



JOINT CANADA-UNITED STATES
NATIONAL STANDARD

ANSI/CAN/UL 9540:2025

STANDARD FOR SAFETY

Energy Storage Systems and Equipment



SCC FOREWORD

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UL Standard for Safety for Energy Storage Systems and Equipment, ANSI/CAN/UL 9540

Third Edition, Dated June 28, 2023

Summary of Topics

This revision of ANSI/CAN/UL 9540 dated March 7, 2025 includes the addition of new Annex [H](#) to help clarify required manufacturer's installation instructions for residential ESS.

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated November 1, 2024.

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ANSI/UL 9540-2025



JUNE 28, 2023

(Title Page Reprinted: March 7, 2025)

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ANSI/CAN/UL 9540:2025

Standard for Energy Storage Systems and Equipment

First Edition – November, 2016
Second Edition – February, 2020

Third Edition

June 28, 2023

This ANSI/CAN/UL Safety Standard consists of the Third Edition including revisions through March 7, 2025.

The most recent designation of ANSI/UL 9540 as an American National Standard (ANSI) occurred on March 7, 2025. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This Standard has been designated as a National Standard of Canada (NSC) on March 7, 2025.

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Preface (UL)

This is the Third Edition of ANSI/CAN/UL 9540 Standard for Safety for Energy Storage Systems and Equipment.

ULSE is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL 9540 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

Comments or proposals for revisions on any part of the Standard may be submitted at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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This Edition of the Standard has been formally approved by the Technical Committee (TC) on Energy Storage Systems and Equipment, TC 9540.

This list represents the TC 9540 membership when the final text in this Standard was balloted. Since that time, changes in the membership may have occurred.

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International Classification for Standards (ICS): 27.100; 29.220

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The intended primary application of this standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

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INTRODUCTION

1 Scope

1.1 These requirements cover an energy storage system (ESS) that is intended to receive and store energy in some form so that the ESS can provide electrical energy to loads or to the local/area electric power system (EPS) when needed. Electrochemical, chemical, mechanical, and thermal ESS are covered by this Standard. The ESS shall be constructed either as one unitary complete piece of equipment or as matched assemblies, that when connected, in accordance with the manufacturer's installation instructions, form the ESS. An ESS consists of at least an energy storage function and energy storage protective function. If the ESS includes multiple parts that are housed in separate enclosures, it shall be considered as a multi-part ESS covered by this Standard. Individual parts (e.g. power conversion equipment, a battery, etc.) of an ESS are not considered an ESS on their own. This Standard evaluates the compatibility and safety of these various components and parts integrated into an ESS. The ESS can be an AC ESS or a DC ESS as defined in this Standard.

1.2 The systems covered by this Standard include those intended to be used in a standalone mode (e.g. islanded) including "self-supply" systems to provide electrical energy and those used in parallel with an electric power system or electric utility grid such as "grid-supply" systems, or applications that perform ancillary operational modes associated with power generation such as voltage support and regulation, frequency support and regulation, volt-var, capacity reserve, energy shifting or other utility grid support services.

1.3 Energy storage systems are intended for installation and use in accordance with the National Electrical Code, NFPA 70, the Canadian Electrical Code, Part I Safety Standard for Electrical Installations, CSA C22.1, the National Electrical Safety Code, IEEE C2, the International Fire Code, ICC IFC, the International Residential Code, ICC IRC, the National Fire Code of Canada, NRC NFC, the Fire Code, NFPA 1, and the Standard for the Installation of Stationary Energy Storage Systems, NFPA 855. Requirements for installation, with the exception of installation manuals and documents for installation provided with the system are outside the scope of this Standard.

1.4 This Standard covers energy storage systems for stationary indoor and outdoor installations. This Standard also covers mobile energy storage systems as defined by this Standard. This Standard includes requirements for energy storage systems used in residential and non-residential installations.

1.5 Systems using lead acid or Ni-cad batteries that fall within the scope of UL 1778/CSA C22.2 No. 107.3 and only serve an uninterruptible power system (UPS) application are outside the scope of this Standard.

NOTE: UL 1778/CSA C22.2 No. 107.3 is applicable to UPS that employ chemistries other than lead acid or Ni-cad, but the fire codes and the ESS installation standard do not exclude UPS applications from ESS criteria including compliance to this Standard for these other chemistries.

1.6 The maximum energy capacity of individual electrochemical ESS shall be determined by the following in (a) – (d). Where the results of testing are used, the results shall be determined in accordance with the Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems, UL 9540A:

- a) The maximum energy capacity of residential use electrochemical ESS shall not exceed 20 kWh (72 MJ). This value shall be permitted to be increased to the value of the unit which meets the performance criteria of the UL 9540A Unit Level test;
- b) The maximum energy capacity of non-residential use electrochemical ESS shall not exceed 50 kWh (180 MJ). This value shall be permitted to be increased to the value of the unit which meets

the performance criteria of the UL 9540A Installation Level test, provided the ESS is marked in accordance with [45.20](#);

c) There is no maximum energy capacity limit for non-residential use electrochemical ESS that are tested in accordance with UL 9540A in which the performance level criteria of the cell level test have been met; and

d) There is no maximum energy capacity limit for non-residential use electrochemical ESS intended for use in remote outdoor locations as defined in the applicable installation code, provided they are marked in accordance with [45.21](#).

NOTE 1: The Standard for the Installation of Stationary Energy Storage Systems, NFPA 855 defines outdoor remote locations as being located more than 30.5 m (100 ft) from exposures.

NOTE 2: Lead acid, Ni-Cad, Ni-MH, and Ni-Zn ESS have exceptions to the capacity energy limits including, in some cases, no limits based upon specific telecom and utility installations as outlined in NFPA 855.

2 Components

2.1 A component or equipment of an energy storage system covered by this Standard shall comply with the safety requirements for that component or equipment. See Annex [A](#) for a list of standards covering components generally used in the energy storage systems covered by this Standard. Components and equipment shall comply with the CSA and/or UL standards as appropriate for the country or countries where the energy storage system is to be installed.

3 Units of Measurement

3.1 Values and their respective units of measurement that are stated without parentheses constitute the requirement of the standard and those in parentheses constitute explanatory or approximate information.

4 Undated References

4.1 Any undated reference appearing in the requirements of this Standard shall be interpreted as referring to the latest edition of the reference, including all revisions and amendments.

5 Normative References

5.1 The following standards are referenced in this Standard, and portions of these referenced standards may be essential for compliance. Energy storage systems covered by this Standard shall comply with the referenced installation codes and standards as appropriate for the country where the energy storage system is to be installed. When the energy storage system is intended for use in more than one country, the energy storage system shall comply with the installation codes and standards for all countries where it is intended to be used.

ASME B31 (all applicable parts), *Power Piping*

ASME BPVC, *Boiler and Pressure Vessel Code*

ASTM D412, *Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers – Tension*

ASTM D4169, *Standard Practice for Performance Testing of Shipping Containers and Systems*

ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*

29 CFR 1910.95, *Occupational Noise Exposure*

29 CFR 1910.1200, *Toxic and Hazardous Substances*

CSA C22.1, *Canadian Electrical Code, Part I Safety Standard for Electrical Installations*

CSA C22.2 No. 0, *General Requirements – Canadian Electrical Code, Part II*

CSA C22.2 No. 0.15, *Adhesive Labels*

CSA C22.2 No. 0.17, *Evaluation of Properties of Polymeric Materials*

CSA C22.2 No. 0.2, *Insulation Coordination*

CSA C22.2 No. 0.8, *Safety Functions Incorporating Electronic Technology*

CSA C22.2 No. 41, *Grounding and Bonding Equipment*

CSA C22.2 No. 94.2, *Enclosures for Electrical Equipment, Environmental Considerations*

CSA C22.2 No. 100, *Motors and Generators*

CSA C22.2 No. 107.1, *Power Conversion Equipment*

CSA C22.2 No. 107.3, *Uninterruptible Power Systems*

CSA C22.2 No. 139, *Electrically Operated Valves*

CSA C22.2 No. 286, *Industrial Control Panels and Assemblies*

CSA C22.2 No. 301, *Industrial Electrical Machinery*

CSA C22.2 No. 60079-2, *Explosive Atmospheres – Part 2: Equipment Protection By Pressurized Enclosure "p"*

CSA C22.2 No. 60529, *Degrees of Protection Provided By Enclosures (IP Code)*

CSA C22.2 No. 61800-5-1, *Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal, and Energy*

CSA C22.2 No. 62109-1, *Safety of Power Converters for Use in Photovoltaic Power Systems – Part 1: General Requirements*

CSA C22.2 No. 62368-1, *Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements*

CSA B51, *Boiler, Pressure Vessel, and Pressure Piping Code*

CSA B52, *Mechanical Refrigeration Code*

CSA B149.1, *Natural Gas and Propane Installation Code*

CSA FC 1, *Fuel Cell Technologies – Part 3-100: Stationary Fuel Cell Power Systems – Safety*

CSA Z462, *Workplace Electrical Safety*

CSA Z662, *Oil and Gas Pipeline Systems*

CSA E60730-1, *Automatic Electrical Controls for Household and Similar Use – Part 1: General Requirements*

ICC IBC, *International Building Code*

ICC IFC, *International Fire Code*

ICC IRC, *International Residential Code*

IEC 60068-2-52, *Environmental Testing Part 2: Tests – Tests Kb, Salt Mist, Cyclic (Sodium Chloride Solution)*

IEC 60364-4-41, *Low-Voltage Electrical Installations – Part 4-41: Protection for Safety – Protection Against Electric Shock*

IEC 60364-6, *Low-Voltage Electrical Installations – Part 6: Verification*

IEC 60417 Database, *Graphical Symbols for Use on Equipment*

IEC 60529, *Degrees of Protection Provided by Enclosures (IP Code)*

IEC 60664-1, *Insulation Coordination for Equipment Within Low-Voltage Systems – Part 1: Principles, Requirements and Tests*

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

IEC 60980, *Recommended Practices for Seismic Qualification of Electrical Equipment of the Safety System for Nuclear Generating Stations*

IEC 61000-4-2, *Electromagnetic Compatibility (EMC) – Part 4-2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test*

IEC 61000-4-3, *Electromagnetic Compatibility (EMC) – Part 4-3: Testing and Measurement Techniques – Radiated, Radio-Frequency, Electromagnetic Field Immunity Test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and Measurement Techniques – Electrical Fast Transient/Burst Immunity Test*

IEC 61000-4-5, *Electromagnetic Compatibility (EMC) – Part 4-5: Testing and Measurement Techniques – Surge Immunity Test*

IEC 61000-4-6, *Electromagnetic Compatibility (EMC) – Part 4-6: Testing and Measurement Techniques – Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields*

IEC 61000-4-8, *Electromagnetic Compatibility (EMC) – Part 4-8: Testing and Measurement Techniques – Power Frequency Magnetic Field Immunity Test*

IEC 61000-6-2, *Electromagnetic Compatibility (EMC) – Part 6-2: Generic Standards – Immunity Standard for Industrial Environments*

IEC 61025, *Fault Tree Analysis (FTA)*

IEC 61180, *High-Voltage Test Techniques for Low Voltage Equipment Definitions, Test and Procedure Requirements, Test Equipment*

IEC 61508 (all parts), *Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems*

IEC 62040-1, *Uninterruptible Power Systems (UPS) – Part 1: Safety Requirements*

IEC 62477-1, *Safety Requirements for Power Electronic Converter Systems and Equipment – Part 1: General*

IEEE C2, *National Electrical Safety Code*

IEEE 344, *Seismic Qualification for Equipment for Nuclear Power Generating Stations*

IEEE 693, *Recommended Practice for Seismic Design of Substations*

IEEE 1547, *Interconnecting Distributed Resources with Electric Power Systems*

IEEE 1547.1, *Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems*

ISO 1496-1, *Series 1 Freight Containers – Specification and Testing – Part 1: General Cargo Containers for General Purposes*

ISO 7010, *Graphical Symbols – Safety Colours and Safety Signs – Registered Safety Signs*

ISO 12944 (all parts), *Paints and Varnishes – Corrosion Protection of Steel Structures by Protective Paint Systems*

ISO 13849-1, *Safety of Machinery – Safety-Related Parts of Control Systems – Part 1: General Principles for Design*

ISO 13849-2, *Safety of Machinery – Safety-Related Parts of Control Systems – Part 2: Validation*

ISO 26262 (all parts), *Road Vehicles – Functional Safety*

NEMA Z535.1, *Safety Colors*

NEMA Z535.2, *Environmental and Facility Safety Signs*

NEMA Z535.3, *Criteria for Safety Symbols*

NEMA Z535.4, *Product Safety Signs and Labels*

NEMA Z535.5, *Safety Tags and Barricade Tape (for Temporary Hazards)*

NEMA Z535.6, *Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials*

NFPA 1, *Fire Code*

NFPA 68, *Explosion Protection by Deflagration Venting*

NFPA 69, *Explosion Prevention Systems*

NFPA 70, *National Electrical Code*

NFPA 70E, *Electrical Safety in the Workplace*

NFPA 72, *National Fire Alarm and Signaling Code*

NFPA 79, *Electrical Standard for Industrial Machinery*

NFPA 286, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth*

NFPA 484, *Combustible Metals*

NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*

NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*

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

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*

NRC NFC, *National Fire Code of Canada*

GR-63-CORE, *Network Equipment Building System (NEBS) Requirements: Physical Protection*

UL 38, *Manual Signaling Boxes for Fire Alarm Systems*

UL 50, *Enclosures for Electrical Equipment, Non-Environmental Considerations*

UL 50E, *Enclosures for Electrical Equipment, Environmental Considerations*

UL 94, *Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 144, *LP Gas Regulators*

UL 157, *Gaskets and Seals*

UL 252, *Compressed Gas Regulators*

UL 268, *Smoke Detectors for Fire Alarm Systems*

UL 268A, *Smoke Detectors for Duct Applications*

UL 429, *Electrically Operated Valves*

UL 429A, *Electrically Operated Valves for Fire Protection Service*

UL 464, *Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories*

UL 467, *Grounding and Bonding Equipment*

UL 508A, *Industrial Control Panels*

UL 521, *Heat Detectors for Fire Protective Signaling Systems*

UL 746C, *Polymeric Materials – Use in Electrical Equipment Evaluations*

UL 840, *Insulation Coordination Including Clearances and Creepage Distances For Electrical Equipment*

UL/ULC 842, *Valves for Flammable and Combustible Liquids*

UL 864, *Control Units and Accessories for Fire Alarm Systems*

UL 969, *Marking and Labeling Systems*

UL 991, *Tests for Safety-Related Controls Employing Solid-State Devices*

UL 1004-1, *Rotating Electrical Machines – General Requirements*

UL 1004-2, *Impedance Protected Motors*

UL 1004-3, *Thermally Protected Motors*

UL 1004-4, *Electric Generators*

UL 1004-5, *Fire Pump Motors*

UL 1004-6, *Servo and Stepper Motors*

UL 1004-7, *Electronically Protected Motors*

UL 1004-8, *Inverter Duty Motors*

UL 1004-9, *Form Wound and Medium Voltage Rotating Electrical Machines*

UL 1012, *Power Units Other Than Class 2*

UL 1564, *Industrial Battery Chargers*

UL 1638, *Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories*

UL 1741, *Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources*

UL 1778, *Uninterruptible Power Systems*

UL 1971, *Signaling Devices for the Hearing Impaired*

UL 1973, *Batteries for Use in Stationary and Motive Auxiliary Power Applications*

UL 1998, *Software in Programmable Components*

UL 2075, *Gas and Vapor Detectors and Sensors*

UL/ULC 2166, *Halocarbon Clean Agent Extinguishing System Units*

UL 2200, *Stationary Engine Generator Assemblies*

UL 2416, *Audio/Video, Information and Communication Technology Equipment Cabinet, Enclosure and Rack Systems*

UL 2755, *Modular Data Centers*

UL 5500, *Remote Software Updates*

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

UL 60079-2, *Explosive Atmospheres – Part 2: Equipment Protection by Pressurized Enclosures "p"*

UL 60079-29-1, *Explosive Atmospheres – Part 29-1: Gas Detectors – Performance Requirements of Detectors for Flammable Gases*

UL 60730-1, *Automatic Electrical Controls for Household and Similar Use – Part 1: General Requirements*

UL 61800-5-1, *Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal, and Energy*

UL 62109-1, *Safety of Power Converters for Use in Photovoltaic Power Systems – Part 1: General Requirements*

UL 62368-1, *Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements*

ULC 525, *Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories*

ULC 526, *Visible Signaling Devices For Fire Alarm And Signaling Systems, Including Accessories*

ULC 527, *Control Units for Fire Alarm Systems*

ULC S528, *Manual Stations For Fire Alarm Systems, Including Accessories*

ULC 529, *Smoke Detectors For Fire Alarm Systems*

ULC S530, *Heat Actuated Fire Detectors For Fire Alarm Systems*

ULC S588, *Gas and Vapour Detectors and Sensors, Including Accessories*

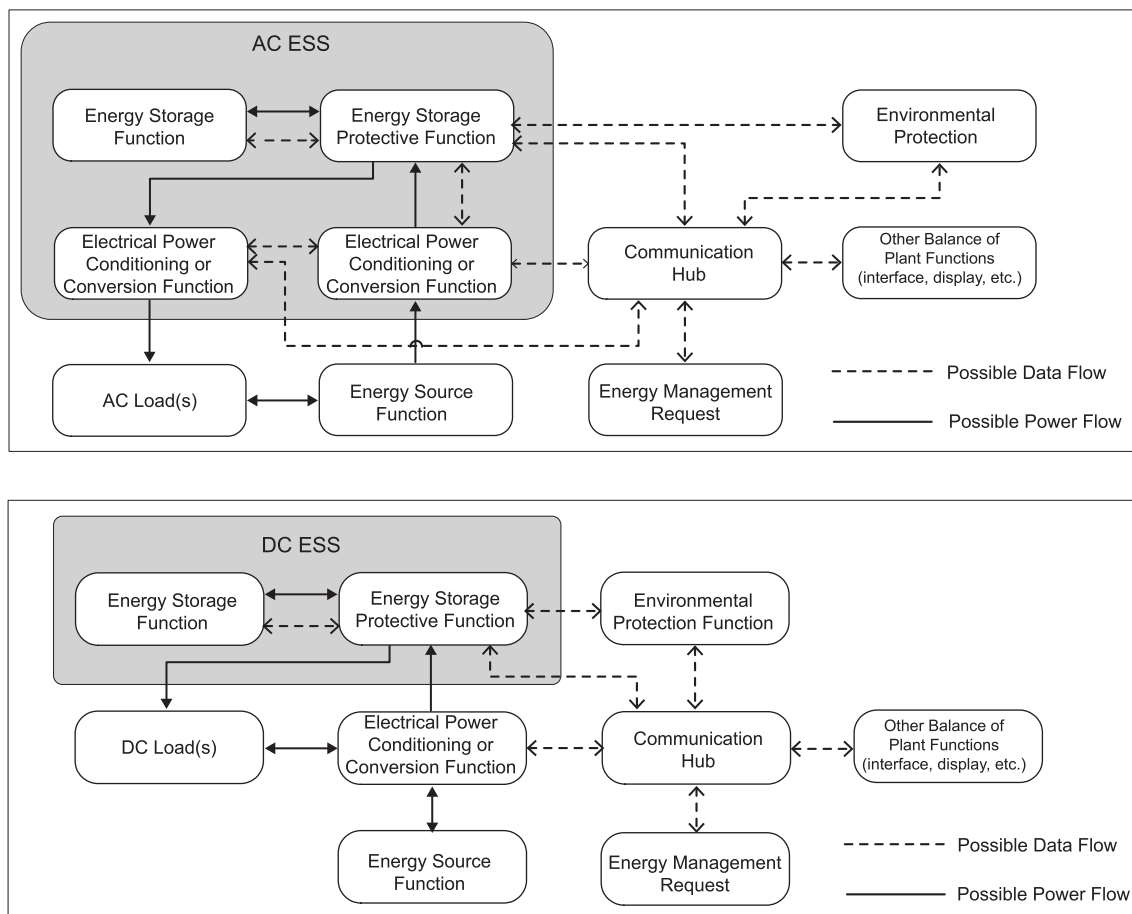
MIL-STD-882E, *System Safety*

6 Glossary

6.1 For the purpose of this Standard, the following definitions apply.

6.2 AC ESS – An energy storage system comprised of the energy storage function and energy storage protective function which are evaluated for functional safety, and electrical power conditioning or conversion function, providing AC output field wiring terminals. See [Figure 6.1](#).

Figure 6.1
AC and DC ESS



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NOTES:

Electrical Power Conditioning Function – Maintaining electrical parameters (e.g. voltage, frequency, waveform, etc.) within defined limits.

Electrical Power Conversion Function – Converting one form of electrical power into another form of electrical power (e.g. from DC to AC, etc.).

Energy Source Function – Source of AC or DC electrical energy that is compatible with the parameters (e.g. voltage, frequency) of the charging function of the ESS.

Energy Storage Function – The conversion of input energy into stored energy, the storing of energy, and conversion of stored energy into output energy.

Energy Storage Protective Function – Maintains ESS within specified operating limits, limiting risk of fire, electrical shock, explosion, mechanical hazards and chemical exposure or any of the preceding associated with the energy storage.

DC Load(s) may include equipment which performs electrical power conditioning or conversion functions.

6.3 ARC FLASH BOUNDARY – The area within which a hazardous arc could occur, and which requires the use of special protective equipment (PPE). See [10.12](#).

6.4 CATASTROPHIC FAILURE – A severe sudden failure that results in damage to the test subject such that the test subject can no longer serve its primary function. The failure may or may not result in hazard to personnel or to items in the surrounding environment or initiate other failures. The test subject may or may not be repairable in a field environment.

6.5 COMMISSIONING – The process by which an energy storage system, upon installation, is tested and otherwise evaluated to verify that it functions according to its design objectives and specifications.

6.6 DC ESS – An energy storage system containing the energy storage function and energy storage protective function which are evaluated for functional safety and providing DC output field wiring terminals. See [Figure 6.1](#).

6.7 DECOMMISSIONING – The act of removing an energy storage system from service, which includes shutting it down, typically some level of dismantling, and then finally removing it from the site of installation.

6.8 DUT – Device under test.

6.9 DWELLING UNIT – See the definition for “dwelling unit” in Chapter 3, Definitions, of NFPA 855, in Section 0, Definitions of CSA C22.1, in the General Definitions, Section 202 of ICC IFC, and in Chapter 2, Definitions of ICC IRC.

6.10 ELECTRIC POWER SYSTEM (EPS) – Equipment or facilities that deliver electric power to a load. The most common example of an EPS is an electric utility.

6.11 ELECTRIC SHOCK HAZARD – A potential for exposure of persons to hazardous voltage circuits through direct contact from openings in protective enclosures and/or insufficient insulation between hazardous voltage circuits and accessible parts.

6.12 ENCLOSURE – The outer cover of the Energy Storage System that provides protection to its contents.

6.13 ENERGY STORAGE MANAGEMENT SYSTEM (ESMS) – A monitoring and control system of an ESS that may receive and coordinate inputs from various other devices in the ESS impacting the ESS safety and performance.

6.14 ENERGY STORAGE SYSTEM (ESS) – Equipment in one or more enclosures that receives energy and then provides a means to store that energy in some form for later use in order to supply electrical energy when needed. It can be either an AC ESS or a DC ESS. See [Figure 6.1](#). An ESS utilizes one of the following technologies:

a) ELECTROCHEMICAL ESS – Consists of a secondary (rechargeable) battery, electrochemical capacitor, flow battery or hybrid battery-capacitor system that stores electrical energy and any associated controls or devices that can provide the stored electric energy upon demand.

b) CHEMICAL ESS – Consists of hydrogen storage, the hydrogen generator to supply the hydrogen for storage, and a fuel cell power system to provide electric energy upon demand.

c) MECHANICAL ESS – Consists of a mechanical means to store energy such as through compressed air, pumped water or fly wheel technologies and associated controls and systems, which can be used to run an electric generator to provide electric energy upon demand.

d) THERMAL ESS – Consists of a system that uses heated fluids such as air as a means to store energy along with associated controls and systems, which can be used to run an electric generator to provide electrical energy upon demand.

NOTE: The ESS may be a single unit or composed of multiple parts.

6.15 ENERGY STORAGE SYSTEM INTEGRATOR – The entity typically responsible for ensuring the various parts of the ESS work together, and that the ESS works with the external systems that either supply energy into the ESS or use energy from the ESS.

6.16 EXTERNAL WARNING COMMUNICATION SYSTEM (EWCS) – A system integral to the ESS that takes in data from various sources within the ESS and then communicates information on potential ESS safety issues to an external operating station, and also initiates local alarms when deemed necessary.

6.17 FAILURE MODES AND EFFECT ANALYSIS (FMEA) – a rigorous and systematic methodology for analyzing reliability and the impact the failure of any one component associated with a technology and its installation has on safety. For the purposes of this Standard, only the impact to safety is considered.

6.18 FLYWHEEL – An electro-mechanical system that stores energy in the form of kinetic energy. It is composed of an electric machine element and an inertia element. The inertia element is used to store the majority of kinetic energy in the system and the electric machine element is used to discharge and recharge the inertia element. These elements may be separate distinct devices or they may be integrated.

6.19 FUEL CELL POWER SYSTEM – Equipment that converts chemical energy in the form of a fuel and oxidant into electrical energy with heat and by-products from the reaction.

6.20 HABITABLE SPACE – See the definition for “habitable space” in ICC IBC and ICC IRC.

NOTE: In the ICC IBC and ICC IRC definition, bathrooms, toilet rooms, closets, halls, storage or utility spaces and similar areas are not considered habitable spaces. However in NFPA 855, the only indoor areas that are considered suitable for residential ESS installation are in garages, detached accessory structures, enclosed utility closets and storage or utility spaces. NFPA 855, ICC IBC, and ICC IRC specifically prohibit installation of ESS in sleeping rooms or in closets or spaces opening directly into sleeping rooms.

6.21 HAZARDOUS ARC – An electrical arc with sufficient energy to result in physical hazards to someone coming in contact with it. See [10.12](#).

6.22 HAZARDOUS FLUID – A hazardous material (e.g. toxic, combustible, etc.) that is either a liquid or a gas.

6.23 HAZARDOUS MATERIAL – A hazardous material is a substance, which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. Hazardous materials are further defined in 29 CFR 1910.1200.

6.24 HAZARDOUS VOLTAGE – Voltage exceeding 30 Vrms/42.4 Vac peak or 60 Vdc is considered hazardous.

6.25 HVAC – Heating, ventilation and air-conditioning.

6.26 INSULATION LEVELS – The following are levels of electrical insulation:

a) BASIC INSULATION – A single level of insulation that is intended to provide protection against electric shock when the insulation has not failed.

b) DOUBLE INSULATION – Insulation comprising both basic insulation and supplementary insulation.

c) **FUNCTIONAL INSULATION** – Insulation that is necessary only for the correct functioning of the equipment that can reduce the likelihood of ignition and fire, and that does not protect against electric shock.

d) **REINFORCED INSULATION** – Single insulation system that provides a degree of protection against electric shock equivalent to double insulation under the conditions specified in this Standard. The "insulation system" consists of one homogeneous piece, or several layers that cannot be tested as basic insulation and supplementary insulation.

e) **SUPPLEMENTARY INSULATION** – Independent insulation applied in addition to basic insulation in order to reduce the risk of electric shock in the event of a failure of the basic insulation.

6.27 MOBILE ENERGY STORAGE SYSTEMS (MESS) – An ESS that is not portable, but has a means so that it can be moved (e.g. mounted on a wheeled trailer or skid) to a site to provide power on a temporary basis.

6.28 MULTI-PART ESS – An energy storage system consisting of assemblies or equipment interconnected in the field to comprise a complete system.

6.29 NON-COMBUSTIBLE DIELECTRIC MEDIUM – A transformer fluid that does not ignite, burn, give off flammable vapors or support combustion in air.

6.30 NON-COMBUSTIBLE MATERIAL – A material that will not ignite or burn when subjected to fire or excessive heat as determined by the test of ASTM E136.

NOTE: Materials meeting this criteria include steel, concrete, masonry and glass.

6.31 NON-RESIDENTIAL USE – Equipment suitable for use on or in structures other than those defined in [6.34](#).

6.32 OUTDOOR USE – An installation where the ESS is located outside of a building and where it may be subject to environmental exposures such as rain and wind.

6.33 REMOTE SOFTWARE UPDATE – A function providing any operation by control devices through external means, which includes, but is not limited to, the use of:

- a) Communication lines/protocols;
- b) IR/RF TRANSMISSION; or
- v) All combinations of (a) – (b) above via internet using, for example, modems, portable telephones, etc.

NOTE: Remote software updates require minimum or no interaction with the ESS. Software updates are received remotely without the use of external hardware such as a USB, SD card, etc.

6.34 RESIDENTIAL USE – Equipment suitable for use on or in detached one- and two-family dwellings and townhouses.

6.35 RESTRICTED ACCESS LOCATION – Location for an ESS as identified in the installation manual and equipment markings, or as required by local codes, where both of the following apply:

- a) Access can only be gained by service persons or by users who have been instructed about the reasons for the restrictions applied to the location, the hazards present at the location, and about any precautions that shall be taken; and

b) Access is through the use of a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location.

6.36 RISK – The potential for fire, electric shock, injury to persons, or damage to equipment associated with the intended use of the ESS as specified by the ESS safety requirements.

6.37 RISK ADDRESSED STATE – A state that is characterized by all reasonably foreseeable risks associated with the ESS, as defined by the safety analysis of the system, being addressed such that there is no longer a likelihood of the risk.

6.38 ROOM AMBIENT – Considered to be a temperature in the range of 25 ± 5 °C (77 ± 9 °F).

6.39 SAFETY CRITICAL CIRCUITS/COMPONENTS – Those circuits or components that are relied upon for critical safety (i.e. mitigating a potential hazard to persons) as identified in the safety analysis of [15.5](#).

6.40 SAFETY EXTRA LOW VOLTAGE (SELV) CIRCUIT – A circuit that exhibits voltages that are not in excess of those in [Table 6.1](#) and are safe to touch both under normal operating conditions and after a single fault.

Table 6.1
SELV Voltage Limits

Voltage limits	
Normal	Single fault
Open circuit voltage with generally sinusoidal shape of 42.4 V _{peak} /30 V _{rms} or 60 V _{dc}	Open circuit voltage with generally sinusoidal shape of 42.4 V _{peak} /30 V _{rms} or 60 V _{dc} with excursions up to 71 V _{peak} /50 V _{rms} or 120 V _{dc} for periods up to 200 ms

6.41 SPECIAL PURPOSE UTILITY-INTERACTIVE (INVERTER / CONVERTER / PRODUCT) – An inverter / converter / product that is functionally similar to a utility-interactive inverter except that it is evaluated for specific applications different from those where utility-interactive inverters are generally used.

6.42 THERMAL RUNAWAY – The incident when an electrochemical cell increases its temperature through self-heating in an uncontrollable fashion. The thermal runaway progresses when the cell's generation of heat is at a higher rate than the heat it can dissipate. This may lead to fire, explosion and gas evolution.

6.43 USER – When pertaining to remote software updates of the ESS controls, the service person or the operator of the ESS.

6.44 UTILITY-INTERACTIVE (INVERTER) – An inverter intended for use in parallel with an electric utility to supply common loads and sometimes deliver power to the utility.

6.45 UTILITY-INTERACTIVE INVERTER / CONVERTER, GRID SUPPORT – An inverter or converter intended for use in parallel with an electric utility that is a Utility Interactive inverter that it is additionally evaluated for specific grid support functions different from those defined in IEEE 1547 and IEEE 1547.1. These units have specific utility interconnection settings that allow them to provide grid support functionality such as voltage and frequency regulation functions and voltage and frequency ride through.