



Edition 1.0 2025-05

# TECHNICAL SPECIFICATION

Electric Energy Storage (EES) Systems – Part 2-3: Unit parameters and testing methods – Performance assessment test during site operation



# THIS PUBLICATION IS COPYRIGHT PROTECTED Copyright © 2025 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat 3, rue de Varembé CH-1211 Geneva 20 Switzerland Tel.: +41 22 919 02 11 info@iec.ch www.iec.ch

## About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

## About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

## IEC publications search -

#### webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

## IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

## IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

## IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

## Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

Warning! Make sure that you obtained this publication from an authorized distributor.

# CONTENTS

FC	REWO	RD	.5
1	Scop	e	.7
2	Norm	ative references	.7
3	Term	s, definitions, abbreviated terms and symbols	.7
		Terms and definitions	
		Abbreviated terms	
		Symbols	
4		ral requirements of the operational performance testing	
		Purpose	
		Stakeholders	
		Principles of assessment intervals and data sampling	
		Data requirements	
		Operational performance testing methods	
5		ational performance testing items	
	5.1	General	12
	-	General operational performance testing items	
	5.2.1	Actual energy storage capacity	
	5.2.2		
	5.2.3		
	5.2.4		
	5.3	Energy-related operational performance testing items	
	5.3.1	Available hours of an EES system	
	5.3.2	Equivalent operation factor of an EES system	12
	5.4	Efficiency-related operational performance testing items	13
	5.4.1	Comprehensive efficiency of an EES system	13
	5.4.2	Energy loss rate of an EES system	13
	5.4.3	Duty cycle roundtrip efficiency	13
	5.5	Reliability-related operational performance testing items	13
	5.5.1	Planned outage factor of an EES system	13
	5.5.2	Unplanned outage factor of an EES system	13
	5.5.3	Availability factor of an EES system	13
	5.6	Grid-connected operational performance testing items	13
	5.6.1	Impact of grid conditions on the performance	
	5.6.2	Active power control test	
	5.6.3	Reactive power control test	
	5.6.4	Primary frequency regulation test	
	5.6.5	Secondary frequency regulation test	
	5.6.6	Grid-connected operation power quality test	
		Operational performance testing items in specific applications	
	5.7.1	Classification and summary of EES system applications	
	5.7.2	Frequency regulation mode	
	5.7.3	Fluctuation reduction mode	
	5.7.4	Reactive power voltage control mode	
	5.7.5	Power quality management mode	
	5.7.6	Peak shaving/peak shifting mode	
	5.7.7	5	
	5.7.8	Islanded grid mode	10

	5.7.9	Backup power mode	16	
6	Opera	ational performance testing methods of EES systems	16	
	6.1	General	16	
	6.2	General operational performance testing method	17	
	6.2.1	Genaral	17	
	6.2.2	Actual energy storage capacity	18	
	6.2.3	Input and output power rating	18	
	6.2.4	Roundtrip efficiency	18	
	6.2.5			
	6.3	Energy-related operational performance testing method	20	
	6.3.1	General	20	
	6.3.2	Available hours of an EES system	20	
	6.3.3	Equivalent operation factor of an EES system	21	
	6.4	Efficiency-related operational performance testing method	22	
	6.4.1	General	22	
	6.4.2	Comprehensive efficiency of an EES system	22	
	6.4.3	Energy loss rate of an EES system	23	
	6.4.4	Duty cycle roundtrip efficiency	24	
	6.5	Reliability-related operational performance testing method	25	
	6.5.1	General	25	
	6.5.2	Planned outage factor of an EES system	25	
	6.5.3			
	6.5.4	Availability factor of an EES system	25	
	6.6	Grid-connected operational performance testing method	26	
	6.6.1	General	26	
	6.6.2	Active power control test	26	
	6.6.3	Reactive power control test	28	
	6.6.4	Primary frequency control	30	
	6.6.5	Secondary frequency control	32	
	6.6.6	Grid-connected operation power quality test	32	
	6.7	Operational performance testing method in specific application	32	
	6.7.1	Genaral		
	6.7.2	Frequency regulation mode	33	
	6.7.3	Fluctuation reduction mode	33	
	6.7.4	Reactive power voltage control mode		
	6.7.5	Power quality management mode		
	6.7.6	Peak shaving/peak shifting mode		
	6.7.7	5		
	6.7.8	Islanded grid mode		
	6.7.9	Backup power mode	36	
		informative) performance indicators of primary concern to major	07	
stakeholders				
Bi	Bibliography			
Fi	- 1 Ann	Example of classification of EES systems	10	

Figure 1 – Example of classification of EES systems	10
Figure 2 – The prioritization and test procedures of the test methods	11
Figure 3 – EES system architecture with one POC type	17
Figure 4 – EES system architecture with two POC types	17

# – 4 – IEC TS 62933-2-3:2025 © IEC 2025

Figure 5 – Example of active power test curve in charging state of an EES system	27
Figure 6 – Active power control response time of an EES system	28

Table 1 – Example of typical and not exclusive applications classification	15
Table 2 – Qualified frequency range of islanded mode	36
Table A.1 – Performance indicators of primary concern to major stakeholders	37

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

# **ELECTRICAL ENERGY STORAGE (EES) SYSTEMS -**

# Part 2-3: Unit parameters and testing methods – Performance assessment tests during site operation

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject deall with may participate in this preparatory work. International, governmental and non-governmental organizations for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references maycited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62933-2-3 has been prepared by IEC technical committee TC 120: Electrical Energy Storage (EES) systems. It is a Technical Specification.

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

Draft	Report on voting
120/392/DTS	120/413/RVDTS

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 Specification 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.

# ELECTRICAL ENERGY STORAGE (EES) SYSTEMS -

# Part 2-3: Unit parameters and testing methods – Performance assessment tests during site operation

## 1 Scope

This part of IEC 62933 specifies the unit parameters and testing methods that validate and assess the performance of EES systems after commissioning.

## 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 61000-4-30, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods* 

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