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Electrical energy storage (EES) systems – Part 1: Vocabulary

Systèmes de stockage de l'énergie électrique (EES) – Partie 1 : Vocabulaire

IEC 62933-1:2024-05(en-fr)

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Electrical energy storage (EES) systems – Part 1: Vocabulary

Systèmes de stockage de l'énergie électrique (EES) – Partie 1 : Vocabulaire

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ELECTRICAL ENERGY STORAGE (EES) SYSTEMS –

Part 1: Vocabulary

FOREWORD

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This second edition cancels and replaces the first edition published in 2018. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) addition (with revision) of the entries developed during the edition 1 stability period and, therefore, included only in other IEC 62933 parts;
b) addition of the entries developed during the edition 1 stability period and published in this document for the first time;
c) complete revision of the entries already present in edition 1.

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

Draft	Report on voting
120/358/FDIS	120/367/RVD

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 International Standard 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/publications.

A list of all parts in the IEC 62933 series, published under the general title *Electrical energy storage (EES) systems*, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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INTRODUCTION

The purpose of this terminology document is to provide terms and definitions for all the publications under the responsibility of TC 120, that standardize electrical energy storage systems (EES systems) including unit parameters, test methods, planning, installation, operation, safety and environmental issues. An EES system includes any type of grid-connected energy storages which can both store electrical energy and provide electrical energy (from electricity to electricity).

All TC 120 normative documents are subject to revision; this part of IEC 62933 will be revised together with other TC 120 publications in order to avoid mismatches.

From the technical point of view, an EES system can be a complex multi-stage system with several possible energy conversions. Each stage is made by well standardized components (e.g. transformers, power conversion systems) or innovative components (e.g. new types of batteries). Several IEC product standards give definitions necessary for the understanding of certain terms used for these components. The International Electrotechnical Vocabulary (IEV, http://www.electropedia.org), the IEC Glossary (http://std.iec.ch/glossary) and the ISO Online Browsing Platform (OBP, http://www.iso.org/obp) allow online access to this information. This document completes the need for precise terminology by giving definitions necessary at the system level.

Without a strong standardization of EES system terminology, focal terms can have a different meaning in EES systems related to different storage technologies. This aspect is critical also from the market point of view. It impacts economics and this can become a barrier for tender processes. The correct comparison among different options is fundamental, therefore basic terms and definitions impact economic decisions.

Terms and definitions have been harmonized with the IEV, the OBP, the IEC Glossary and relevant IEC documents as far as possible. Definitions not included in this terminology document can be found elsewhere in other IEC documents.

The use of abbreviated terms has been optimized: on the one hand to avoid tedious repetition and on the other hand to avoid confusion. A minimum set of abbreviated terms was identified and used in the definitions, the other terms are written out in full spelling when needed. The widely accepted abbreviated terms are:

EESS – EES system – Electrical energy storage system

EES – Electrical energy storage

POC – Point of connection

In order to facilitate document usage, Clause A.1 offers a term index and Clause A.2 offers an abbreviated term index.

ELECTRICAL ENERGY STORAGE (EES) SYSTEMS –

Part 1: Vocabulary

1 Scope

This part of IEC 62933 defines terms applicable to electrical energy storage (EES) systems including terms necessary for the definition of unit parameters, test methods, planning, installation, operation, environmental and safety issues.

This terminology document is applicable to grid-connected systems able to extract electrical energy from an electric power system, store energy internally, and provide electrical energy to an electric power system. The step for charging and discharging an EES system can comprise an energy conversion.

2 Normative references

There are no normative references in this document.

3 Terms and definitions for EES systems classification

3.1 Fundamental concepts for EES systems classification

3.1.1
electrical energy storage
EES
electrical *installation* (IEV 826-10-01) able to absorb electrical energy, to store energy for a certain duration and to provide electrical energy

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

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

Note 2 to entry: The term "electrical energy storage" is generally not used to designate a grid-connected installation, for which *electrical energy storage system* (3.1.2) is the appropriate term.

Note 3 to entry: Energy conversion processes can be included during energy absorption, storage or release.

[SOURCE: IEC 60050-631:2023, 631-01-01, modified – minor editorial modifications in the definition and in the note 2.]

3.1.2
electrical energy storage system
EES system
EESS
grid-connected *installation* (IEV 826-10-01) with defined electrical boundaries, comprising at least one *electrical energy storage* (3.1.1), which extracts electrical energy from an *electric power system* (IEV 601-01-01), stores this energy internally in some manner and provides electrical energy to an *electric power system* (IEV 601-01-01), including grid-connection works and which can include 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* (IEV 601-01-01) operators or to the electric power system users.

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

[SOURCE: IEC 60050-631:2023, 631-01-02, modified – minor editorial modifications in the definition and in the note 2.]

3.1.3
utility grid
part of an *electric power network* (IEV 601-01-02) that is operated by a *system operator* (IEV 617-02-09) within a defined area of responsibility

Note 1 to entry: A utility grid is normally used for electricity transfer from or to grid users or other grids. The grid users can be electricity producers or consumers. The area of responsibility is fixed by relevant legislation or regulation.

[SOURCE: IEC 60050-631:2023, 631-01-04 modified – system operator concept is added in the definition and minor editorial modifications in the note 1.]

3.1.4
grid-connected, adj
connected to an *electric power system* (IEV 601-01-01)

3.1.5
islanded grid
electric island
part of an *electric power system* (IEV 601-01-01) that is electrically disconnected from the remainder of the interconnected electric power system but remains energized from the local electric power sources

[SOURCE: IEC 60050-692:2017, 692-02-11, modified – the term “islanded grid” has been added and notes have been deleted.]

3.1.6
load profile
line graph illustrating the variation in loads over a specific time

3.1.7
allowed charging time
time period when an EES system is allowed to charge the accumulation subsystem in the peak shaving application

3.1.8
allowed discharging time
time period when an EES system is allowed to discharge the accumulation subsystem in the peak shaving application

3.2 EES systems classification

3.2.1
battery energy storage system
BESS
electrical energy storage system where the accumulation subsystem is a *battery storage subsystem* (5.2.4)

EXAMPLE *Flow battery energy system* (IEC 62932-1:2019, 2.17), *lithium ion battery* (IEV 482-05-07) energy storage system and lead acid battery energy storage system are different types of battery energy storage systems.

[SOURCE: IEC 60050-631:2023, 631-01-03, modified – battery storage subsystem concept inserted in the definition, notes deleted and the example added.]

3.2.2
capacitor energy storage system
CESS
electrical energy storage system with the accumulation subsystem based on *capacitors* (IEV 151-13-28)

Note 1 to entry: Usually, capacitor energy storage systems are based on *supercapacitors* (IEV 114-03-03).

3.2.3
flywheel energy storage system
FESS
electrical energy storage system with the accumulation subsystem based on flywheels

Note 1 to entry: A flywheel is a mechanical device where rotational kinetic energy is stored.

3.2.4
low voltage EESS
EES system designed to be connected to a *low voltage* (IEV 601-01-26) primary POC

3.2.5
medium voltage EESS
EES system designed to be connected to a *medium voltage* (IEV 601-01-28) primary POC

3.2.6
high voltage EESS
EES system designed to be connected to a *high voltage* (IEV 601-01-27) primary POC

3.2.7
residential EESS
EES system designed for *residential customer* (IEV 617-02-05), excluding professional users

Note 1 to entry: A residential EES system is normally compliant with the applicable standards for residential devices (e.g. electromagnetic compatibility).

Note 2 to entry: Professional users include commercial or industrial customers.

3.2.8
commercial EESS
EES system designed for professional users

Note 1 to entry: A commercial and industrial EES system is normally compliant with the applicable standards for commercial or industrial devices (e.g. electromagnetic compatibility).

Note 2 to entry: Professional users include commercial or industrial customers.

3.2.9
utility EESS
EES system which is integrated into the utility grid and serving solely to ensure safe and reliable operation of the *electric power network* (IEV 601-01-02)

[SOURCE: IEC 60050-631:2023, 631-01-05, modified – definition is reworded for better clarity.]

3.2.10
self-contained EES system
EES system whose components have been matched and partially or totally assembled at the factory, that are shipped in one or more containers, and that are ready to be installed in the field

Note 1 to entry: For a definition of container, refer to IEC TS 62686-1:2020, 3.1.2.

3.2.11
stationary EES system
EES system that, once installed and placed into service, is not intended to be moved from one place to another

[SOURCE: IEC 60601-1:2005 and IEC 60601-1:2005/AMD1:2, 3.118, modified – definition has been particularized for the EES system and the note to entry has been deleted.]

3.2.12
movable EES system
EES system mounted on a vehicle capable of being moved on a railway or road, to be connected to primary POC at sites where temporary basis connection is planned

Note 1 to entry: The *portable* (IEV 151-16-47) concept cannot be applied to a grid connection installation like the EES system, therefore a movable EES system cannot include such situation.

[SOURCE: IEC 60050-811:2017, 811-36-05, modified – definition has been particularized for the EES system and the note to entry has been added.]

3.2.13
hybrid EES system
EES system with an accumulation subsystem composed of different storage technologies

EXAMPLE Hybrid EESS that incorporates *batteries* (IEV 482-01-04) and *supercapacitors* (IEV 114-03-03).

3.3 EES systems long-duration application

3.3.1
long-duration application
energy-intensive application
EES system application with long charge and discharge phases at variable powers

Note 1 to entry: Reactive power exchange with the *electric power system* (IEV 601-01-01) can be present along with the *active power* (IEV 131-11-42) exchange.

Note 2 to entry: Long-duration application are generally not very demanding in terms of step response performances but there are cases where high step response performances are required.

[SOURCE: IEC 60050-631:2023, 631-01-06 modified – alternate term deleted and part of the definition moved in the note 2.]

3.3.2
active power flow control
<for an EES system> long-duration application of an EES system used to compensate partially or totally the *active power* (IEV 131-11-42) flow in a determined subsection of an *electric power system* (IEV 601-01-01)

EXAMPLE Load shaving or levelling or shifting are active power flow controls.

Note 1 to entry: Active power flow control can require hours of continuous EES system charge or discharge.

3.3.3
feeder current control
<for an EES system> long-duration application of an EES system used to maintain the current in a certain grid branch within defined limits through *active power* (IEV 131-11-42) exchange with the *electric power network* (IEV 601-01-02)

EXAMPLE Congestion relief is a feeder current control.

Note 1 to entry: Theoretically, feeder current control can also be realised by *reactive power* (IEV 131-11-44) exchange. Because of typical distribution feeder characteristics such as the resistance-to-reactance ratio (R/X), the *active power* (IEV 131-11-42) exchange is practically more effective in most cases.

3.3.4
renewable energy resources generation firming
long duration application of an EES system used to decouple non-dispatchable renewable energy source generation and electricity consumption for a specific time by absorbing energy in periods with a surplus of energy generation and by provision of energy in periods with a surplus of electricity consumption

3.3.5
peak shaving
limitation of the power consumption from the power grid to a maximum value by providing the power exceeding the maximum value from other active power sources

3.3.6
fluctuation reduction of consumption
reduction of power oscillation of power consumption at the grid connection point by absorbing the active power of the grid by EES systems at low power demand phases and by feeding in additional active power by EES systems at high power demand phases

3.4 EES systems short-duration application

3.4.1
short-duration application
power intensive application
EES system application demanding in terms of step response performances and with frequent charge and discharge phase transitions or with *reactive power* (IEV 131-11-44) exchange with the *electric power system* (IEV 601-01-01)

[SOURCE: IEC 60050-631:2023, 631-01-07, modified – alternate term deleted and minor editorial modifications in the definition.]

3.4.2
grid frequency control
power frequency control
frequency regulation
short-duration application of an EES system used for the stabilization of the *electric power system* (IEV 601-01-01) frequency through *active power* (IEV 131-11-42) exchange

Note 1 to entry: The balancing of temporal variations of grid frequency occurs typically over time periods of the order of seconds to minutes.

3.4.3
nodal voltage control
voltage support
short-duration application of an EES system used for the stabilization of the voltage at the primary POC or neighbouring nodes through active or reactive power exchange

Note 1 to entry: *Reactive power* (IEV 131-11-44) is generally used in HV and MV grids, and *active power* (IEV 131-11-42) in LV grids, depending on the resistance-to-reactance (R/X) ratio of the relevant lines.

3.4.4
power quality event mitigation
short-duration application of an EES system used to mitigate conducted disturbances in *electric power systems* (IEV 601-01-01) such as short-duration supply interruptions, voltage dips, voltage swells, voltage and currents harmonics, transient overvoltages, rapid voltage changes, through active or reactive power exchange with the *electric power network* (IEV 601-01-02)

Note 1 to entry: The mitigation of *power quality* (IEV 617-01-05) events, except supply interruptions and harmonics, occurs typically over time periods of the order of milliseconds to seconds. Power quality events are described in IEC TS 62749.

Note 2 to entry: In power quality event mitigation, active and reactive power exchange can be intended also in relation to harmonics and interharmonics.

Note 3 to entry: Theoretically a supply interruption can have a long duration, but practically most of the supply interruptions have a duration ≤ 1 min. The mitigation of events with duration > 1 min is defined as outage mitigation.

3.4.5
reactive power flow control
short-duration application of an EES system used to compensate partially or totally the *reactive power* (IEV 131-11-44) flow in a determined subsection of an *electric power system* (IEV 601-01-01)

EXAMPLE Power factor adjustment of loads, normally obtained by capacitor banks, is a reactive power flow control.

3.4.6
fast frequency response
fast frequency control
short-duration application of an EES system used to contain the frequency change of the *electric power system* (IEV 601-01-01) during sudden failures and reduce the amplitude of the transient frequency difference, through the capability to actively support grid frequency by discharging or charging very fast (e.g. within 100 ms)

3.4.7
fluctuation reduction
power smoothing
short-duration application of an EES system used to reduce power oscillation fluctuation of power generation units (especially renewable energy sources) with regard to their *points of connection* (4.1.3) absorbing active power at times of high generation output and by feeding in additional active power at times of low generation output

3.4.8
power oscillation damping
POD
short-duration application of an EES system used to restrain power oscillations in one or more connected AC *electric power networks* (IEV 601-01-02) by active or reactive power flow control

Note 1 to entry: Low frequency power oscillation range is typically from 0,1 Hz to 2 Hz.

3.4.9
primary frequency control
primary frequency regulation
short-duration application of an EES system used to stabilize the *electric power system* (IEV 601-01-01) frequency on a steady state value through the capability to respond to a measured frequency deviation

Note 1 to entry: Primary frequency control is a proportional control (also known as droop control) which is usually activated by an autonomous primary control system with a dead time of less than a few seconds from the measured frequency deviation and fully activated according a given ramp rate.

3.4.10
secondary frequency control
secondary frequency regulation
short-duration application of an EES system used to restore system frequency to the nominal system frequency usually following a primary frequency regulation

Note 1 to entry: Generally, the secondary frequency control is manually or automatically activated between 30 s up to 15 min from the primary frequency regulation completion.

3.4.11
voltage sag mitigation
voltage dip mitigation
short-duration application of an EES system used to compensate the voltage drop during a specified time and for a predefined maximum power, when a voltage sag occurred at the primary POC

Note 1 to entry: The power quality events are described in IEC TS 62749. Voltage dip and voltage sag are frequently used as synonyms.

3.5 EES systems hybrid and emergency application

3.5.1
hybrid application
EES system application demanding in terms of step response performances but with frequent and long discharge phases at variable discharge power

Note 1 to entry: Emergency use cases, for example with uninterruptible power supplies, are included in this application class.

[SOURCE: IEC 60050-631:2023, 631-01-08, modified – in the term "and emergency" has been removed", "generally" has been removed from the definition, and the note 1 has been added.]

3.5.2
outage mitigation
back-up power
hybrid application of an EES system used to provide electrical energy during a specified time and for a pre-defined maximum power, during which the main electrical energy supply is not available at the primary POC

Note 1 to entry: In theory a supply interruption can have a long duration; in practice the majority of them have a duration ≤ 1 min. The mitigation of events with a duration ≤ 1 min is defined as *power quality* (IEV 617-01-05) event mitigation. Power quality events are described in IEC TS 62749.

3.5.3
back-up power supply
provision of power to all internal loads connected to user side equipment during a specified time period without relying on an external power source in the event of electrical grid outage

3.5.4
black start capability
capability of the EES system to start the *electric power system* (IEV 601-01-01) only with internal energy resources

3.5.5
emergency load
set of devices and equipment that should be operated during an electrical grid outage

3.5.6
emergency support
provision of power to emergency loads within a specified time and duration without relying on an external power source in the event of electrical grid outage

4 Terms and definitions for EES systems specification

4.1 Fundamental concepts for EES systems specification

4.1.1
continuous operating conditions, pl
operating conditions within which the EES system is designed to operate within specified performance limits

Note 1 to entry: The continuous operating conditions are usually defined at least as follows, but other conditions can depend on the technology:

a. the voltage and frequency at POCs are within the continuous operating ranges;

b. the EES system is fully available;

c. the EES system is within the reference environmental conditions.