भारतीय मानक

Indian Standard

IS 19095 (Part 1) : 2024
IEC 62932-1 : 2020

स्टेशनरी प्रयोग के लिए प्रवाह बैटरी ऊर्जा प्रणाली

भाग 1 शब्दावली एवं समान्य पहलू

Flow Battery Energy Systems for Stationary Applications

Part 1 Terminology and General Aspects

ICS 29.220.99

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December 2024 **Price Group 7**

Secondary Cells and Batteries Sectional Committee, ETD 11

NATIONAL FOREWORD

This Indian Standard (Part 1) which is identical to IEC 62932-1 : 2020 ‘Flow battery energy systems for stationary applications — Part 1: Terminology and general aspects’ issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of Secondary Cells and Batteries Sectional Committee and approval of the Electrotechnical Division Council.

The text of the IEC standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words ‘International Standard’ appears referring to this standard, they should be read as ‘Indian Standard’; and

b) Comma (,) has been used as a decimal marker, while in Indian Standards the current practice is to use a point (.) as the decimal marker.

Only English language text has been retained while adopting it in this Indian Standard, and as such the page numbers given here are not the same as in the International Standard.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

CONTENTS

Indian Standard

FLOW BATTERY ENERGY SYSTEMS FOR STATIONARY APPLICATIONS

PART 1 TERMINOLOGY AND GENERAL ASPECTS

1 Scope

This part of IEC 62932 relates to flow battery energy systems (FBES) used in electrical energy storage (EES) applications and provides the main terminology and general aspects of this technology, including terms necessary for the definition of unit parameters, test methods, safety and environmental issues.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1
ambient temperature
environmental temperature around a flow battery energy system

3.1.2
auxiliary energy
energy consumed by all the auxiliary equipment and components of a flow battery and of a flow battery energy system

Note 1 to entry: The equipment and components include, but are not limited to, battery management system, battery support system, fluid circulation system.

3.1.3
battery management system
BMS
electronic system associated with a flow battery energy system which monitors and/or manages its state, calculates secondary data, reports that data and/or controls its environment to influence the flow battery energy system’s performance and/or service life

Note 1 to entry: The function of the battery management system can be fully or partially assigned to the battery pack and/or to equipment that uses flow battery energy store systems.

[SOURCE: IEC 61427-2:2015, 3.8, modified – admitted terms "battery management unit" and "BMU" omitted, "battery" replaced by "flow battery energy system", Notes 2 to 4 deleted.]

3.1.4
battery support system
BSS
auxiliary units, such as heat exchanger, ventilation system, safety system, and inert gas system, used in an FBES, and which are not stacks, or part of the fluid circulation system, power conversion system, or battery management system

Note 1 to entry: The battery support system is controlled by the battery management system.

3.1.5
charge
charging
<of a battery> operation during which a secondary cell or battery is supplied with electric energy from an external circuit which results in chemical changes within the cell and thus the storage of energy as chemical energy

Note 1 to entry: A charge operation is defined by its maximum voltage, current, duration and other conditions as specified by the manufacturer.

[SOURCE: IEC 60050-482:2004, 482-05-27, modified – term "charging of a battery" separated into "charge" and "charging" with "of a battery" as the domain, and addition of the note.]

3.1.6
cold standby
standby state requiring warm up before a demand to operate can be met

Note 1 to entry: A cold standby state may apply to redundant or stand-alone items.

Note 2 to entry: In this context "warm up" includes meeting any conditions required to operate as required (e.g. achieving the required temperature, speed, pressure).

[SOURCE: IEC 60050-192:2015, 192-02-11, modified – "state" omitted from the term, and the domain, "of an item", deleted.]

3.1.7
discharge
discharging
<of a battery> operation during which a secondary battery supplies electric energy to an external circuit which results in chemical changes within the cell and the release of energy as electrical energy

Note 1 to entry: A discharge operation is defined by its maximum voltage, current, duration and other conditions as specified by the manufacturer.

3.1.8
emergency shutdown
rapid regulated shutdown of the flow battery energy system triggered by a protection system or by manual intervention

[SOURCE: IEC 60050-415:1999, 415-01-11, modified – the word "regulated" added, and "wind turbine" replaced by "flow battery energy system".]

3.1.9
emergency stop
function which is intended to avert arising or reduce existing hazards to persons, damage to machinery or to work in progress and be initiated by a single action

[SOURCE: ISO 13850:2015, 3.1, modified – "(E-Stop)" omitted from the term, second preferred term "emergency stop function" omitted, layout modified.]

3.1.10
energy efficiency
useful energy output at primary POC divided by the required energy input by the FBES/FBS including all parasitic and auxiliary energy needed to run the system and evaluated during FBES/FBS operation with the same final state of charge as the initial state of charge

Note 1 to entry: The energy efficiency for FBES includes necessary conversion loss of power conversion system (PCS), auxiliary enrgy required for fluid circulation system, BMS and BSS.

Note 2 to entry: Efficiency is generally expressed in percentage.

[SOURCE: IEC 62933-1:2018, 4.12, modified – "EES" replaced by "FBES/FBS", Note 1 to entry replaced.]

3.1.11
energy storage fluid
fluid that contains active materials and flows through the battery cell, consisting of liquid, suspension or gas

3.1.12
end of charge
limit conditions specified by the manufacturer at which a charge is (to be) terminated

3.1.13
end of discharge
limit conditions specified by the manufacturer at which a discharge is (to be) terminated

3.1.14
flow cell
secondary cell characterized by the spatial separation of the electrodes and the movement of the energy storage fluids

Note 1 to entry: Flow battery cell includes the hybrid flow cell.

3.1.15
flow battery energy system
FBES
system to store energy consisting of FBS(s) and power conversion system(s)

3.1.16
flow battery system
FBS
two or more flow cells electrically connected including all components for use in an electrochemical energy storage system such as battery management system, battery support system and fluid circulation system

3.1.17
fluid system
components and equipment destined to store and circulate energy storage fluids, such as tanks, pipes, manual valves, electrical valves, pumps and sensors

3.1.18
forced ventilation
movement of air and its replacement with fresh air by mechanical means

[SOURCE: IEC 62282-3-300:2012, 3.9]

3.1.19
fully charged
condition (status) where, after a charge process as specified by the manufacturer, the flow battery energy system reaches the end of charge point

3.1.20
fully discharged
condition (status) where, after a discharge process as specified by the manufacturer, the flow battery energy system reaches the end of discharge point

3.1.21
gas release
emission of gas from the flow battery energy system to the environment

3.1.22
grid-connected state
condition in which the flow battery energy system is connected to the point of connection

3.1.23
ground fault
occurrence of an accidental or an unplanned conductive path between a live conductor on the fluid system of the battery and the earth

Note 1 to entry: A conductive path can pass through faulty insulation, liquid films, structures (e.g. poles, scaffoldings, cranes, ladders), or vegetation (e.g. trees, bushes).

3.1.24
hot standby
standby state providing for immediate operation upon demand

Note 1 to entry: A hot standby state may apply to redundant or stand-alone items.

Note 2 to entry: In some applications, an item in a hot standby state is considered to be operating.

[SOURCE: IEC 60050-192:2015, 192-02-12, modified – "state" omitted from the term, and the domain, "of an item", deleted.]

3.1.25
hybrid flow battery
hybrid flow cell
flow battery or flow cell in which one of the active materials is, depending on the state of charge, a solid material deposited on one of the electrode surfaces

3.1.26
input power
electrical power supplied to the FBES during charge and standby

3.1.27
insulation resistance
resistance under specified conditions between two conductive elements separated by insulating materials

[SOURCE: IEC 60050-151:2001, 151-15-43]

3.1.28
interlock
circuit linking mechanical, electrical or other devices, for example through auxiliary contacts, intended to make the operation of a piece of apparatus dependent on the condition or position of one or more others

[SOURCE: IEC 60050-811:2017, 811-25-13, modified – "circuit" omitted from the term.]

3.1.29
fluid leakage
unplanned escape of fluids from a cell or from an FBS

Note 1 to entry: Concentrating on leakage of energy storage fluids is incomplete as there is also leakage of fluid which is considered in the "safety" standard text.

3.1.30
maximum ambient temperature
highest ambient temperature at which the battery is operable and should perform according to specified requirements

3.1.31
maximum discharge energy
largest energy declared by the manufacturer that an FBS/FBES can provide under specified discharge operating conditions

Note 1 to entry: The maximum discharge energy is normally expressed in watt hour (Wh).

Note 2 to entry: The maximum discharge energy of an FBES is customarily measured at the point of connection (POC) to account for the auxiliary energy consumption.

3.1.32
maximum input power
highest level of power in watt that can be supplied to the FBES and at which it is operable and performs according to specified conditions

Note 1 to entry: This level is specified by the manufacturer.

3.1.33
maximum output power
highest level of power in watt that can be supplied by the FBES and at which it is operable and performs according to specified conditions

Note 1 to entry: This level is specified by the manufacturer.

3.1.34
minimum ambient temperature
lowest ambient temperature at which the battery is operable and should perform according to specified requirements

3.1.35
natural ventilation
movement of air and its replacement with fresh air due to the effects of wind and/or temperature gradients

[SOURCE: IEC 60050-426:2008, 426-03-07]

3.1.36
negative terminal
accessible conductive part provided for the connection of an external electric circuit to the negative electrode of the cell

[SOURCE: IEC 60050-482:2004, 482-02-24]

3.1.37
non-operating state
state of not performing any required function

Note 1 to entry: The adjective "non-operating" designates an item in a non-operating state.

[SOURCE: IEC 60050-192:2015, 192-02-06]

3.1.38
on-state
state of a flow battery energy system when it is actively delivering or absorbing energy

3.1.39
operating state
state of performing as required or ready to perform

Note 1 to entry: The adjective "operating" designates an item in an operating state.

Note 2 to entry: In some applications, an item in an idle state is considered to be operating.

[SOURCE: IEC 60050-192:2015, 192-02-04, modified – The domain "<of an item>" omitted and the words "or ready to perform" added to the definition.]

3.1.40
operational coordination
activity or status where all the different elements of a complex activity such as PCS, BMS and BSS, are brought into a harmonious and efficient relationship

3.1.41
output power
electrical power supplied by the flow battery energy system during discharge

3.1.42
overcharge
continued charging of a fully charged FBS

[SOURCE: IEC 60050-482:2004, 482-05-44, modified – "secondary cell or battery" replaced with "FBS" and note omitted.]

3.1.43
point of connection
POC
reference point in the electric power system where the FBES is connected to the grid or to the final application point

[SOURCE: IEC 60050-617:2009, 617-040-1, modified – abbreviated term "POC" added, "user's electrical facility" replaced by "FBES", and "to the grid or to the final application point" added to the definition.]

3.1.44
point of measurement
POM
physical location in the (FBES) circuit where the energy delivered to or from the battery and the energy consumed by the BMS/BSS is to be reproducibly measured/recorded

Note 1 to entry: This location is specified by the manufacturer and may be indicated in contractual documents.

3.1.45
positive terminal
accessible conductive part provided for the connection of an external electric circuit to the positive electrode of the cell

[SOURCE: IEC 60050-482:2004, 482-02-25]

3.1.46
rated energy
manufacturer declared value of the energy content of the FBES system when discharged under specified (rated) conditions and measured at the primary POC

Note 1 to entry: (J) is the base unit, other units may be chosen for convenience as well (kWh, MWh).

3.1.47
rated input power
manufacturer declared value of input power for a specific set of operating conditions of the FBS/FBES

Note 1 to entry: The rated input power is expressed in watts (W).

3.1.48
rated maximum power
manufactuer declared highest power level that the FBS/FBES can accept or deliver

3.1.49
rated output power
manufacturer declared value of output power for a specific set of operating conditions of the FBS/FBES

3.1.50
routine test
conformity test made on each individual item during or after manufacture

[SOURCE: IEC 60050-151:2001, 151-16-17]

3.1.51
sampling test
test on a sample

[SOURCE: IEC 60050-151:2001, 151-16-20]

3.1.52
sensor
<of a measurement element> device which detects or measures a physical property and records, indicates or responds to it

3.1.53
service life
duration from the time of the FBES system commissioning test to the end of service life

Note 1 to entry: The term "commissioning test" is defined in IEC 60050-411:1996, 411-53-06.

3.1.54
short-circuit current
maximum current which should be delivered by a flow battery system or flow battery energy system into an external circuit with zero electric resistance, or an external circuit which depresses the cell or battery voltage to approximately zero volt

Note 1 to entry: Zero electric resistance is a hypothetical condition and in practice the short-circuit current is the peak current following in a circuit of very low resistance compared to the internal resistance of the battery.

[SOURCE: IEC 60050-482:2004, 482-03-26, modified – "(related to cells or batteries)" omitted from term, and "cell or battery" replaced by "flow battery system or flow battery energy system" in the definition.]

3.1.55
site requirement
prerequisite for the operation of the battery in conditions as specified by the manufacturer

3.1.56
stack
<of an FBS> group of flow cells, assembled in a contiguous form and usually connected electrically in series

Note 1 to entry: In theory, stacks can also be formed by connecting cells in parallel. But due to minimum voltage requirements, the cells are usually connected in series.

3.1.57
standby state
state of a flow battery energy system when it is fully functional but not actively delivering or absorbing energy

3.1.58
stopped state
operating state in which the FBES is in grid-disconnected state and the accumulation subsystem is not connected with the power conversion subsystem

Note 1 to entry: In this state the auxiliary subsystem is energized.

[SOURCE: IEC 62933-1:2018, 6.1.8, modified – "EES system" replaced with "FBES" and Note 1 to entry replaced.]

3.1.59
tank
<of an FBS> large receptacle or storage chamber for energy storage fluid

3.1.60
type test
conformity test made on one or more items representative of the production

3.2 Abbreviated terms

BMS battery management system
BSS battery support system
EES electrical energy storage
FBES flow battery energy system
FBS flow battery system
PCS power conversion system
POC point of connection
POM point of measurement

4 Descriptive overview of the flow battery

4.1 Diagram of a flow battery system (FBS)

Figure 1 shows an example schema of a flow battery system (FBS).

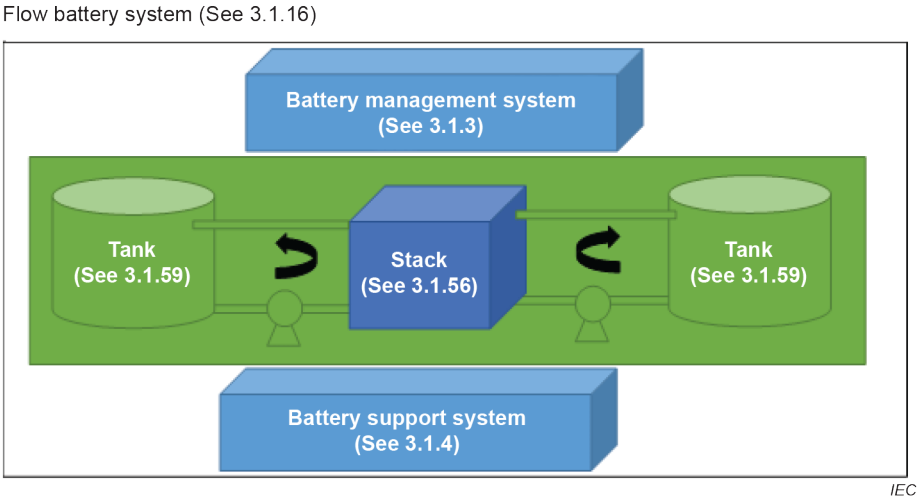


Figure 1 – Flow battery system (FBS)

4.2 Component descriptions and the boundaries

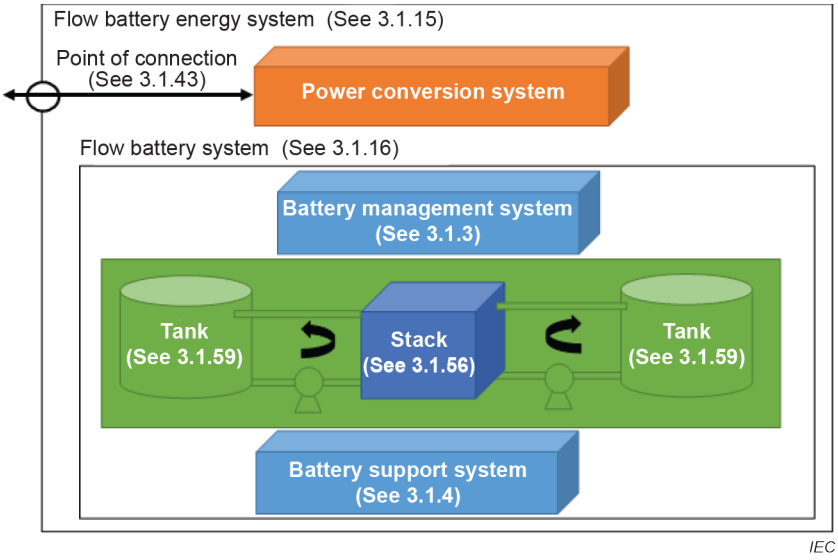
A flow battery system consists of four main parts:

- Stack(s) (see 3.1.56)
- Fluid system (see 3.1.17)
- Battery support system (see 3.1.4)
- Battery management system (see 3.1.3).

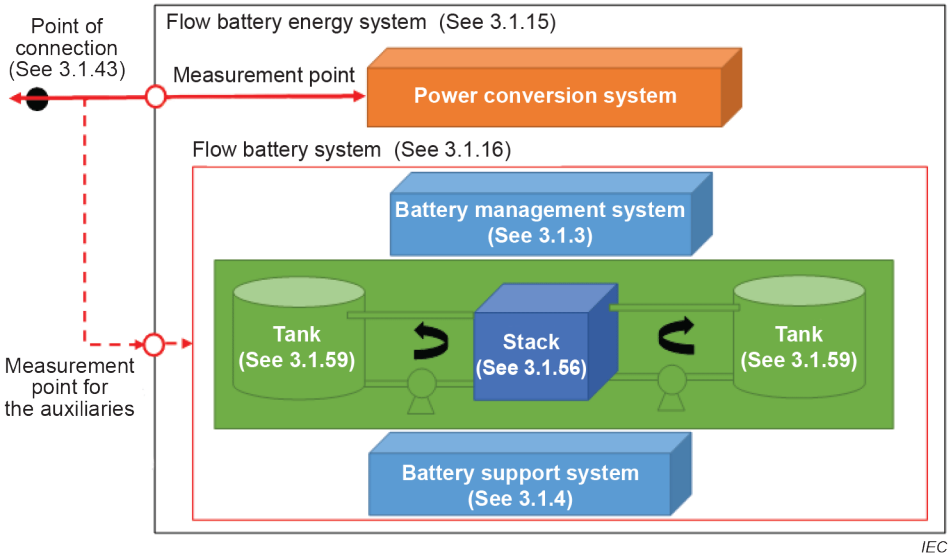
NOTE See also Annex A and Annex B.

4.3 Diagram of a flow battery energy system (FBES)

Figure 2 shows an example diagram of a flow battery energy system (FBES).



a) Flow battery energy system (FBES) in case of one POC



b) Flow battery energy system (FBES) in case of two POC

Figure 2 – Flow battery energy system (FBES)

4.4 Component descriptions and the boundaries of FBES

A flow battery energy system consists of a flow battery system and a power conversion system. The complete system is connected to the final application at the point of connection.

Annex A
(informative)

Components of the flow battery energy system

A.1 General

This annex gives the non-exhaustive list of the components of a flow battery energy system.

A.2 Stacks – Revised description

Stacks are made up of cells. A cell may consist of the following components:

- current collector
- bipolar plate
- electrode
- membrane.

A.3 Fluid system

A fluid system may consist of the following components:

- pump
- tank
- piping
- valves
- sensors
- energy storage fluids
- heat exchanger
- filters.

Annex B
(informative)

Types of chemistries

This annex gives the most conventional chemistries and associated fluid sytems' layout for the different types of flow battery systems.

Table B.1 – Example chemistries of flow batteries

One-phase (liquid solution)	Two phases (gas/liquid solutiuon)
V/V	H/Br
Cr/Fe	H/Cl
	H/Fe
	H/V

Table B.2 – Example chemistries of hybrid flow batteries

Two phases
Zn/Ni
Zn/Br
Zn/Cl
Fe/Fe
Pb/Pb
Cu/Cu

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This Indian Standard has been developed from Doc No.: ETD 11 (26097).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Published by BIS, New Delhi