IEC TR 62933-4-200

Edition 1.0 2024-04

TECHNICAL REPORT

colour inside

Electrical Energy Storage (EES) Systems – Part 4-200: Guidance on environmental issues – Greenhouse gas (GHG) emission assessment by electrical energy storage (EES) systems

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CONTENTS

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ELECTRICAL ENERGY STORAGE (EES) SYSTEMS –

Part 4-200: Guidance on environmental issues – Greenhouse gas (GHG) emissions assessment by electrical energy storage (EES) systems

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IEC TR 62933-4-200 has been prepared by IEC technical committee 120: Electrical Energy Storage (EES) systems. It is a Technical Report.

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

Draft	Report on voting
120/351/DTR	120/364/RVDTR

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 Report 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- withdrawn, or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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ELECTRICAL ENERGY STORAGE (EES) SYSTEMS –

Part 4-200: Guidance on environmental issues – Greenhouse gas (GHG) emissions assessment by electrical energy storage (EES) systems

1 Scope

This part of IEC 62933, which is a Technical Report, describes aspects on reduction of greenhouse gas (GHG) emissions associated with electrical energy storage systems (EES systems), and presents current practices, research activities and related researches in each country.

This document is intended to be used by those involved in design, development and use of EES systems, the grids and the renewable energy sources in the grids, where various applications, including but not limited to long term ones (peak shaving, load levelling, backup power, etc.) and short term ones (frequency regulation, renewable energy stabilization, etc.), are considered.

The current version of this document is structured in as follows: Clause 4 describes the general concept of GHG emissions reduction, Clause 5 describes the current practices, and Clause 6 describes academic approaches.

2 Normative references

There are no normative references in this document.

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 energy storage system
BESS
electrical energy storage system with accumulation subsystem based on batteries with secondary cells

Note 1 to entry: The battery energy storage system includes a flow battery energy system (IEC 62932-1:2020, 3.1.15).

Note 2 to entry: Batteries are defined in IEC 60050-482:2004, 482-01-04, and secondary cells are defined in IEC 60050-482:2004, 482-01-03.

3.2
grid
particular installations, substations, lines or cables for the transmission and distribution of electricity

Note 1 to entry: The boundaries of the different parts of this network are defined by appropriate criteria, such as geographical situation, ownership, voltage, etc.

Note 2 to entry: The term grid is used as in 3.2 unless otherwise defined.

[SOURCE: IEC 60050-601:1985, 601-01-02, modified – in the term, “grid” has replaced “electric power network” and note 2 has been added.]

3.3
greenhouse gas reduction
GHG reduction
calculated decrease of GHG emissions between a baseline scenario and the project

4 General

The promotion of renewable energy (RE) is a global agenda, and in particular the mass introduction of solar and wind power is in progress. IEC White Paper “Electrical Energy Storage [1][1]” states that “Electrical Energy Storage, EES, is one of the key technologies in the areas covered by the IEC. EES techniques have shown unique capabilities in coping with some critical characteristics of electricity, for example hourly variations in demand and price. In the near future EES will become indispensable in emerging IEC-relevant markets in the use of more renewable energy, to achieve CO_2 reduction and for Smart Grids”. Thus, this document tries to address GHG (e.g. CO_2 and others) emissions reduction associated with EES systems. For example, EES systems contribute to the replacement of a number of thermal power generators in the context of long and short duration application and grid frequency control where rapid response and controllability as the major characteristics of EES systems are utilised (see Figure 1).

- As renewable energy increases, some fossil fuel power plants should be shut down, resulting in a decrease in the balancing power force.
- Frequency fluctuation becomes bigger issue because of insufficient balancing power force.
- Fast response EES systems could be a solution.

[1] Numbers in square brackets refer to the Bibliography.

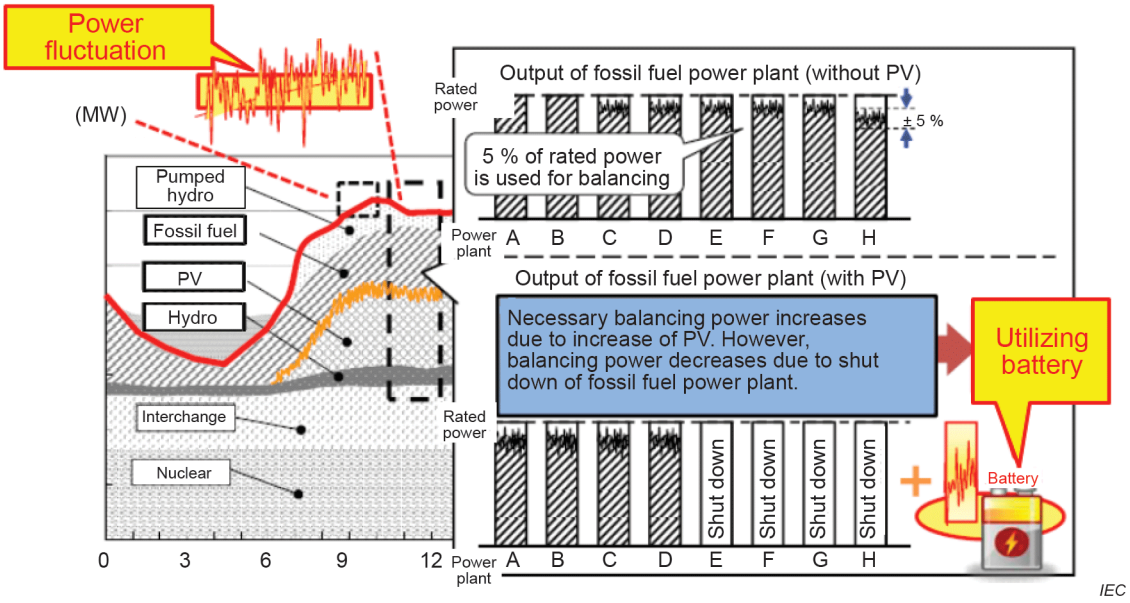

Figure 1 – Actions to take against frequency fluctuation (short duration)

As more RE has been promoted, electrical energy storage (EES) systems have become indispensable. [2] The recent key usages of EES systems, for example battery-based energy storage systems (BESS), aimed at the GHG reduction are listed below:

NOTE The terms used in the list below and in Clause 5 and Clause 6 are sometimes different from the definitions in IEC 62933-1, but the terms used in the cited references are used "as is" to avoid mistranscriptions in their inclusion in this document.

- Mobile battery loaded in electric vehicles (EVs) [3]
  The widespread use of battery-powered EVs potentially contributes to the reduction of GHG emissions in the transportation sector. In addition, EVs' contribution to GHG reductions depends on the power supply configuration when charging the EVs.
- Store surplus energy of photovoltaic (PV) power [4] [5]
  If abundant PV will be installed in a grid, its surplus energy is suppressed to maintain stability of the grid and to make effective use of excess energy. Without BESS, such curtailment means waste of energy. The BESS provides storage function of energy and addresses duck curve issue (shifting the daytime energy to night time).
- Regulation/reserve for frequency control [6] [7] [13]
  In the grid, regulation/reserve is used to balance supply/demand and maintain frequency. This regulation/reserve is supplied by a fossil fuel power plant and a pumped storage hydro power plant. BESS also has a potential to provide the regulation/reserve. EES systems can potentially replace the balancing and system services of a fossil fuel power plant and thereby enable reduction of GHG emissions in combination with RE sources.
- Load levelling (LL) and load shift [8] [9]
  One of the potential usages of BESS is load levelling (LL) and load shift. Peak demand has traditionally been served by fossil fuel power plant, while BESS has a potential to assist the peak demand. BESS contributes to reduction of the fossil fuel power plant (and thus contributes to GHG emissions reduction).
- Smart grid with BESS in physically isolated grids, for example in islands [4] [10] [11]
  100 % RE power supply is possible on isolated islands by using BESS.
- Miscellaneous assist by BESS to promote RE [12] [13]
  GHG can be reduced by BESS, since BESS enhances the introduction of RE. Distributed BESS improves the congestion of grids and compensates the imbalance caused by RE. Dynamic stability can be improved by a virtual synchronous generator which is realized by a BESS with a special power conversion system (PCS). Emergency power supply by diesel generators can be replaced by the BESS.

The tasks that are desired to be solved are:

– cost down of the BESS;
– development of more effective operation of the BESS which realizes the multiple purpose use;
– GHG emissions throughout the lifecycle of BESS.

In the following clauses, this document describes the current practices in Clause 5 and the academic approaches in Clause 6.

As for the current practices of Clause 5, it was not possible to confirm the practices aimed at contributing directly to GHG emissions reduction at the time of drafting this document. Therefore, the practices are picked up that are supposed to contribute to GHG emissions reductions.

As for Clause 6, this field is at the academic stage because it is necessary to estimate GHG emissions reduction by combining the following various conditions:

- current power supply configuration;
- power supply configuration assuming replacement by EES systems;
- usage of EVs and EES systems;
- type of energy storage technology.

In Clause 6, representative examples of papers or articles that are expected to contribute to GHG emissions reductions are given.

Furthermore, the life cycle of EES systems, as shown in IEC TS 62933-4-1, consists of four stages: acquisition, installation, operation and maintenance, and disassembly. The product state is out of the scope of the IEC TS 62933-4 series since it is before acquisition or after disassembly. The current version of IEC TS 62933-4-1 describes the “operation and maintenance” stage of the EES systems. For the “acquisition”, “installation” and “disassembly” stages, the current version of IEC TS 62933-4-1only describes the potential for GHG emissions as indicated below.

- Acquisition:
  GHG emissions occur when purchasing the products “battery”, “PCS”, and “auxiliary equipment” that make up the EES systems and transporting them to the location where the EES systems are installed. Acquisition requires communication and GHG emissions associated with those social activities. There is also GHG emissions from the transport sector in the transportation of the products that make up the EES systems.
- Installation:
  There are GHG emissions associated with the use of assembly equipment on site. There are GHG emissions associated with the use of test power sources on-site.
- Disassembly:
  There are GHG emissions associated with the use of disassembly equipment on site.

Furthermore, the environmental aspect is required to be described in IEC documents, as stated in IEC Guide 109 and ISO Guide 64.

For more information about GHG emissions/sinks inventory, there are various documents available. For example, there is one compiled by the United States Environmental Protection Agency. [14]

The information in Clause 5 and Clause 6 is obtained using the example presented in Annex A, which is considered useful for the further development of this document in a future edition.