SLOVENSKI STANDARD
oSIST prEN IEC 62933-5-1:2023

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Električne naprave za shranjevanje energije (EES) - 5-1. del: Varnostni vidiki za sisteme EES, vključene v omrežje - Splošna specifikacija

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

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120/325/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER:	
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120/298/CD, 120/309A/CC	

IEC TC 120 : ELECTRICAL ENERGY STORAGE (EES) SYSTEMS	
SECRETARIAT: Japan	SECRETARY: Mr Hideki HAYASHI
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 21,SC 21A,TC 64	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☒ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE:

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

PROPOSED STABILITY DATE: 2029

NOTE FROM TC/SC OFFICERS:

This CDV has been reflected the observations of 120/309A/CC by MT8 experts.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRICAL ENERGY STORAGE (EES) SYSTEMS –

Part 5-1: Safety considerations for grid-integrated EES systems – General specification

FOREWORD

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IEC TS 62933-5-1, which is a standard, has been prepared by IEC technical committee TC 120: Electrical Energy Storage (EES) Systems.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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. Additional criteria specific to electrochemical type electrical energy storage (EES) systems are in IEC 62933-5-2.

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.

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

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INTRODUCTION

Many governments' plans for how electricity will be generated and managed in the future have been determined. Such current plans cannot be implemented without long-term storage with capacities in the multi-MWh range.

There are a number of types of storage technologies that have emerged. Examples of these technologies are pumped hydro storage (PHS), electrochemical batteries, flywheel storage systems and hydrogen and synthetic natural gas (SNG). Pumped hydro storage has been widely used in terms of the total amount of stored energy. A flywheel is a model of kinetic energy storage with a high power density, excellent cycle stability and long life. While some flywheels are intended for short term operation, others can operate over longer periods of time of up to a few hours. Batteries require development primarily to decrease cost, and for some technologies to increase energy density as well. Hydrogen and synthetic natural gas (SNG) added to natural gas are likely to be essential elements of future electric grids because of their energy storage duration and capacity. Hydrogen and SNG should be further researched and developed across a broad front, including physical facilities, interactions with existing uses of gas for supply and distribution network, optimal chemical processes, safety, reliability and efficiency. The IEC White Paper “Electrical Energy Storage” (2011-12) may provide further background information concerning EES systems.

The IEC expects to keep pace, as in other areas in the past, with the need for international consensus standards for the safety of new storage technologies. It encourages regulators to anticipate the requirement to guarantee the safety of these technologies, and to contribute to shaping suitable international standards upon which harmonized regulations may be based.

For mature EES systems, various IEC standards exist, covering technical features, testing and system integration. For other technologies, there are only a few standards, covering special topics.

Up to now no general standard addressing safety for EESS integration into an electrical grid has been developed.

The rapid growth and the new technologies involved in electrical energy storage in the near future, as well as their installation by consumers will impose particular requirements for safety. At the same time, society and governments will need assurance of safety before the much-needed systems can be deployed.

This document stands as a decisive step towards the gradual alignment with specific technologies and applications concerning the safety of packaged or site-assembled grid-integrated EESS.

ELECTRICAL ENERGY STORAGE (EES) SYSTEMS –

Part 5-1: Safety considerations for grid-integrated EES systems – General specification

1 Scope

This part of IEC 62933 specifies safety considerations (e.g. hazards identification, risk assessment, risk mitigation) applicable to EES systems integrated with the electrical grid.

This provides criteria to enable the safe application and use of electrical energy storage systems of any type or size intended for grid-integrated applications.

This standard can be applied to all EESS technologies, but for requirements specific to electrochemical EES systems, additionally refer to IEC 62933-5-2.

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.

ASME B31.1, *ASME B31 Code for Pressure Piping, Section 1: Power Piping*

ASME B31.3, *ASME B31 Code for Pressure Piping, Section 3: Process piping*

IEC/ISO 31010*, Risk management – Risk assessment techniques*

IEC 60068-2-52*, Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60079-2:2014, *Explosive Atmospheres - Part 2: Equipment Protection by Pressurized Enclosures "p"*

IEC 60204-1, *Safety of Machinery – Part 1: General requirements*

IEC 60204-11, Safety of Machinery – Electrical equipment of machines – Part 11 Requirements for equipment for voltages above 1000 VAC or 1500 VDC and not exceeding 36kV

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-41:2017, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-4-43*, Low-voltage electrical installations – Part 4-43: Protection for safety – Protection against overcurrent*

IEC 60364-4-44*, Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60529*, Degrees of Protection Provided by Enclosures (IP Code)*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60730-1: *Automatic Electrical Controls - Part 1: General Requirements*

IEC 60730-2-9, *Automatic Electrical Controls - Part 2-9: Particular Requirements for Temperature Sensing Controls*

IEC 60947-5-1, *Low-Voltage Switchgear and Controlgear – Part 5-1: Control Circuit Devices and Switching Elements – Electromechanical Control Circuit Devices*

IEC 61000-1-2, *Electromagnetic compatibility (EMC) – Part 1-2: General – Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*.

IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential environments.*

IEC 61000-6-5, *Electromagnetic compatibility (EMC) – Part 6-5: Generic standards – Immunity for equipment used in power station and substation environment.*

IEC 61000-6-7, *Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61511 (all parts), *Functional safety – Safety instrumented systems for the process industry sector*

IEC 61936-1, *Power installations exceeding 1 kV AC and 1,5 kV DC – Part 1: AC*

IEC 61936-2, *Power installations exceeding 1 kV a.c. and 1,5 kV d.c. – Part 2: d.c.*

IEC 62061*, Safety of machinery – Functional safety of safety-related control systems*

IEC 62116:2014*, Utility interconnected photovoltaic inverters – Test procedure of islanding prevention measures*

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

IEC 62477-1:2022, *Safety requirements for power electronic converter systems and equipment – Part 1: General*

IEC 62477-2:2018, *Safety requirements for power electronic converter systems and equipment – Part 2: Power electronic converters from 1 000 V AC or 1 500 V DC up to 36 kV AC or 54 kV DC*

IEC 62933-1, *Electrical energy storage (EES) systems – Part 1: Terminology*

IEC 62933-5-2, *Electrical energy storage (EES) systems Part 5-2: Safety requirements for grid integrated EES systems - electrochemical based systems*

IEEE 1547.1, *Standard conformance test procedures for equipment interconnecting distributed energy resources with electric power systems and associated interfaces*

ISO 1182, *Reaction to fire tests for products – Non-combustibility test*

ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 12100, *Safety of machinery – General principles for design – Risk assessment and risk reduction*

ISO 12944, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems*

ISO 13849 (all parts), *Safety of machinery – safety-related parts of control systems*

ISO 15649, *Petroleum and natural gas industries — Piping*

3 Terms and definitions

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

3.1.1
commissioning
activities undertaken to prepare a system or product prior to demonstrating that it meets its specified requirements

[SOURCE: IEC 60050-821:2017, 821-12-09]

3.1.2
decommissioning
administrative and technical actions taken to allow the removal of some or all of the EESS regulatory controls from a facility

Note 1 to entry: These actions may include the processes of discharging ~~decontamination~~ and dismantling.

[SOURCE: IEC 60050-395: 2014, 395-08-28, modified - the term “regulatory controls” is replaced with “EESS” and the term “decontamination” with “discharging”]

3.2
electrical installation
assembly of electrical equipment which is used for the generation, transmission, conversion, distribution and/or use of electric energy

Note 1 to entry: The electrical installation includes energy sources such as batteries, capacitors and all other sources of stored electric energy.

[SOURCE: IEC 60050-651:2014, 651-26-01]

365

366 **3.3**
367 **energized,** adj.
368 **live,** adj.
369 at an electric potential different from that of earth at the worksite and which presents an electrical
370 hazard

371 Note 1 to entry: A part is energized when it is electrically connected to a source of electric energy. It can also be
372 energized when it is electrically charged and/or under the influence of an electric or magnetic field.

373 [SOURCE: IEC 60050-651:2014, 651-21-08]
374

375 **3.3.1**
376 **hazardous-live-part**

377 live part that, under certain conditions, can give a harmful electric shock

378 Note 1 to entry: A hazardous voltage can be present on the accessible surface of solid insulation. In such a case,
379 this surface is considered to be a hazardous-live-part.

380 [SOURCE: IEC 60050-195:2021, 195-06-05]

381
382 **3.4**
383 **harm**
384 physical injury or damage to persons, property, and livestock

385 [SOURCE: IEC 60050-903:2013, 903-01-01]

386 **3.5**
387 **hazard**
388 potential source of harm

389 Note 1 to entry: In English, the term “hazard” can be qualified in order to define the origin of the hazard or the nature
390 of the expected harm (e.g. “electric shock hazard”, “crushing hazard”, “cutting hazard”, “toxic hazard”, “fire hazard”,
391 “drowning hazard”).

392 Note 2 to entry: In French, the synonym “risque” is used together with a qualifier or a complement to define the origin
393 of the hazard or the nature of the expected harm (e.g. “risque de choc électrique”, “risque d'écrasement”, “risque de
394 coupure”, “risque toxique”, “risque d'incendie”, “risque de noyade”).

395 Note 3 to entry: In French, the term “risque” also denotes the combination of the probability of occurrence of harm
396 and the severity of that harm, in English “risk” (see 3.6).

397 [SOURCE: IEC 60050-903:2013, 903-01-02]

398 **3.6**
399 **risk**
400 combination of the probability of occurrence of harm and the severity of that harm
401
402 Note 1 to entry: In French, the term “risque” also denotes the potential source of harm, in English “hazard” (see 3.5).
403
404 [SOURCE: IEC 60050-903:2013, 903-01-07]

405

406 **3.6.1**
407 **tolerable risk**
408 risk which is accepted in a given context based on the current values of society

[SOURCE: IEC 60050-903:2013, 903-01-12]

3.7
risk and hazard analysis

3.7.1
failure mode
manner in which failure occurs

Note 1 to entry: A failure mode may be defined by the function lost or other state transition that occurred.

[SOURCE: IEC 60050-192:2015, 192-03-17]

3.7.2
failure modes and fault tree analysis
FMEA
qualitative method of analysis that involves the study of possible failure modes and faults in sub items, and their effects at various system and subsystem levels

[SOURCE: IEC 60050-192:2015, 192-11-05]

3.7.3
failure modes, effects and criticality analysis
FMECA
quantitative or qualitative method of analysis that involves failure modes and effects analysis together with a consideration of the probability of the failure mode occurrence and the severity of the effects

[SOURCE: IEC 60050-192:2015, 192-11-06]

3.7.4
fault tree analysis
FTA
deductive analysis using fault trees

[SOURCE: IEC 60050-192:2015, 192-11-08]

3.7.5
hazard and operability studies
HAZOP studies
structured and systematic technique for examining a defined system with the objective of identifying potential hazards in the system and identifying potential operability problems with the system and, in particular, identifying causes of operational disturbances and production deviations likely to lead to non-conforming products

Note 1 to entry: The hazards involved may include both those essentially relevant only to the immediate area of the system and those with a much wider sphere of influence, for example some environmental hazards

3.7.6
risk analysis
systematic use of available information to identify hazards and to estimate the risk

[SOURCE: IEC 60050-903:2013, 903-01-08]

3.7.7
risk assessment
overall process comprising a risk analysis and a risk evaluation

[SOURCE: IEC 60050-903:2013, 903-01-10]