supply-side RENKEI))	55

140	Table A.6 – Functions included in a process (overall optimization (demand and supply	
141	RENKEI)).....	57
142	Table A.7 – Functions included in a energy optimization process	60
143	Table A.8 – Functions included in a Energy Profiles Optimization Process.....	62
144		
145		

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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.

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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.

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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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.

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.

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

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

60 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.

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*”

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.

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

101 **3.1.2**

102 **equipment**

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

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

105 **3.1.3**

106 **enterprise**

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

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

110 **3.1.4**

111 **facility**

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

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

115 **3.1.5**

116 **operator**

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

118 **3.1.6**

119 **organization**

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

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

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

125 **3.1.7**

126 **plant**

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

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

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

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

133 **3.1.8**

134 **site**

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

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

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139 **3.1.9**
 140 **unit**
 141 Lowest level of equipment typically scheduled by the Level 4 or Level 3 functions for continuous
 142 manufacturing processes.

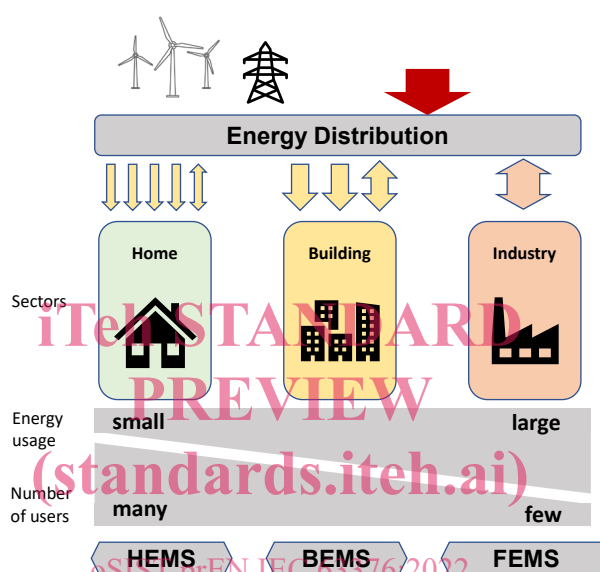
143 **3.2 Abbreviations**

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

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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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