International Association of Oil & Gas Producers

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Supplementary Specification to IEC TS 62933-3-1 for Battery Energy Storage Systems (BESS)

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
0.1	January 2025	Issued for Public Review

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

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Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

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Introduction

The purpose of the IOGP S-753 specification documents is to define a minimum common set of requirements for the procurement of battery energy storage systems (BESSs) in accordance with IEC TS 62933-3-1, Edition 1.0 2018-08 Electrical energy storage (EES) systems – Part 3-1: Planning and performance assessment of electrical energy storage systems – General specification, for application in the petroleum and natural gas industries.

The IOGP S-753 specification documents follow a common structure (as shown below) comprising a specification, also known as a technical requirements specification (TRS), a procurement data sheet (PDS), an information requirements specification (IRS) and a quality requirements specification (QRS). These four specification documents, together with the purchase order, define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Requirements Specification (TRS)

This specification is to be applied in conjunction with the supporting PDS, IRS and QRS as follows.

IOGP S-753: Supplementary Specification to IEC TS 62933-3-1 for Battery Energy Storage Systems (BESS)

This specification defines technical requirements for the supply of the equipment and is written as an overlay to IEC TS 62933-3-1, following the IEC TS 62933-3-1 clause structure. Clauses from IEC TS 62933-3-1 not amended by this specification apply as written. Modifications to IEC TS 62933-3-1 defined in this specification are introduced by a description that includes the type of modification (i.e. *Add*, *Replace* or *Delete*) and the position of the modification within the clause.

NOTE Lists, notes, tables, figures, equations, examples and warnings are not counted as paragraphs.

IOGP S-753D: Procurement Data Sheet for Battery Energy Storage Systems (BESS) (IEC)

The PDS defines application-specific requirements. The PDS is applied during the procurement cycle only and does not replace the equipment data sheet. The PDS may also include fields for supplier-provided information required as part of the purchaser's technical evaluation. Additional purchaser-supplied documents may also be incorporated or referenced in the PDS to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-753L: Information Requirements for Battery Energy Storage Systems (BESS) (IEC)

The IRS defines information requirements for the scope of supply. The IRS includes information content, format, timing and purpose to be provided by the supplier, and may also define specific conditions that invoke the information requirements.

IOGP S-753Q: Quality Requirements for Battery Energy Storage Systems (BESS) (IEC)

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the PDS or in the purchase order.

The specification documents follow the editorial format of IEC TS 62933-3-1 and, where appropriate, the drafting principles and rules of ISO/IEC Directives Part 2.

The PDS and IRS are published as editable documents for the purchaser to specify application-specific requirements. The TRS and QRS are fixed documents.

The order of precedence of documents applicable to the supply of the equipment, with the highest authority listed first, shall be as follows:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser-defined requirements (e.g. PDS, IRS and QRS);

d) this specification;

e) IEC TS 62933-3-1.

1 Scope

Replace all instances of term "accumulation subsystem" in IEC TS 62933-3-1 with

accumulation subsystem (secondary batteries)

Add to section

This specification covers additional requirements for the design, safety, functionality, performance, testing, transport, storage and handling of the BESS.

Add to section

This specification also covers safety requirements for the BESS identified through a gap analysis between IEC TS 62933-5-2 and the following standards:

– AS 5139;

– DNV GL Handbook for Maritime and Offshore Battery Systems;

– DNV GL Rules for classification:2023, Part 6 Chapter 2;

– DNV-RP-00-43;

– NFPA 855;

– UL 9540.

2 Normative References

Add to first paragraph

The following documents are referred to in this specification, the PDS (IOGP S-753D) or the IRS (IOGP S-753L) in such a way that some or all of their content constitutes requirements of these specification documents.

Add to clause

IEC 60092 (all parts except 301, 302, 306, 307, 501, 502, 506 and 507), *Electrical installations in ships*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61000-2-4, *Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61000-6-5, *Electromagnetic compatibility (EMC) – Part 6-5: Generic standards – Immunity for equipment used in power station and substation environment*

IEC 61892 (all parts), *Mobile and fixed offshore units – Electrical installations*

IEC 62281, *Safety of primary and secondary lithium cells and batteries during transport*

IEC 62619, *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 62620, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for use in industrial applications*

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

IEC 63056, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries for use in electrical energy storage systems*

IEC 63462-1, *Maritime battery system – Part 1: Secondary lithium cells and batteries – Safety requirements*

IEEE 1584, *IEEE Guide for Performing Arc-Flash Hazard Calculations*

IOGP S-620, *Supplementary Specification to IEC 62271-200 High-voltage switchgear and controlgear*

IOGP S-720, *Supplementary Specification to IEC 60076-1 Transformers*

ISO 1496-1, *Series 1 freight containers — Specification and testing — Part 1: General cargo containers for general purposes*

NFPA 70E, *Standard for Electrical Safety in the Workplace*

NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*

UL 9540A, *STANDARD FOR SAFETY Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems*

UN 38.3, *Transportation Testing for Lithium Batteries and Cells*

UN 3536, *LITHIUM BATTERIES INSTALLED IN CARGO TRANSPORT UNIT lithium ion batteries or lithium metal batteries*

Replace Clause 3 title with

3 Terms, definitions, abbreviated terms and symbols

Add new subclause 3.0 to start of clause

3.0 Abbreviated terms

AC alternating current

BESS battery energy storage system

BMS battery management system

CAS conformity assessment system

DC direct current

ECMS electrical control and management system

EMC electromagnetic compatibility

ESD emergency shutdown

FGS fire and gas system

HVAC heating, ventilation and air conditioning

LED light emitting diode

LV low voltage

IP ingress protection (rating code)

IRS information requirements specification

IT insulatum terra (latin) electrical system earthing

NRTL nationally recognized testing laboratory

PCS power conversion subsystem

PDS procurement data sheet

PMS power management system

QRS quality requirements specification

TRS technical requirements specification

3.1 Terms and definitions

Add new term 3.1.3

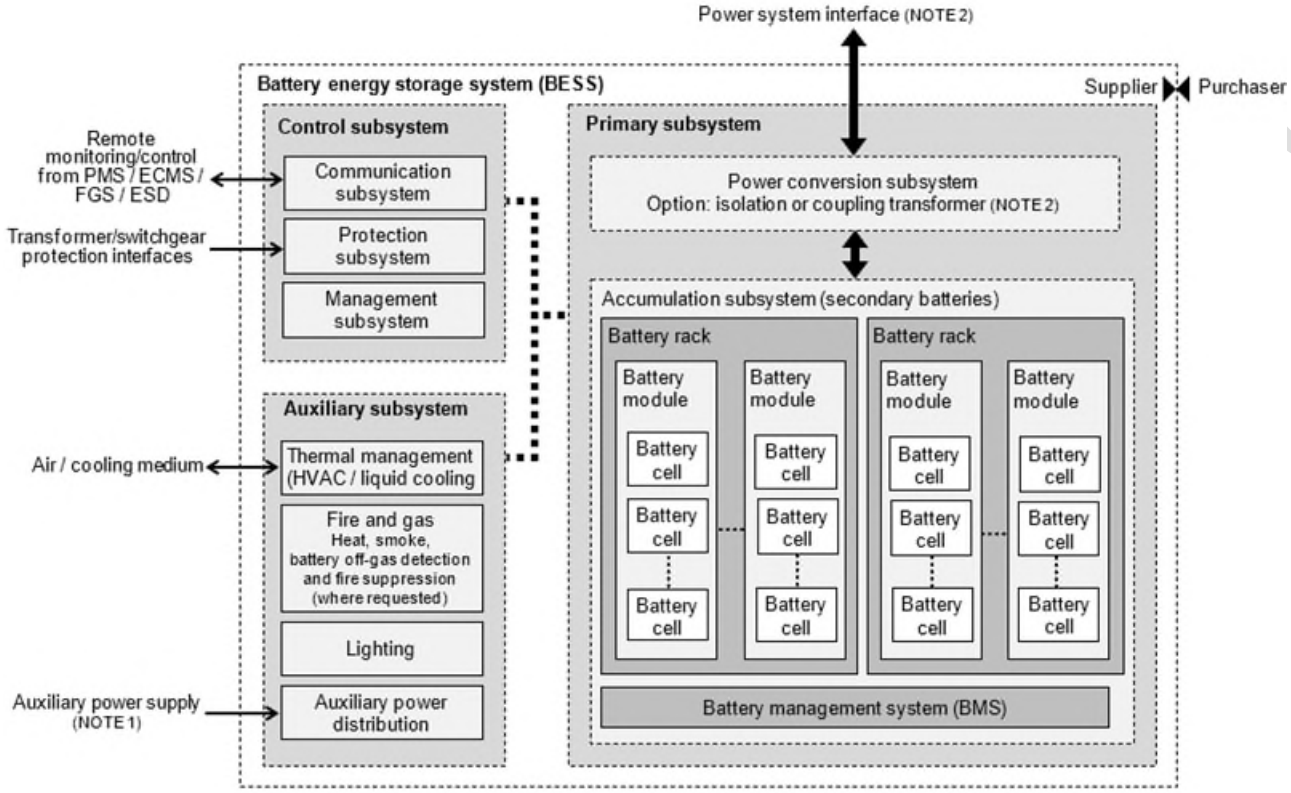
3.1.3
power system interface
interface point on the BESS where the primary subsystem connects to the external power system marks the boundary of the supply scope

Note 1 to entry: The location of the power system interface may vary based on whether isolation or coupling transformer and other optional switching devices are included as part of the supply scope, either inside or outside of it.

4 General structure of EES systems

4.1 Architecture of an EES system

Add a new Figure 1 c)



Key

Internal interfaces managed by the supplier

External interfaces

Primary power interface

Array of battery cells

Scope demarcation

NOTE 1 The auxiliary subsystem power may be derived internally from the power conversion subsystem or supplied from an external course.

NOTE 2 See the definition of term 3.1.3 "power system interface".

c) BESS

Figure 1 – Typical architectures of EES systems

Add new NOTE after second paragraph

NOTE Figure 1 c) shows a typical structure of a BESS and its external communication interfaces. The boundary between the supplier's and purchaser's scopes is demarcated.

4.2 Subsystem specifications

Replace subclause 4.2.1 title with

4.2.1 Accumulation subsystem (secondary batteries)

Add to subclause

Among the storage systems listed under the electrochemical category in Figure 2, only secondary batteries shall apply to the accumulation subsystem.

Add new NOTE

NOTE Refer to Clause 8 for additional requirements for the accumulation subsystem (secondary batteries).

4.2.3 Auxiliary subsystem

Add new NOTE

NOTE Refer to Clause 9 for additional requirements for auxiliary subsystems.

4.2.4 Control subsystem

Add to subclause

Remote control functionality shall not bypass or override the built-in safety devices and systems of the BESS.

5 Planning of EES systems

5.2 EES system environment

5.2.2 Grid parameters and requirements

5.2.2.4 Immunity of the EES system

Replace second sentence with

BESS equipment shall conform to the requirements of electromagnetic immunity levels specified in IEC 61000-6-5.

5.2.4 Standards and local regulations

5.2.4.2 Emissions of EES system

Add to section

BESS equipment shall conform to the requirements of electromagnetic emission levels specified in IEC 61000-6-4.

5.5 Functional system performance

5.5.1 General

5.5.1.2 Typical applications

Class C

Add new list item 6)

6) Spinning reserve in microgrids

The EES system designed for spinning reserve application is an operating reserve that remains synchronised with the microgrid.

It is typically kept in standby mode while continuously monitoring the microgrid load and generation levels.

The spinning reserve EES system has the capacity to supply AC power to the microgrid, preventing local power generation from becoming overloaded in the event of a power generation unit failure.

The spinning reserve capacity eliminates the need to operate additional generators, reducing emissions, fuel consumption, and operational hours on power generation equipment.

5.5.5 Active power limitation

Replace last sentence with

The ESS system shall be capable of performing active power limitation as specified in the project documents and, where applicable, in accordance with the local grid code.

5.6 Communication interface

5.6.3 Remote monitoring and control

5.6.3.4 Development of an EES system information model

Table 4 – Example of messages of an EES system information model

Add new row to Table 4

Messages related to accumulation system (secondary batteries) alarms	The alarm messages to be exchanged shall cover the following: • high and low cell or module temperature • battery over and under voltage • battery system isolation • battery breaker / contactor trip • cooling failure • liquid cooling leakage, where applicable • low insulation level monitoring (LV AC and DC sections of PCS with IT earthing) • battery unbalance • safety protection function alarms as required by the battery system design

Add new subclause

5.7 Additional design requirements

5.7.1 Insulation monitoring system

5.7.1.1

Insulation monitoring shall be provided for isolated (IT) electrical systems of the BESS.

NOTE The LV AC system (supply to the PCS from the isolation transformer) and the DC system (supply to the secondary batteries of the accumulation subsystem from PCS) are typically isolated (IT) electrical supplies in the BESS.

5.7.1.2

Insulation monitoring shall have an alarm and trip provision for low insulation resistance.

5.7.1.3

The insulation monitoring system shall have network communication capabilities.

5.7.2 Internal wiring and terminals

5.7.2.1

Wiring shall be labelled with alphanumeric characters located adjacent to the terminals.

5.7.2.2

Wiring for external connections of the BESS (e.g. external power supplies, hardwired external control signals and hardwired field equipment) shall be routed to individual terminals on an accessible terminal block.

5.7.2.3

Terminal blocks shall be grouped by operating voltage.

5.7.3 Interconnecting cables

5.7.3.1

If specified, interconnecting cables shall be provided between BESS equipment or subsystems that are separately installed and are not part of the integrated container assembly.

NOTE Examples of interconnecting cables include the following:

– power cables between the isolation or coupling transformer and the PCS;

– power and control cables between the PCS and the battery container or cabinet;

– control and communication cables between the isolation transformer, PCS, battery container or cabinet, and the separately installed local BESS control.

5.7.3.2

The separation distance between the cable entry and the associated connection terminals within the cabinet or container shall provide the required cable core bending radius.

Add new subclause

5.8 Specific requirements for offshore (fixed and floating) installations

5.8.1

For offshore installations, BESS associated equipment, components and assemblies shall be in accordance with the general requirements of IEC TS 62933-3-1, IEC TS 62933-5-2 and one of the following:

– IEC 61892 (all parts) for electrical installations in mobile and fixed offshore units;

– IEC 60092 (all parts except 301, 302, 306, 307, 501, 502, 506 and 507) for electrical installations in ships and IEC 63462-1 for safety requirements for secondary lithium cells and batteries in maritime battery systems.

5.8.2

If the requirements of the International Maritime Organization (IMO), International Association of Classification Societies Ltd. (IACS) or other applicable classification societies contradicts or conflicts with the requirements of IEC standards, the more stringent requirements shall be applied.

6 EES system performance assessment

6.2 Installation and commissioning

6.2.3 Commissioning phase

6.2.3.1 General

Add to start of fourth paragraph

Doors of BESS equipment shall be lockable.

Add new clause

7 BESS Safety

7.1

The safety requirements for the BESS shall be in accordance with IEC TS 62933-5-2.

7.2

Caution, danger, warning labels and safety markings of the BESS shall display information in English and, if specified, in an additional language.

7.3

Warning labels shall be provided on access doors of compartments containing external AC and DC voltage sources.

7.4

The warning labels for the BESS shall indicate the presence of lithium-ion batteries.

7.5

The nameplate of the BESS container or battery cabinet shall include the manufacturer's name, purchase order reference, item serial number, item model number, technical parameters, and the month and year of manufacture.

7.6

The BESS shall have an integrated battery management system (BMS) to continuously monitor, control and protect the battery for the functional safety of the specific battery type (e.g. lithium-ion).

7.7

The acoustic noise level, measured at a distance of 1 m from the container and any equipment placed outside the container in any direction, shall not exceed the specified limit.

7.8

The design of the BESS shall include measures (e.g. insulation, segregation, fast-acting protective devices) to mitigate arc flash incident energy hazards and electric shocks.

7.9

BESS arc flash calculations and hazard assessment shall be conducted in accordance with IEEE 1584 and NFPA 70E.

Add new clause

8 Accumulation subsystem (secondary batteries)

8.1 Battery

Secondary lithium cells and batteries shall comply with the requirements of the standards listed in Table 9.

Add new Table 9

Table 9 – Compliance requirements

Requirement	Applicable standards
Marking, designation and performance	IEC 62620
Safety	IEC 62619 and IEC 63056
Safety during shipping and transportation	IEC 62281, UN 38.3 and UN 3536
Test method for evaluating thermal runway fire propagation in battery systems	UL 9540A

8.2 Battery module

8.2.1

The battery module design shall allow access for maintenance and replacement.

8.2.2

A cell failure or thermal runaway within a module shall comply with one of the following requirements:

– not propagate and cascade to other cells of the module;

– not propagate and cascade to the neighbouring module where the total energy of the cells that propagate within the module is limited to 11 kWh.

8.2.3

If the battery module is cooled by a liquid, the cooling system shall include a means to detect leakage of the cooling medium.

8.3 BESS container

8.3.1 Common requirements to non-walk-in and walk-in type container

8.3.1.1

The container design and fabrication shall comply with the requirements of ISO 1496-1 and the specified local codes or regulatory standards.

8.3.1.2

The container shall be fabricated using non-combustible material.

8.3.1.3

The floor shall be seal welded.

8.3.1.4

The floor finish shall have a non-skid epoxy surface.

8.3.1.5

The floor shall be reinforced to withstand the load and stress of the installed electrical equipment.

8.3.1.6

Container openings and penetrations created for external electrical and mechanical connections (e.g. conduit sleeves, transit frames, pipes) shall be provided with a prefabricated solution.

8.3.1.7

Joints around openings and penetrations shall be sealed using fire-resistant material.

8.3.1.8

The ingress protection design of the container shall be in accordance with the specified site location, environmental conditions and special conditions.

8.3.1.9

The container shall have a provision to release the excess pressure in the event of a deflagration.

8.3.1.10

The container shall be equipped with a thermal management system.

8.3.1.11

The container shall be equipped with a fire detection system.

8.3.1.12

The container shall be equipped with an off-gas detection system.

8.3.1.13

The main electrical equipment housed inside the container shall be earthed at a minimum of two connection points.

8.3.1.14

Earthing connections and terminations shall be made using compression-type termination accessories (e.g. compression lug, anti-loosening washer, bolt and nut).

8.3.1.15

Non-current carrying metallic components and parts of the container shall be earthed.

8.3.1.16

The container shall have a provision for earthing to the local (main) earth grid at a minimum of two opposite connection points.

8.3.2 Specific requirements to walk-in type container

8.3.2.1

Walk-in containers that are at least 6.09 m (20 ft) shall have two separate means of access and egress through hinged doors.

NOTE Walk-in containers that are less than 6.09 m (20 ft) long can have a single access and egress.

8.3.2.2

The walk-in container shall have at least one door suitable for the installation and removal of equipment housed inside the container.

8.3.2.3

Access and egress doors shall have inside panic hardware for emergency exit.

8.3.2.4

Door panic hardware shall override key locks.

8.3.2.5

The electrical equipment enclosures inside the container shall have a minimum internal degree of protection in accordance with Table 10.

Add new Table 10

Table 10 – Minimum internal degree of ingress protection for the container

Location	Minimum internal degree of ingress protection
Between panels or cabinet enclosures	IP 2X
Between compartments of each functional unit and other compartments	IP XXB
Fuse-links and associated fuse carriers	IP XXB
Air-insulated live parts inside enclosures or on the inside face of compartment doors that are accessible with the compartment door open	IP XXB
NOTE IPXXB is stipulated in accordance with IEC 60529 as distinct to the use of designation IP2X when the door is open and the danger is access to hazardous parts within. IPXXB provides finger "touch-safe" protection against contact with live parts and electric shock equivalent to IP2X.	

8.3.2.6

The container interior normal, emergency and egress lighting shall comply with the requirements of the specified local codes or regulatory standards.

8.3.2.7

The container shall be fitted with LED lighting.

8.3.2.8

The container shall be provided with a minimum of one single phase and neutral, 3-pin receptacle.

8.4 Outdoor battery cabinet

8.4.1

The cabinet shall be a free-standing assembly.

8.4.2

The cabinet shall be fabricated using non-combustible material.

8.4.3

Joints around the cabinet openings and penetrations created for external connections shall be sealed using fire-resistant material.

8.4.4

The cabinet shall be provided with an integral thermal management system.

8.4.5

The cabinet shall be provided with integral heat and smoke detectors.

8.4.6

The cabinet shall be provided with integral off-gas detectors.

8.4.7

The cabinet shall have provision to release the excess pressure in the event of a deflagration.

8.4.8

The ingress protection design of the cabinet shall be in accordance with the specified site location, environmental conditions and special conditions.

8.4.9

The cabinet shall have a minimum internal degree of ingress protection in accordance with Table 11.

Add new Table 11

Table 11 – Minimum internal degree of ingress protection for the outdoor battery cabinet

Location	Minimum internal degree of ingress protection
Between panels or cabinet enclosures	IP 2X
Between compartments of each functional unit and other compartments	IP XXB
Fuse-links and associated fuse carriers	IP XXB
Air-insulated live parts inside enclosures or on the inside face of compartment doors that are accessible with the compartment door open	IP XXB
NOTE IPXXB is stipulated in accordance with IEC 60529 as distinct to the use of designation IP2X when the door is open and the danger is access to hazardous parts within. IPXXB provides finger "touch-safe" protection against contact with live parts and electric shock equivalent to IP2X.	

8.4.10

The non-current carrying metallic components and parts of the cabinet shall be earthed.

8.4.11

Earthing connections and terminations shall be made using compression-type termination accessories (e.g. compression lug, anti-loosening washer, bolt and nut).

8.4.12

Hinged doors and panels with powered devices shall be bonded with a flexible copper conductor, connecting the devices to the cabinet earth bar or metallic structure.

8.4.13

If the BESS is skid mounted, main electrical equipment including the battery cabinet shall be earthed to the skid at a minimum of two connection points.

8.4.14

If the BESS is skid mounted, the skid shall have a provision for earthing to the local (main) earth grid at a minimum of two opposite connection points.

Add new clause

9 Auxiliary subsystem

9.1 Fire and gas system

9.1.1

The fire and gas detection system shall comply with the requirements of NFPA 855 and the specified local codes or regulatory standards.

NOTE An integrated design approach is important for a fire and gas system when placing a battery inside a room. Liaising with the battery supplier is essential for gathering specific inputs regarding the fire and gas safety features incorporated into the battery system while designing the overall system requirements for the room.

9.1.2

The fire and gas detection system shall at least be provided with heat detectors, smoke detectors, battery off-gas detectors and local fire alarm panels.

9.1.3

The off-gas detection system shall initiate actions to mitigate the risks associated with a thermal runaway event.

9.1.4

The fire and gas detection system shall be provided with an externally mounted high-visibility strobe light.

9.1.5

If specified, an integrated fire suppression system shall be provided.

9.1.6

The fire and off-gas detectors shall be connected to a local fire alarm panel.

9.1.7

The local fire alarm panel and detectors shall be microprocessor-based with network communication capabilities for remote alarming and diagnostics.

9.2 Thermal management system

9.2.1

The thermal management system shall comply with the requirements of NFPA 855 and the specified local codes or regulatory standards.

NOTE An integrated design approach is important for a thermal management system when placing a battery inside a room. Liaising with the battery supplier is essential for gathering specific inputs regarding cooling or thermal management features incorporated into the battery system while designing the overall system requirements for the room.

9.2.2

The thermal management system shall maintain climatic conditions required by the battery design for the specified site location, the environmental conditions and special conditions.

9.2.3

If an HVAC system is provided, it shall be supplied with air-conditioning units, electrical heaters, air handling and associated ductwork accessories required by the system design.

9.2.4

If the HVAC system includes an air handling or ventilation system, the HVAC system shall be provided with the air intake and exhaust facilities required by the system design.

9.2.5

If outdoor HVAC equipment is supplied, it shall be suitable for the specified site location, environmental conditions and special conditions.

Add new clause

10 Transformers

10.1

If supplied, the isolation or coupling transformer upstream of the BESS (PCS) shall comply with the requirements of IOGP S-720.

10.2

If supplied, the distribution transformer associated with the externally fed auxiliary power supply of the BESS shall comply with the requirements of IOGP S-720.

Add new clause

11 High-voltage switchgear

If supplied, the high-voltage switchgear and associated devices upstream of the BESS (PCS) shall comply with the requirements of IOGP S-620.

Add new clause

12 Transport, storage and handling

12.1

Transport and anchoring hardware shall be installed to prevent damage due to tilt or inclination of shipping sections when manoeuvring during transportation and installation.

12.2

Transport and anchoring hardware shall be identified for removal post-installation.

12.3

Assemblies supplied in multiple transport units shall be identified to facilitate reassembly at site.

12.4

If specified, the packaging shall have a means of electrical connection (e.g. receptacle, disconnect switch) for an external power supply to the internal space heaters of the equipment during storage.

12.5

The connection device for the external power supply to the internal space heaters shall be clearly labelled with the required electrical service information.

Bibliography

Add to Bibliography

The following documents are informatively cited in the text of this specification, IEC TS 62933-3-1, the PDS (IOGP S-753D) or the IRS (IOGP S-753L).

API Specification Q1, *Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry*

API Specification Q2, *Specification for Quality Management System Requirements for Service Supply Organizations for the Petroleum and Natural Gas Industries*

AS 5139, *Electrical installations - Safety of battery systems for use with power conversion equipment*

DNV GL Handbook for Maritime and Offshore Battery Systems, *Report No.: 2016-1056, Revision: V1.0 Document No.: 15DJV2L-2*

DNV GL Rules for classification, Part 6 Chapter 2, *Part 6 Additional class notations Chapter 2 Propulsion, power generation and auxiliary systems*

DNV-RP-0043, *Safety, operation and performance of grid-connected energy storage systems*

IEC 60721-2-6, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Earthquake vibration and shock*

IEC 60812, *Failure modes and effects analysis (FMEA and FMECA)*

IEC 61025, *Fault tree analysis (FTA)*

IEC 61508, *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 62402 , *Obsolescence management*

IEEE 802.3, *IEEE Standard for Ethernet*

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country code*

ISO 9001, *Quality management systems — Requirements*

ISO 10005, *Quality management — Guidelines for quality plans*

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ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

ISO/IEC Directives, Part 2, *Principles and rules for the structure and drafting of ISO and IEC documents*

NFPA 68, *Standard on Explosion Protection by Deflagration Venting*

UL 9540, *STANDARD FOR SAFETY Energy Storage Systems and Equipment*

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