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TECHNICAL REPORT

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Microgrids –
Part 4: Use cases

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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IEC TR 62898-4 has been prepared by subcommittee SC 8B: Decentralized electrical energy systems, of IEC technical committee 8: System aspects of electrical energy supply. It is a Technical Report.

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

Draft	Report on voting
8B/120/DTR	8B/142/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 62898 series, published under the general title *Micrographs*, can be found on the IEC website.

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- withdrawn,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.

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INTRODUCTION

This document provides a set of use cases related to microgrids, as a form of "decentralized energy system". Decentralized energy systems are small energy systems containing loads and distributed energy resources (generation, storage) with decentralized management for energy supply. This document completes the SC 8B roadmap for decentralized electrical energy systems. The goal is to explain the methodology retained on the microgrid sub-domain, which is a kind of decentralized system. This methodology, based on IEC 62913-1, describes high-level use cases (business use cases) covering the main typical usage of microgrids, and details some of them through system use cases. The proposed list of use cases is a first version, proposed for review; the goal is to cover all use cases with the same level of depth.

MICROGRIDS –

Part 4: Use cases

1 Scope

In line with the methodology specified in IEC SRD 62913-1, this document describes business use cases (high-level use cases covering the main typical usage of microgrids) and details some of them. System use cases linked to those business use cases are listed and briefly described for contextualizing the main functions to be performed for managing microgrids. Ultimately, the goal of this document is to provide a consistent level of detail for all business use cases. The document details the methodology retained to develop system use cases from the business use cases.

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 SRD 62913-1, *Generic smart grid requirements – Part 1: Specific application of the Use case methodology for defining generic smart grid requirements according to the IEC systems approach*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC SRD 62913-1 and the following 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

3.1.1
black start
start-up of an electric power system from a blackout through internal energy resources

[SOURCE: IEC 60050-617:2017, 617-04-24]

3.1.2
distributed energy resources
DER
generators (with their auxiliaries, protection and connection equipment), including loads having a generating mode (such as electrical energy storage systems), connected to a low-voltage or a medium-voltage network

[SOURCE: IEC 60050-617:2017, 617-04-20]

3.1.3
distributed energy resource management system
DERMS
system which, on behalf of other interested systems, manages the communications and control of individual distributed energy resources (DER), and can do this with a variety of field message protocols, and aggregates this information and communicates with other utility systems, such as a distribution management system (DMS)

3.1.4
distributed generation
DG
generation of electric energy by multiple sources which are connected to the power distribution system

[SOURCE: IEC 60050-617:2009, 617-04-09, modified – The preferred terms "embedded generation" and "dispersed generation" have been omitted.]

3.1.5
distribution management system
DMS
integration of business processes, hardware, software, and telecommunications equipment that provide effective tools to manage the operational business processes related to network management, outage management, power quality and other supporting operational practices

[SOURCE: IEC TS 61968-2:2011, 2.88]

3.1.6
electrical energy management system
EEMS
system monitoring, operating, controlling and managing energy resources and loads of the installations

Note 1 to entry: This equipment can be stand-alone or integrated in other larger equipment such as a home and building electronic system.

[SOURCE: IEC 60364-8-1:2019, 3.2.1, modified – Note 1 to entry has been added.]

3.1.7
electrical energy storage
EES
installation able to absorb electrical energy, to store it for a certain amount of time and to release electrical energy during which energy conversion processes can be included

EXAMPLE A device that absorbs AC electrical energy to produce hydrogen by electrolysis, stores the hydrogen, and uses that gas to produce AC electrical energy is an electrical energy storage.

Note 1 to entry: The term "electrical energy storage" may also be used to indicate the activity that an apparatus, described in the definition, carries out when performing its own functionality.

Note 2 to entry: The term "electrical energy storage" should not be used to designate a grid-connected installation; *electrical energy storage system* (3.1.8) is the appropriate term.

3.1.8
electrical energy storage system
EES system
EESS
installation with defined electrical boundaries, comprising at least one electrical energy storage, which extracts electrical energy from an electric power system, stores this energy internally in some manner and injects electrical energy into an electric power system and which includes civil engineering works, energy conversion equipment and related ancillary equipment

Note 1 to entry: The EES system is controlled and coordinated to provide services to the electric power system operators or to the electric power system users.

Note 2 to entry: In some cases, an EES system may require an additional energy source (non-electrical) during its discharge, providing more energy to the electric power system than the energy it stored. Compressed air energy storage is a typical example where additional thermal energy is required.

3.1.9
electric power system
EPS
composite, comprised of one or more generating sources, and connecting transmission and distribution facilities, operated to supply electric energy

Note 1 to entry: A specific electric power system includes all installations and plant, within defined bounds, provided for the purpose of generating, transmitting and distributing electric energy.

[SOURCE: IEC 60050-692:2017, 692-01-02]

3.1.10
isolated microgrid
group of interconnected loads and distributed energy resources forming a local electric power system at distribution voltage levels not currently capable of being connected to a wider electric power system

Note 1 to entry: Isolated microgrids are usually designed for geographical islands or for rural electrification.

Note 2 to entry: The definition includes a modification with respect to the IEV 617-04-23 to consider the fact that in the future, an isolated microgrid may be connected to an electric power system thanks to grid extension (this feature is explored further in this document).

[SOURCE: IEC 60050-617:2017, 617-04-23:2017, modified – In the definition, "with defined electrical boundaries" has been deleted, and "that cannot be connected" has been replaced with "not currently capable of being connected".]

3.1.11
microgrid
group of interconnected loads and distributed energy resources with defined electrical boundaries forming a local electric power system at distribution voltage levels, that acts as a single controllable entity and is able to operate in either grid-connected or island mode

Note 1 to entry: This definition covers both (utility) distribution microgrids and (customer owned) facility microgrids.

[SOURCE: IEC 60050-617:2017, 617-04-22]

3.1.12
prosumer's electrical installation
PEI
electrical installation connected to a public distribution network or not able to operate with one or both of local power supplies and local storage units, and that monitors and controls the energy from the connected sources delivering it to one or more of loads, local storage units, and public distribution network

3.1.13
virtual power plant
VPP
group of distributed energy resources which combine to function as a dispatchable unit

Note 1 to entry: A virtual power plant can be used for the purpose of participating in the electricity market or aggregating ancillary services.

[SOURCE: IEC 60050-617:2017, 617-04-27]

3.2 Abbreviated terms

BUC	business use cases
CIM	common information model
DC	direct current
DER	distributed energy resource(s)
DERMS	distributed energy resources management system
DG	distributed generation
DMS	distribution management system
DSO	distribution system operator
EEMS	electrical energy management system
EES	energy storage system
EESS	electrical energy storage system
EMS	energy management system
EV	electric vehicle
EPS	electric power system
FACTS	flexible alternating current transmission system
HV	high voltage
HVDC	high voltage direct current
IEC	International Electrotechnical Commission
LV	low voltage
MV	medium voltage
POC	point of connection
PEI	prosumer’s electrical installation
PQ	power quality
REP	retail energy provider
SCADA	supervisory control and data acquisition
SMU	system management unit
SUC	system use cases
SyC	system committee
TSO	transmission system operator
UML®[1]	Unified Modeling Language™
VPP	virtual power plant

1 UML® and Unified Modeling Language™ are trademarks of The Object Management Group. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named.

4 Overview of the document

In line with the methodology specified in IEC SRD 62913-1, this document describes business use cases (high-level use cases covering the main typical usage of microgrids) and details some of them.

Like any business use cases, these use cases attempt to be agnostic from any solutions or systems used for supporting the implementation of these use cases.

System use cases linked to those business use cases are listed for contextualizing the main functions to be performed for managing microgrids. For each of these, a short description and the involved system roles are listed with the intent to lay out technical requirements for further analysis. In the current document, not all the business use cases are covered in detail. Ultimately, the goal of the document is to provide a consistent level of detail for all business use cases. The document details the methodology selected to develop system use cases from the business use cases.

This work feeds the setting up of the standardization roadmap for decentralized energy systems, in the specific case of microgrids.

This means that this work will be followed by three next steps.

- Derive from these use cases some high-level objects to be standardized to ensure the implementation of a standard based solution for microgrids.
- Identify standards or standardization initiatives relevant in the context of microgrids and engage in a collaboration for coordination.
- Conclude on possible standardization recommendations to SC 8B or other TCs/SCs in IEC. Standardization activities could proceed with cooperation of concerned TC/SCs and SyCs, including but not limited to IEC SyC Smart Energy, SyC LVDC, TC 22, TC 57, TC 64, TC 82, TC 88, TC 95, TC 120.

Some additional benefits are expected from the content of this document:

- harmonization of the vocabulary related to microgrids across IEC initiatives;
- harmonization of the roles and functions;
- harmonization of the context of standardization for features cross cutting the IEC organization.

By nature, such a document is expected to evolve in order to reflect in the closest way market needs related to microgrids usage.

The proposed list of system use cases is a first version, proposed for review; the ultimate goal is to cover all use cases with the same level of depth.

5 Role model associated to decentralized electrical energy systems

5.1 Role model based on SGAM

The grouping of roles and actors (systems, components, operators, etc.) is based on a commonly accepted breakdown model, the EU M490 smart grid conceptual model Smart Grid Architecture Model (SGAM) in order to apprehend its complexity and to help maintain a global vision. SGAM is described in detail in IEC TR 62357-1 and IEC SRD 63200. IEC established a link between the SGAM framework and the use case methodology through key concepts: roles, business processes, activities, systems and functions in IEC SRD 62913-1. The SGAM framework enables the design of new smart grid architecture components to be organized on a three-axis basis (see Figure 1).

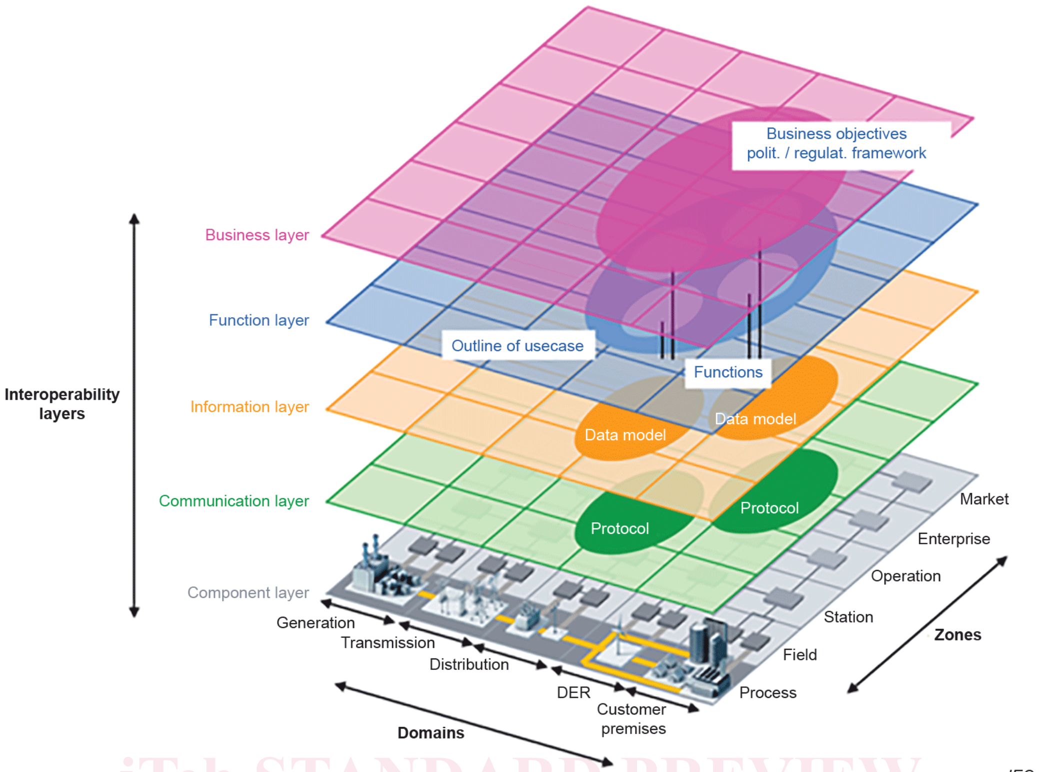

Figure 1 – The Smart Grid Architecture Model (CEN-CENELEC-ETSI, 2014)

5.2 Business roles

Table 1 lists the business roles that have been identified so far by IEC SyC Smart Energy following the guidelines for role modelling of IEC SRD 62913-1. This list is not exhaustive and will be updated as the use cases are drafted.

Table 1 – Business roles of the domain

Business roles	Definition
Generation and DER roles	
DER owner	Responsible party for overall market and financial decisions and contracts related to DER including microgrid design and operations
DER operator	Responsible party for operational aspects of the facilities and their DER systems including real time microgrid operations
Flexibility aggregator	A party which aggregates flexibilities for its customers. Can activate flexibility sites. Equivalent to retail energy provider (REP) in this document.
DER equipment manufacturer	Entity that produces, tests, sells, and implements DER systems
Producer	Party generating electric energy. Additional information: This is a type of grid user. [SOURCE: IEC 60050-617:2009, 617-02-01]
Prosumer	Network user that consumes and produces electrical energy [SOURCE: IEC 60050-617:2017, 617-02-16]
Decentralized electricity producer	Electricity producer with generator(s) connected to the distribution grid. Production can be dispatchable or non-dispatchable. This is a type of producer.
Power plant operator	Responsible party for operational aspects of a power plant