



BSI Standards Publication

## **Industrial-process measurement, control and automation**

---

Part 1: System interface between industrial facilities and the smart grid

## National foreword

This Published Document is the UK implementation of IEC TS 62872-1:2019. It supersedes PD IEC/TS 62872:2015, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/65, Measurement and control.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2019

Published by BSI Standards Limited 2019

ISBN 978 0 539 00503 5

ICS 25.040.40; 29.240.99; 35.100.05

**Compliance with a British Standard cannot confer immunity from legal obligations.**

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 July 2019.

### Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

---



# IEC TS 62872-1

Edition 1.0 2019-06

# TECHNICAL SPECIFICATION



---

**Industrial-process measurement, control and automation –  
Part 1: system interface between industrial facilities and the smart grid**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 25.040.40; 29.240.99; 35.100.05

ISBN 978-2-8322-7084-4

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references .....	8
3 Terms and definitions .....	8
3.1 General.....	9
3.2 Models in automation.....	11
3.3 Models in energy management system and smart grid .....	11
4 Abbreviated terms .....	15
5 Requirements .....	16
5.1 Considerations and approaches in industry.....	16
5.1.1 General .....	16
5.1.2 Approaches to maintain grid stability .....	18
5.1.3 Price-based and incentive-based demand response .....	18
5.2 Architecture requirements .....	20
5.2.1 General .....	20
5.2.2 Energy management in industrial facilities .....	22
5.3 System interface mode between facility and smart grid .....	25
5.4 Security requirements .....	26
5.5 Safety requirements.....	27
5.6 Communication requirements.....	27
5.6.1 General .....	27
5.6.2 Use of common communications technology.....	27
5.6.3 Communication security requirements .....	27
5.6.4 Network availability.....	27
5.6.5 Time synchronization.....	27
5.7 Audit logging requirements .....	28
5.8 Information requirements .....	28
5.8.1 General .....	28
5.8.2 Information attributes.....	28
5.8.3 Example of data and data type .....	44
Annex A (normative) User stories and use cases .....	47
A.1 General.....	47
A.2 User stories .....	47
A.3 Use cases.....	49
A.3.1 Use case analysis.....	49
A.3.2 Actor names and roles.....	51
A.3.3 Use case descriptions.....	54
Annex B (normative) Use cases of incentive-based DR programs .....	73
B.1 General.....	73
B.2 Use cases of incentive-based DR (IBDR) programs .....	74
B.2.1 Use case analysis.....	74
B.2.2 Use case description .....	75
Annex C (informative) Example of an application of demand response energy management model .....	86
C.1 General.....	86

C.2	Main architecture .....	86
C.3	Structure of a task .....	87
C.4	Approaches of energy management .....	87
C.4.1	General .....	87
C.4.2	Approach 1 .....	88
C.4.3	Approach 2 .....	88
C.5	Mapping industrial demand response energy management model to use cases .....	88
Annex D (normative)	Security services .....	90
Annex E (informative)	Solutions for information requirement .....	91
E.1	General .....	91
E.2	Existing standards .....	91
E.3	Analysis for each use case .....	93
E.3.1	General .....	93
E.3.2	Analysis of "OpenADR2.0b" (IEC 62746-10-1:2018) .....	93
E.3.3	Analysis of "OASIS Energy Interoperation 1.0" .....	95
E.3.4	Analysis of "NAESB Energy Services Provider Interface (ESPI)" .....	97
E.3.5	Analysis of "ISO 17800:2017 Facility Smart Grid Information Model" (FSGIM) .....	98
Bibliography	.....	100
Figure 1	– Overview of interface between FEMS and smart grid .....	17
Figure 2	– General approach common today for grid management of DR .....	19
Figure 3	– Example facility electric power distribution .....	20
Figure 4	– Facility enterprise and control systems .....	21
Figure 5	– Model elements .....	23
Figure 6	– Model architecture .....	23
Figure 7	– Network architecture model .....	26
Figure A.1	– Use case overview .....	51
Figure A.2	– Generic communication diagram between the smart grid and the FEMS .....	51
Figure A.3	– Actors in role hierarchy (IEC 62264-1) .....	52
Figure A.4	– Sequence diagram for FG-100 .....	56
Figure A.5	– Sequence diagram for FG-200 .....	58
Figure A.6	– Sequence diagram for FG-300 .....	60
Figure A.7	– Sequence diagram for FG-400 .....	61
Figure A.8	– Sequence diagram for FG-500 .....	63
Figure A.9	– Sequence diagram for FG-600 .....	64
Figure A.10	– Sequence diagram for FG-710 .....	66
Figure A.11	– Sequence diagram for FG-720 .....	68
Figure A.12	– Sequence diagram for FG-810 .....	70
Figure A.13	– Sequence diagram for FG-820 .....	72
Figure B.1	– Role of incentive-based demand response in electric system planning and operations .....	74
Figure B.2	– Sequence diagram for IBDR-1 (DLC) .....	76
Figure B.3	– Sequence diagram for IBDR-2 (I/C) .....	78
Figure B.4	– Sequence diagram for IBDR-3 (EDRP) .....	79

Figure B.5 – Sequence diagram for IBDR-4 (DB) .....	81
Figure B.6 – Sequence diagram for IBDR-5 (CMP).....	83
Figure B.7 – Sequence diagram for IBDR-6 (ASM).....	85
Figure C.1 – An application example of demand response energy management model .....	86
Figure C.2 – Structure of water cooling task.....	87
Figure E.1 – Interaction to register report.....	93
Figure E.2 – Interaction to request report.....	94
Figure E.3 – Simple setup exchange .....	94
Table 1 – Required information .....	29
Table 2 – Example of data and data type .....	45
Table A.1 – Facility user stories: facility operation view points .....	48
Table A.2 – Utility user stories: utility operation view points .....	49
Table A.3 – Dependency between user stories and use cases .....	50
Table A.4 – Actors and roles .....	53
Table A.5 – Exchanged information in FG-100 .....	56
Table A.6 – Exchanged information in FG-200 .....	58
Table A.7 – Exchanged information in FG-300 .....	60
Table A.8 – Exchanged information in FG-400 .....	61
Table A.9 – Exchanged information in FG-500 .....	63
Table A.10 – Exchanged information in FG-600 .....	64
Table A.11 – Exchanged information in FG-710 .....	66
Table A.12 – Exchanged information in FG-720 .....	68
Table A.13 – Exchanged information in FG-810 .....	70
Table A.14 – Exchanged information in FG-820 .....	72
Table B.1 – Dependency between user stories and use cases .....	75
Table B.2 – Exchanged information in IBDR-1 (DLC) .....	76
Table B.3 – Exchanged information in IBDR-2 (I/C).....	78
Table B.4 – Exchanged information in IBDR-3 (EDRP).....	80
Table B.5 – Exchanged information in IBDR-4 (DB) .....	81
Table B.6 – Exchanged information in IBDR-5 (CMP).....	83
Table B.7 – Exchanged information in IBDR-6 (ASM).....	85
Table E.1 – Overview of existing standard applicability .....	92

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION –****Part 1: system interface between industrial facilities and the smart grid****FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62872-1, which is a technical specification, has been prepared by IEC technical committee 65: Industrial-process measurement, control and automation.

This first edition edition cancels and replaces IEC TS 62872, published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC TS 62872:

- Normative references, Terms and definitions, and Abbreviations were updated;
- Subclause 5.1 was reformulated with price-based and incentive-based demand response;
- Subclause 5.8.3 “Example of data and data type” was added;
- New actors were added in Annex A;
- Use cases FG-7xx and FG-8xx were added in Annex A;
- Annex B “Use cases of incentive-based DR programs” was added.

The text of this Technical Specification is based on the following documents:

Enquiry draft	Report on voting
65/731/DTS	65/743/RVDTS

Full information on the voting for the approval of this Technical Specification 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.

A review of this document will be carried out not later than 3 years after its publication with the options of: extension for another 3 years; conversion into an International Standard; or withdrawal.

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.

A bilingual version of this publication may be issued at a later date.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**



## INTRODUCTION

The World Energy Outlook 2017 [19]<sup>1</sup> reported that industry consumed over 40 % of world electricity generation in 2015. Furthermore, industry itself is a significant generator of internal power, with many facilities increasingly implementing their own generation, co-generation and energy storage resources. As a major energy consumer, the ability of some industries to schedule their consumption can be used to minimize peak demands on the electrical grid. As an energy supplier, industries with in-house generation or storage resources can also assist in grid load management. While some larger industrial facilities already manage their use and supply of electric power, more widespread deployment, especially by smaller facilities, will depend upon the availability of a readily available standard interface between industrial automation equipment and the “smart grid”.

NOTE In this document “smart grid” is used to refer to the external-to-industry entity with which industry interacts for the purpose of energy management. In other documents this term can be used to refer to all of the elements, including internal industrial energy elements, which work together to optimize energy generation and use.

Industry is a major consumer of electric power and in many cases this consumption can be scheduled to assist in minimizing overall peak demands on the smart grid. In addition, many industrial facilities have in-house generation or storage resources. These facilities can assist in smart grid load and supply management. For example, in-house generation can supply energy to the smart grid and to the facility. Furthermore, storage resources can assist in smart grid load management. While some larger industrial facilities already manage their use and supply of electric power, more widespread deployment, especially by smaller facilities, will depend upon the availability of readily available standard automated interfaces.

Standards are already being developed for home and building automation interfaces to the smart grid; however, the requirements of industry differ significantly and are addressed in this document. For industry, the planning of energy resources and production processes are under the responsibility of the facility energy planner and production planner and the operations are under the responsibility of the facility energy operator and production operator.

Incorrect operation of a resource could impact the safety of personnel, the facility, the environment or lead to production failure and equipment damage. In addition, larger facilities may have in-house production planning capabilities which might be co-ordinated with smart grid planning, to allow longer term energy planning.

---

<sup>1</sup> Numbers in square brackets refer to the Bibliography.

## INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION –

### Part 1: system interface between industrial facilities and the smart grid

#### 1 Scope

This part of IEC 62872 defines the interface, in terms of information flow, between industrial facilities and the “smart grid”. It identifies, profiles and extends where required, the standards needed to allow the exchange of the information needed to support the planning, management and control of electric energy flow between the industrial facility and the smart grid.

The scope of this document specifically excludes the protocols needed for the direct control of energy resources within a facility where the control and ultimate liability for such control is delegated by the industrial facility to the external entity (e.g. distributed energy resource (DER) control by the electrical grid operator).

#### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62264-1:2013, *Enterprise-control system integration – Part 1: Models and terminology*

IEC 62443 (all parts), *Industrial communication networks – Network and system security*

IEC TS 62443-1-1:2009, *Industrial communication networks – Network and system security – Part 1-1: Terminology, concepts and models*

IEC 62443-2-1, *Industrial communication networks – Network and system security – Part 2-1: Establishing an industrial automation and control system security program*

IEC TR 62443-3-1, *Industrial communication networks – Network and system security – Part 3-1: Security technologies for industrial automation and control systems*

IEC 62443-3-3, *Industrial communication networks – Network and system security – Part 3-3: System security requirements and security levels*

#### 3 Terms and definitions

For the purposes of this document, the following terms and definitions 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>