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**Electrical energy storage (EES) systems –
Part 5-3: Safety requirements for grid-integrated EES systems – Performing
unplanned modification of electrochemical based system**

**Systèmes de stockage de l'énergie électrique (EES) –
Partie 5-3: Exigences de sécurité pour les systèmes EES intégrés dans un
réseau – Modification non programmée d'un système électrochimique**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL ENERGY STORAGE (EES) SYSTEMS –**Part 5-3: Safety requirements for grid-integrated EES systems –
Performing unplanned modification of electrochemical based system**

FOREWORD

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IEC 62933-5-3 has been prepared by IEC technical committee 120: Electrical Energy Storage (EES) Systems. It is an International Standard.

This International Standard is to be used in conjunction with IEC 62933-5-2:2020.

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

Draft	Report on voting
120/331/FDIS	120/335/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.

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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

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INTRODUCTION

The initial design or planning cannot cover all modifications that are made to a BESS over its lifetime. Unplanned modifications entail a careful evaluation of their potential impact on the safety of the BESS.

This document provides safety requirements, considerations and procedures when unplanned modifications of the BESS are carried out.

Appropriate attention is given to safety issues in the relative redesign, installation, commissioning, operation and maintenance phases during such modification activities of the BESS.

Unplanned modifications which are dealt with in this document are:

- changes in energy storage capacity;
- changes of chemistries, design and manufacturer of the accumulation subsystem;
- changes of a subsystem component using non-OEM parts;
- changes to the mode of operation;
- changes of the installation site;
- changes in an accumulation subsystem due to an installation of reused or repurposed batteries.

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ELECTRICAL ENERGY STORAGE (EES) SYSTEMS –

Part 5-3: Safety requirements for grid-integrated EES systems – Performing unplanned modification of electrochemical based system

1 Scope

This part of IEC 62933 applies to those instances when a BESS undergoes unplanned modifications. Such modifications can involve one or more of the following:

- changes in energy storage capacity;
- changes of chemistries, design and manufacturer of the accumulation subsystem;
- changes of a subsystem component using non-OEM parts,
- changes to the mode of operation,
- changes of the installation site, or
- changes in an accumulation subsystem due to an installation of reused or repurposed batteries.

Any such modification can impair the original state of safety of the BESS.

This document complements IEC 62933-5-2, which relates to the overall safety aspects of a BESS. The requirements covered by this document are applied in addition to the requirements in IEC 62933-5-2 in accordance with each situation.

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 62619:2022, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

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

IEC 62933-5-2:2020, *Electrical energy storage (EES) systems – Part 5-2: Safety requirements for grid-integrated EES systems – Electrochemical-based systems*

IEC 63330¹, *General requirements for repurposing of secondary batteries*

IEC 63338², *General guidance on reuse and repurposing of secondary cells and batteries*

¹ Under preparation. Stage at the time of publication: IEC AFDIS 63330:2023.

² Under preparation. Stage at the time of publication: IEC CDV 63338:2023.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

battery operating range

range of parameters to ensure the safe use of the accumulation subsystem

Note 1 to entry: Examples of parameters are voltage, current, temperature, SOC, SOE and so on.

3.2

critical stakeholder

stakeholder (IEV 904-01-10) related to the part or component whose modification, installation, or removal affects the safe operation of the BESS

3.3

unplanned modification

modification that has not been intended to be carried out or planned prior to the start of operation of the BESS

Note 1 to entry: IEC 62933-5-2:2020, 7.13.1, "Operation and maintenance" deals with a planned modification.

3.4

OEM part

part supplied to or by an original equipment manufacturer (OEM)

Note 1 to entry: OEM parts are generally used to manufacture new equipment and can also be purchased for maintenance and repair.

Note 2 to entry: A part that is not an OEM part is called "non-OEM part".

3.5

relocation

<of an EES system> moving of an installation physically from its current location which requires disconnecting from the initial point of connection (POC) and connecting it at new location to another POC

3.6

reused battery

battery that is used again in the same application as it was used for when commissioned the first time

3.7

repurposed battery

battery that is used again in a different application as it was used for when commissioned the first time

3.8

residual usable period

actual or estimated remaining length of service life

3.9 safety margin

<of an EES system> margin defined within the battery operating range considering the system application, environmental conditions and so on for safe operation of the BESS

3.10 safe-operating range

<of an EES system> range excluding the safety margin from the battery operating range

4 General requirements on performing unplanned modifications

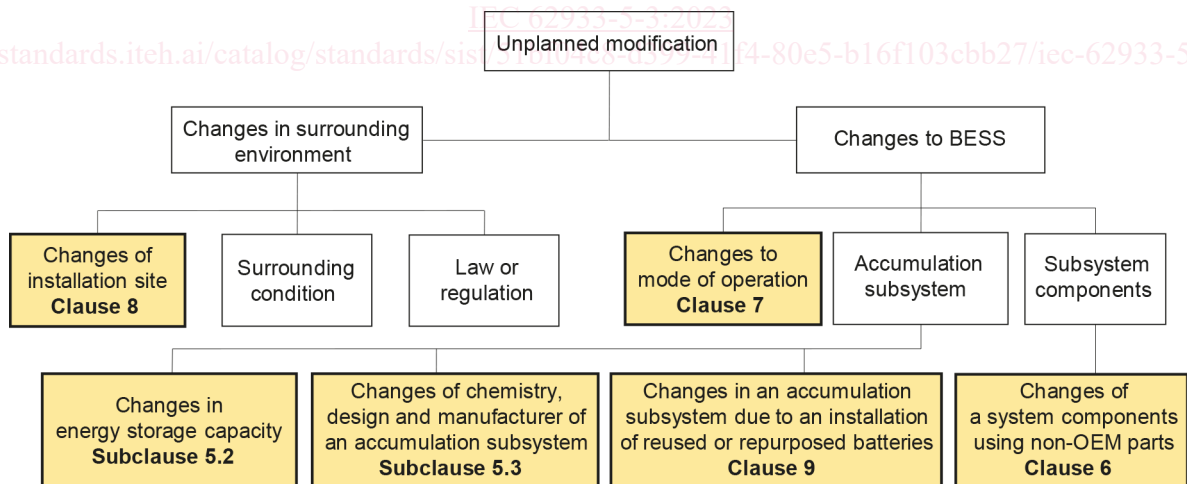
The BESS, including the batteries, can be exposed to the following changes in safety conditions during its operation:

- 1) changes due to changes in the surrounding environment,
- 2) changes due to unplanned modifications of the BESS,
- 3) changes due to ageing, and
- 4) changes due to modifications planned at the time of the initial design.

This document describes the safety measures that shall be taken for BESS in the event of items 1) and 2) above. The events of items 3) and 4) should be considered and addressed at the time of initial design of the BESS, which is under the scope of IEC 62933-5-2.

NOTE 1 The modifications that occur in the BESS can be at the component, subsystem or system level. While the primary focus of this document is on changes in safety and their evaluation at the system level, the process can also require evaluation at the component or subsystem level (e.g., interactions between subsystems).

Figure 1 shows the modifications that affect safety, which are made by the subdivision of changes in item 1) and item 2). This document deals with the modifications shown in the yellow boxes in Figure 1.



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Figure 1 – Major modifications and their classification

An unplanned modification of a BESS can result in conditions where multiple safety related conditions are potentially affected at the same instance.

In such an event, the impact on safety of the individual modifications is to be assessed and all the resulting risk mitigation actions are to be implemented. The detailed requirements of assessment or measures, etc., are described in Clause 5 to Clause 9 of this document.

A wide range of stakeholders are involved in the modification process. Examples of stakeholders are shown in Table 1. The requirements described in this document shall be met as appropriate in cooperation with the stakeholders.

NOTE 2 Responsibility for ensuring the BESS safety depends on each case and local regulations.

Table 1 – Examples of relevant stakeholders

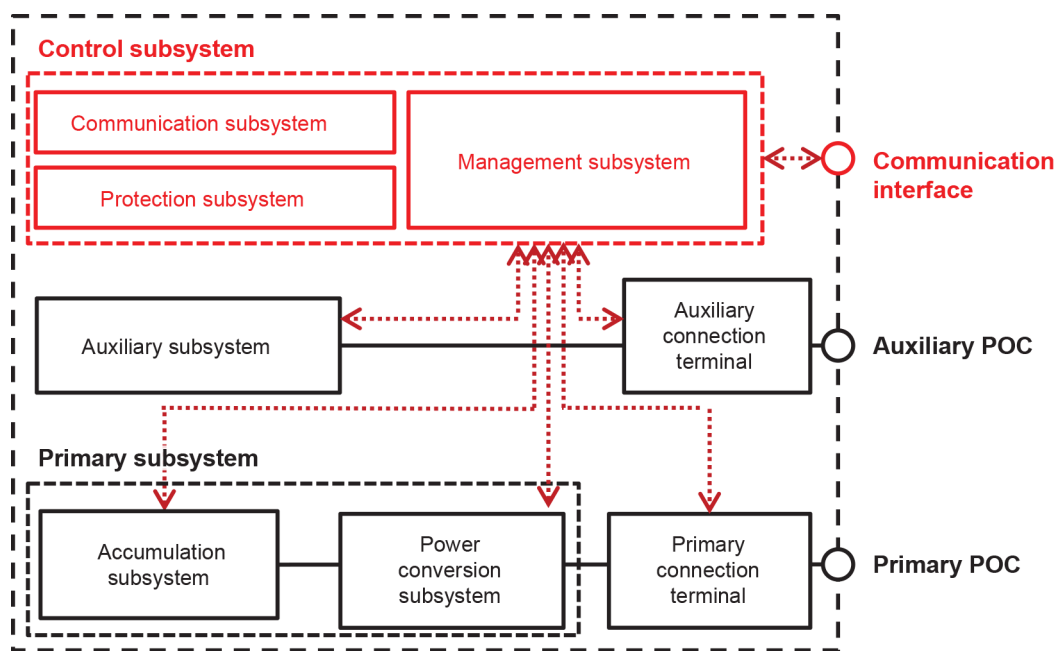
Type of stakeholders	Specific examples of stakeholders
Ownership	Owner
	User
Operation	Operator
	Service provider
Engineering, procurement and construction (EPC)	Project manager and administrator
	Overall system integrator
	Subsystem integrator
	Integrator performing modification *
Component	Component manufacturer
	Component vendor
	Additional component manufacturer *
	Additional component vendor *
Certification body	Certification authority of original parts
	Certification authority of additional parts *
Local	Local government
	Fire-fighting agency
NOTE The stakeholders with "*" marking can be involved in cases where there are modifications with additional parts (e.g. Clause 5, Clause 6 and Clause 9).	

5 Changes to an accumulation subsystem

5.1 General

The intention of Clause 5 is to describe safety requirements, considerations and processes to follow for situations where changes are made to an accumulation subsystem in a BESS.

Clause 5 describes the requirements when an accumulation subsystem (see Figure 2) undergoes unplanned modifications.



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NOTE "POC" means "point of connection".

Figure 2 – Example of BESS architecture

The unplanned modifications of the accumulation subsystem described in Clause 5 are:

- changes in energy storage capacity;
- changes of chemistry and design of an accumulation subsystem.

5.2 Changes in energy storage capacity

5.2.1 General

Subclause 5.2 specifies the safety requirements, considerations and processes for situations where the energy storage capacity of the electrochemical accumulation subsystem is changed.

The energy storage capacity of the BESS can be modified when batteries are removed due to their failures or added to meet a higher energy demand or a modified operating mode.

NOTE "Energy storage capacity of the BESS" means the total energy capacity of electrochemical accumulation subsystems.

Such changes modify the voltage versus time profile during discharge and charge and possibly bring the batteries to voltage, temperature and SOC values that were not originally planned.

This can mean that the existing safety measures become inadequate and the safety of the BESS can be impaired.

The possible negative consequences of capacity changes are:

- a) dielectric breakdowns and loss of the electrical insulation levels resulting in dangerous voltages on operator-accessible surfaces;
- b) electric shock risks arising from changes causing malfunction of protective measures and devices;
- c) increases of the fire load level necessitating adjustment of firefighting measures and their capabilities;

- d) increases in the amount of thermal energy released by the accumulation subsystem to be handled by the heat, ventilation and air conditioning (HVAC);
- e) increases of the quantity of chemicals to be handled in an emergency;
- f) voltage and capacity imbalances between aged and new batteries causing accelerated ageing;
- g) management/control subsystem errors when the batteries that are added to increase capacity have different operating conditions and are installed in the same management/control section as existing batteries;
- h) increases in the occurrence of operator and maintenance personnel mistakes;
- i) decreases in available space for operator and maintenance engineer to do work properly.

The risk assessment shall be done in accordance with IEC 62933-5-2 in the first stage of planning and before any other work, and the necessary corrective measures concerning hardware and software shall be undertaken in accordance with the assessment results.

5.2.2 Safety requirements in the redesign phase

In order to maintain the safety level of the BESS, the following actions are required in the redesign phase:

- The safety level of the capacity-modified BESS shall not be less than that present prior to the modification.
- If the change of capacity results in a change of the BESS category as defined in IEC 62933-5-2:2020, Table 1, then the appropriate safety measures shall be implemented in the modified BESS.
- The suppliers of the existing BESS shall approve in writing the capacity modification.
- The general safety protection systems (e.g., deflagration protection, ventilation subsystem) of the BESS shall be updated to reflect the capacity modification.

In cases where it is difficult to modify or add safety measures to an existing BESS due to space or other restrictions, the following reinforcement of risk reduction measures shall be undertaken:

Inherently safe design: Set the conditions and parameters sufficiently to ensure the safety of the accumulation subsystem. For example, narrow the SOC range or the operation temperature range, etc.

Guards and protection: If the prevention of fire propagation at the accumulation subsystem level cannot be ensured, add a protection measure against fire propagation (e.g. fireproof boards or walls) to prevent fire propagation at the cubicle, building, or container levels.

Information for use: Use on-site labels to distinguish between the added accumulation subsystem and existing one. Set warning devices (audible alerts, visible signals) and remote alerts to distinguish between the added one and the existing one so that prompt and accurate responses can be made in the event of trouble.

5.2.3 Safety requirements in the installation and commissioning phase

The modification of the capacity of the BESS entails access, by installation personnel, to components carrying dangerous voltages or containing toxic compounds.

In order to maintain the safety of the BESS and workers, the following actions are required in the installation and commissioning phase:

- The necessary safety measures for the workers shall be defined prior to the commencement of work.
- All activities shall be assessed in advance for the risk due to live electrical parts that cannot be adequately protected, and shall comply with live electrical work standards.