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Electrical energy storage (EES) systems - Part 3-1: Planning and performance assessment of electrical energy storage systems - General specification

Systèmes de stockage de l'énergie électrique (EES) - Partie 3-1: Planification et évaluation des performances des systèmes de stockage de l'énergie électrique - Spécifications générales

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Electrical energy storage (EES) systems - Part 3-1: Planning and performance assessment of electrical energy storage systems - General specification

FOREWORD

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IEC 62933-3-1 has been prepared by IEC technical committee TC 120: Electrical Energy Storage (EES) systems. It is an International Standard.

This first edition cancels and replaces the first edition of IEC TS 62933-3-1 published in 2018. This edition constitutes a technical revision.

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

a) improvements regarding design and sizing of an EES system;
b) adding "EES system decommissioning";
c) adding "Inspection and test aspects";
d) adding "Feasibility and permission";

e) adding "Basic planned activities for feasibility study";

f) adding "Aspects considered with regard to EES system decommissioning".

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

Draft	Report on voting
120/426/FDIS	120/442/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– withdrawn, or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.

INTRODUCTION

IEC 62933-2-1 should be used as a reference when selecting testing items and their corresponding evaluation methods as well as principal parameters. The principal terms used in this document are defined in IEC 62933-1. Environmental issues are covered by IEC TS 62933-4-1. The personnel safety issues are covered by IEC 62933-5-1.

1 Scope

This part of IEC 62933 is applicable to EES systems designed for grid-connected indoor or outdoor installation and operation. This document considers:

– necessary functions and capabilities of EES systems;
– sizing and design of EES system;
– operation of EES system;
– test items and performance assessment methods for EES systems;
– requirements for monitoring and acquisition of EES system operating parameters;
– exchange of system information and control capabilities required;
– maintenance of EES system.

Stakeholders of this document comprise personnel involved with EES systems, which include:

– planners of electric power systems and EES systems;
– owners of EES systems;
– operators of electric power systems and EES systems;
– constructors;
– suppliers of EES systems and its equipment;
– aggregators.

Use-case-specific technical documentation, including planning and installation specific tasks such as system design, monitoring, measurement, tests, operation and maintenance, are very important and can be found throughout this document.

NOTE This document has been written for AC grids, however parts can also apply to DC grids.

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 60721-1, *Classification of environmental conditions - Part 1: Environmental parameters and their severities*

IEC 61850 (all parts), *Communication networks and systems for power utility automation*

IEC 62351 (all parts), *Power systems management and associated information exchange - Data and communications security*

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

IEC 62933-1:2024, *Electrical energy storage (EES) systems - Part 1: Vocabulary*

IEC 62933-2-1:2017, *Electrical energy storage (EES) systems - Part 2-1: Unit parameters and testing methods - General specification*

IEC 62933-5-1, *Electrical energy storage (EES) systems - Part 5-1: Safety considerations for grid-integrated EES systems - General specification*

ISO/IEC 27000, *Information technology - Security techniques - Information security management systems - Overview and vocabulary*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62933-1 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

3.2 Symbols

$\cos\varphi$	power factor
E	energy
E_C	energy storage capacity
η	efficiency
f	frequency
I	current
P	active power
Q	reactive power
S	apparent power
SOE	state of energy
SOH	state of health
U	voltage

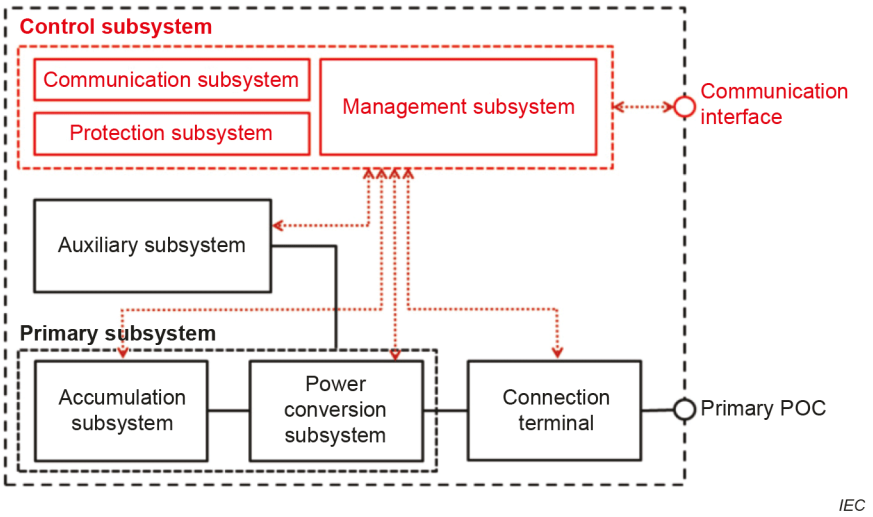
4 General information about EES systems

4.1 Main functional aspects

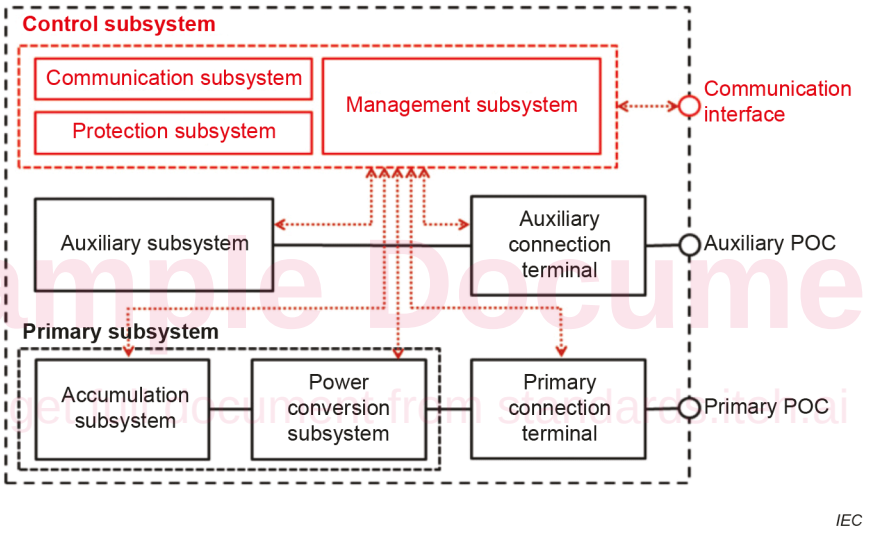
According to IEC 62933-1 an EES system is a grid-connected installation with defined electrical boundaries, comprising at least one electrical energy storage unit, which extracts electrical energy from an electric power system, stores this energy internally in some manner and injects electrical energy into an electric power system. An EES system can include civil engineering works, energy conversion equipment and related ancillary equipment. The EES system is controlled and coordinated to provide services to the electric power system operators or to the electric power system users.

4.2 Architecture of an EES system

The typical architecture of an EES system, which internally feeds the auxiliary subsystem, is given in Figure 1 a).



a) EES system without auxiliary POC



b) EES system with auxiliary POC

Figure 1 – Typical architectures of EES systems

If the auxiliary subsystem is fed from another feeder, the optional architecture of an EES system is shown in Figure 1 b).

4.3 Subsystem specifications

4.3.1 General

To meet the requirements of the entire EES system, it is necessary to break down the system requirements to the requirements of the subsystems. The requirements for the subsystems shall be formulated in a general and technology-independent manner but requirements arising from the subsystems (e.g. regarding safety or maintenance), which are technology dependent, shall also be considered.

Constraints and deratings regarding power rating, available energy, ambient conditions and other internal or external aspects shall also be considered for all subsystems.

The requirements of the subsystems of an EES system are described in 4.3.2 to 4.3.5. In general, for all subsystems, the contribution to the overall system efficiency, for example roundtrip efficiency, shall be indicated.

4.3.2 Accumulation subsystem

The energy storage capacity of the accumulation subsystem of the EES system has to be evaluated in an appropriate way with respect to the energy form (e.g. mechanical or electrochemical). The energy storage capacity of the accumulation subsystem directly influences the rated input and output energy capacity at the primary point of connection (POC), i.e. it influences the active input and output power values at the primary POC as well as the duration the active input and output power can be applied at the primary POC.

A widely-used approach for classifying EES systems is the determination according to the form of energy used in the accumulation subsystem. A classification example of EES systems according to energy form in the accumulation subsystem is shown in Figure 2.

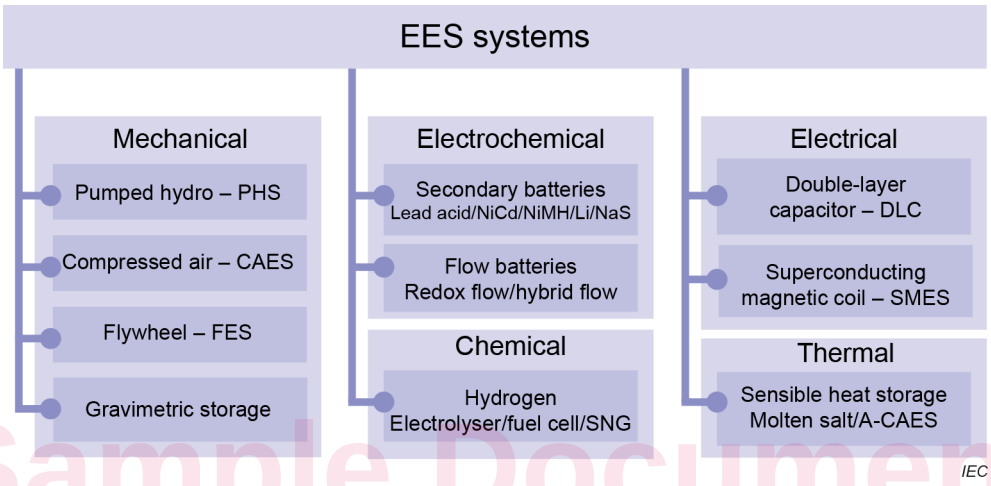


Figure 2 – Example of classification of EES systems according to energy form

Accumulation subsystems shall meet performance specifications such as energy storage capacity as well as input and output power throughout their service life. This includes their service life under use conditions such as operation patterns (see IEC 62933-1:2024, Figure 1), environmental conditions, maintenance cycle, etc.

a) General requirements

The following information shall be provided irrespective of the technology applied:

For each accumulation subsystem the energy storage capacity and the maximum charge and discharge power shall be considered because this has a direct influence on the overall EES system.

Also, the present energy content is important for the EES system. A forecast method, i.e. how the resulting energy content after charging or discharging with a certain power for a certain time can be estimated, shall be given.

Typical service life values (possibly differentiated into cyclical and calendrical ageing) shall be specified. Information on the energy and power density shall also be given to be able to make a comparison with other accumulation subsystems if necessary.

Information about necessary service and maintenance cycles shall be given. The auxiliary power demand of the accumulation subsystem shall also be provided, if applicable. Furthermore, efficiency parameters of the accumulation subsystem shall be provided:

– charging efficiency of the accumulation subsystem;

– discharging efficiency of the accumulation subsystem;
– self-discharge or "energy storage efficiency" of the accumulation subsystem.

b) Specific requirements

If there are requirements that are specific to the accumulation technology applied, then these requirements shall be provided. For example, if a reduction in charging or discharging power is necessary in certain operating areas, this shall be indicated. Special regulations can apply for the accumulation subsystem (for example, for disposal). If that is case this shall be specified, as it could be relevant for planning. If galvanic isolation between POC and accumulation subsystem is provided, this shall also be given.

4.3.3 Power conversion subsystem

The power conversion subsystem converts the power of the accumulation subsystem into electrical power at the POC, typically AC output power during discharge of the accumulation subsystem and can convert grid AC input power to suitable power for charging the accumulation subsystem. This conversion can be performed by electrical and/or mechanical systems. The power conversion subsystem influences the apparent power characteristic of the EES system. The power conversion subsystem can also influence the power quality at the POC.

Generally, the power conversion subsystem is connected to the accumulation subsystem and to the (primary) connection terminal. For planning issues, the power conversion subsystem shall also include all power transfer apparatus between the connection terminal and the accumulation subsystem, for example any kind of power transformer, sine filter or switching elements.

a) General requirements

The following information shall be provided irrespective of the technology applied:

The auxiliary power demand of the power conversion subsystem shall be given, if applicable. If galvanic isolation between the POC and accumulation subsystem is provided, this shall also be stated. Furthermore, efficiency parameters of the conversion subsystem shall be provided:

– charging efficiency of the power conversion subsystem, for example efficiency at rated input power;
– discharging efficiency of the power conversion subsystem, for example efficiency at rated output power.

b) Specific requirements

If there are requirements that are specific to the power conversion technology applied, then these requirements shall be provided. For example, if the voltage, frequency and power factor of an electrical power grid are set by the power conversion subsystem using grid forming technology, specific requirements shall be given. The conversion type (AC/DC, AC/AC, pump/generator, etc.) as well as the operational ranges, for example the DC voltage or frequency range, shall be given.

4.3.4 Auxiliary subsystem

All necessary equipment intended to perform the EES system’s auxiliary functions shall be considered, for example, HVAC (heating, ventilation and air conditioning system) and fire suppression system.