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Flow battery energy systems for stationary applications – Part 2-2: Safety requirements

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CONTENTS

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FLOW BATTERY ENERGY SYSTEMS FOR STATIONARY APPLICATIONS –

Part 2-2: Safety requirements

FOREWORD

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International Standard IEC 62932-2-2 has been prepared by IEC technical committee 21: Secondary cells and batteries, in collaboration with IEC technical committee 105: Fuel cell technologies.

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

FDIS	Report on voting
21/1029/FDIS	21/1035/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

A list of all parts in the IEC 62932 series, published under the general title *Flow battery energy systems for stationary applications*, 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 "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- withdrawn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.

INTRODUCTION

A flow battery system (FBS) can be utilized in a flow battery energy system (FBES). Such an FBES can consist of:

– a flow battery system,
– a power conversion system,
– other equipment and surroundings.

The FBES is connected to the external power input/output via a point of connection (POC).

This document covers the domain of the FBES, as shown in Figure 1. Energy to the auxiliary systems such as the battery management system (BMS), the battery support system (BSS), and the power conversion system (PCS) may be supplied by one of the following:

a) direct connection to the external power source;
b) the internal power source of the FBES or FBS itself.

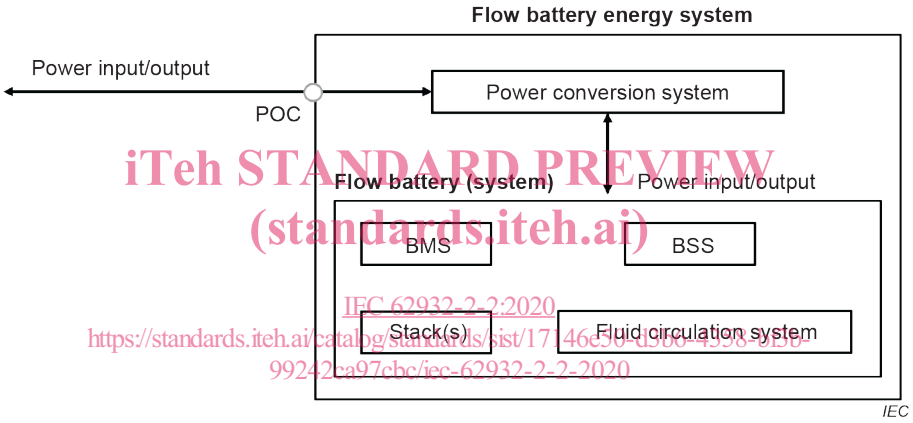

Figure 1 – Flow battery energy system

FLOW BATTERY ENERGY SYSTEMS FOR STATIONARY APPLICATIONS –

Part 2-2: Safety requirements

1 Scope

This part of IEC 62932 applies to flow battery systems for stationary applications and their installations with a maximum voltage not exceeding 1 500 V DC in compliance with IEC 62932-1.

This document defines the requirements and test methods for risk reduction and protection measures against significant hazards relevant to flow battery systems, to persons, property and the environment, or to a combination of them.

This document is applicable to stationary flow battery systems intended for indoor and outdoor commercial and industrial use in non-hazardous (unclassified) areas.

This document covers significant hazards, hazardous situations and events, with the exception of those associated with natural disaster, relevant to flow battery systems, when they are used as intended and under the conditions foreseen by the manufacturer including reasonably foreseeable misuse thereof.

The requirements described in this document are not intended to constrain innovations. When considering fluids, materials, designs or constructions not specifically dealt with in this document, these alternatives are evaluated as to their ability to yield levels of safety equivalent to those specified in this document.

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 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*

IEC 60364-4-41, *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 60364-6, *Low voltage electrical installations – Part 6: Verification*

IEC 61936-1, *Power installations exceeding 1 kV a.c. – Part 1: Common rules*

IEC 62485-2:2010, *Safety requirements for secondary batteries and battery installations – Part 2: Stationary batteries*

IEC 62932-1, *Flow battery energy systems for stationary applications – Part 1: Terminology and general aspects*

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

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62932-1 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

3.2 Abbreviated terms

BMS battery management system
BSS battery support system
EES electrical energy storage
FBES flow battery energy system
FBS flow battery system
FMEA failure mode and effects analysis
FTA fault tree analysis
GHS global harmonized system
HAZOP hazard and operability study
MSDS material safety data sheet
PCS power conversion system
POC point of connection
SDS safety data sheet
UPS uninterruptible power system

4 Procedure of the risk analysis

A written risk analysis shall be performed on an FBES to ensure that:

a) all reasonably foreseeable hazards and hazardous events, including reasonably foreseeable misuse throughout the anticipated lifetime, have been identified;

b) the risk for each of these hazards has been estimated from the combination of its probability of occurrence and of its foreseeable severity;

c) the two factors which determine each one of the estimated risks (probability and severity) have been eliminated or reduced to a level not exceeding the acceptable risk level as far as reasonably possible according to the following principles in the order given:

   – eliminate hazards or reduce risks by inherent design measures,

   – take necessary protective measures in relation to risks that cannot be reduced by inherent design measures,

   – inform intended users and where appropriate other persons of the residual risks, indicate whether any particular training is required and specify any need to use personal protective equipment.

For example, failure mode and effects analysis (FMEA), fault tree analysis (FTA) methods, hazard and operability study (HAZOP), and/or the following International Standards shall be used as guidance:

- IEC 60812;
- IEC 61025.

5 Safety requirements and protective measures

5.1 General

Each secondary battery has a different structure and therefore only the features critical or specific to the flow battery shall be taken into consideration. The flow battery energy system as shown in Figure 1 differs from other secondary batteries, in that a system for circulating the electrolyte is present. The fluid circulating system consists of tanks, pumps, piping, sensors and some safety-relevant devices.

From a chemical safety point of view, since fluid is contained in tanks, pipes and stacks, the sealing is an important factor. There is also the possibility of hazardous gases being present, requiring that appropriate countermeasures be implemented.

Clause 5 specifies the safety requirements and protective measures in consideration of the above-mentioned aspects.

5.2 Risk information

The manufacturer shall provide the user with risk information based on the risk analysis to describe hazards and the appropriate measures taken or to be taken for mitigation purposes.

The information shall include a safety data sheet (SDS).

The information can be provided in the form of a user manual. See the recommended structure for user manual in Annex A.

5.3 Electrical hazards

5.3.1 Electrical shock

The FBS is an electrical energy storage device and contains hazardous live parts of DC and/or AC voltage which can cause a risk of electrical shock. Electrolyte is to be considered as carrying dangerous voltages.

Batteries are sources of dangerous voltages and energy (current flow) also when they are not connected to an external power circuit. In flow batteries the amount of residual energy is, when no electrolyte circulates, limited to the charge stored in the electrolyte remaining in the stack itself. In all cases protective measures according to IEC 60364-4-41 shall be implemented.

5.3.2 Short-circuits

The electrical energy stored in an FBS can be released in an inadvertent and uncontrolled manner due to short-circuiting the terminals. Because of its considerable level of energy and subsequent high current, the heat generated can melt metal, produce sparks, cause explosion, or vaporize fluid.

To avoid short-circuits, protective devices such as insulation shrouds, fuses and circuit breakers shall be installed in a way that a short-circuit does not occur under any foreseeable conditions. For the type of conductor arrangement of unprotected sections, IEC 60364-4-43 shall be taken into consideration.

For protective measures, the FBS shall mitigate a short-circuit fault which occurs outside stacks by:

– stopping the supply of energy and fluids to the flow battery cells;
– stopping PCS and opening circuit breaker(s); and,
– interrupting the short-circuit current path by using fuses between stacks.