

ENERGY STORAGE SYSTEM TEST PLAN



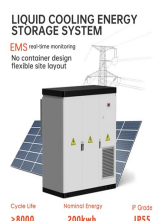
What is energy storage performance testing? Performance testing is a critical component of safe and reliable deployment of energy storage systems on the electric power grid. Specific performance tests can be applied to individual battery cells or to integrated energy storage systems.



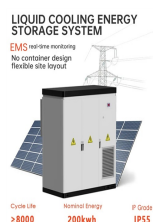
What are the test procedures for energy storage systems? Test procedures can be based on established test manuals, such as the Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems [iii] or similar protocols. 4.



What is a stored energy test? The goal of the stored energy test is to calculate how much energy can be supplied discharging, how much energy must be supplied recharging, and how efficient this cycle is. The test procedure applied to the DUT is as follows: Specify charge power P_{cha} and discharge power P_{dis} Preconditioning (only performed before testing starts):

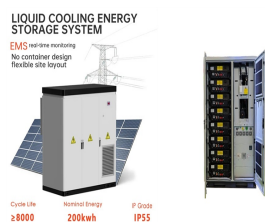


What if the energy storage system and component standards are not identified? Table 3.1. Energy Storage System and Component Standards 2. If relevant testing standards are not identified, it is possible they are under development by an SDO or by a third-party testing entity that plans to use them to conduct tests until a formal standard has been developed and approved by an SDO.

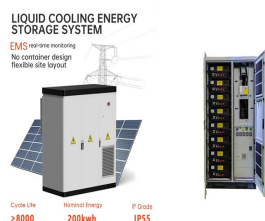


What is the energy storage standard? The Standard covers a comprehensive review of energy storage systems, covering charging and discharging, protection, control, communication between devices, fluids movement and other aspects.

ENERGY STORAGE SYSTEM TEST PLAN



Do electric energy storage systems need to be tested? It is recognized that electric energy storage equipment or systems can be a single device providing all required functions or an assembly of components, each having limited functions. Components having limited functions shall be tested for those functions in accordance with this standard.



??? The decommissioning plan should include: descriptions of the steps that will be taken, a cost estimate, a funding plan, and a contingency plan for handling damaged batteries. Siting NYSEERDA published the Battery Energy Storage System Guidebook, most-recently updated



Thermal energy storage draws electricity from the grid when demand is low and uses it to heat water, which is stored in large tanks. When needed, the water can be released to supply heat or hot water. Ice storage systems do the opposite, drawing electricity when demand is low to freeze water into large blocks of ice, which can be used to cool



BESS battery energy storage system . CR Capacity Ratio; "Demonstrated Capacity"/"Rated Capacity" DC direct current . DOE Department of Energy . E Energy, expressed in units of kWh . FEMP Federal Energy Management Program . IEC International Electrotechnical Commission . KPI key performance indicator . NREL National Renewable Energy



6 UTILITY SCALE BATTERY ENERGY STORAGE SYSTEM (BESS) BESS DESIGN IEC - 4.0 MWH SYSTEM DESIGN Battery storage systems are emerging as one of the potential solutions to increase power system flexibility in the presence of variable energy resources, such as solar and wind, due to their unique ability to absorb quickly, hold and then



Storage capacity is the amount of energy extracted from an energy storage device or system; usually measured in joules or kilowatt-hours and their multiples, it may be given in number of hours of electricity production at power plant nameplate capacity; when storage is of primary

ENERGY STORAGE SYSTEM TEST PLAN

type (i.e., thermal or pumped-water), output is sourced only with

ENERGY STORAGE SYSTEM TEST PLAN



??? UL 9540 Standard for Energy Storage Systems and Equipment ???
Published in November 2016, binational US and Canada ??? Referenced
by NFPA 855 Standard for the Installation of Stationary Energy Storage
Systems; "tested and listed equipment" per NEC ??? UL 1973 (stationary
battery) + UL 1741 (inverter) + System Considerations UL 9540



TES systems are divided into two categories: low temperature energy
storage (LTES) system and high temperature energy storage (HTES)
system, based on the operating temperature of the energy storage
material in relation to the ambient temperature [17, 23]. LTES is made up
of two components: aquiferous low-temperature TES (ALTES) and
cryogenic

APPLICATION SCENARIOS



Our energy storage experts work with manufacturers, utilities, project
developers, communities and regulators to identify, evaluate, test and
certify systems that will integrate seamlessly with today's grid, while
planning for tomorrow. Through our dedicated labs and expertise around
the world, we have created an industry-leading combination



New requirements are changing how you need to test your battery energy
storage systems. A revised edition of UL 9540 includes updates for
large-scale fire testing. It goes into effect on July 15, 2022. We will work
with you to understand your products and develop an individualized test
plan that works for your company and meets your needs



The commissioning plan is focused on testing activities, i.e. testing the
sequence of operations (SOO) to demonstrate selected applications,
performing balance-of-plant checkout, testing ???

ENERGY STORAGE SYSTEM TEST PLAN



The various applications for energy storage systems (ESSs) on the grid are discussed in Chapter 23: Applications and Grid Services. A useful analogy of technical performance is miles This chapter reviews the methods and materials used to test energy storage components and integrated systems. While the emphasis is on battery-based ESSs



Energy storage systems (ESS) store energy in batteries until needed. These systems capture generated energy (often paired with renewable sources such as wind or solar) and supply it to end users during off hours. The battery ESS consists of multiple battery cells, creating a large system with capacities in the hundreds of kilowatt-hours.



spin ("spin-to-failure") tests conducted in heavily reinforced test cells. 1
Fig. 1 ??? A prototype flywheel energy-storage system designed by Trinity Flywheels is being tested by CEM engineers are developing two flywheel energy storage systems under U.S. government contract: a 2 kilowatt-hour, 150-kilowatt, 40,000-rpm unit for a hybrid

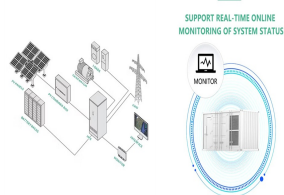


Battery storage is a technology that enables power system operators and utilities to store energy for later use. A battery energy storage system (BESS) is an electrochemical device that charges (or collects energy) from the grid or a power plant and then discharges that energy at a later time



Office: Office of Clean Energy Demonstrations Solicitation Number: DE-FOA-0003399 Access the Solicitation: OCED eXCHANGE FOA Amount: up to \$100 million Background Information. On September 5, 2024, the U.S. Department of Energy's (DOE) Office of Clean Energy Demonstrations (OCED) opened applications for up to \$100 million in federal ???

ENERGY STORAGE SYSTEM TEST PLAN



pursuant to its Comprehensive Plan]. Tier 1 Battery Energy Storage Systems have an aggregate energy capacity less than or equal to 600kWh and, Tier 2 Battery Energy Storage Systems have an aggregate energy capacity greater than 600kWh or are comprised of ???



Singapore's First Utility-scale Energy Storage System. Through a partnership between EMA and SP Group, Singapore deployed its first utility-scale ESS at a substation in Oct 2020. It has a capacity of 2.4 megawatts (MW)/2.4 megawatt-hour (MWh), which is equivalent to powering more than 200 four-room HDB households a day.



science-based techniques used to validate the safety of energy storage systems must be documented a relevant way, that includes every level of the system and every type of system. These science-based safety validation techniques will be used by each stakeholder group to ensure the safety of each new energy storage system deployed onto the grid.



Energy Storage Test Pad ??? System Testing ??? Scalable from 5 kW to 1 MW, ??? 480 VAC, three phase ??? 1 MW/1 MVAR load bank for either parallel microgrid or series uninterruptible power supply operations ??? Subcycle metering in feeder breakers for system identification and transient



Handoff to Operators: During handoff, it is important that the distribution system and energy resource operators (and other parties with control of storage system) are well-informed and trained regarding the storage system operational software, the intended use of the product, the protection systems and schemes invoked, the planned operational



on energy storage system safety." This was an initial attempt at bringing safety agencies and first responders together to understand how best to address energy storage system (ESS) safety. In 2016, DNV-GL published the GRIDSTOR Recommended Practice on "Safety, operation and

ENERGY STORAGE SYSTEM TEST PLAN

performance of grid-connected energy storage systems."

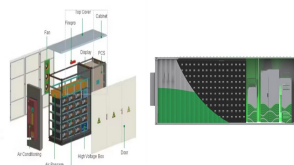
ENERGY STORAGE SYSTEM TEST PLAN



1. Energy Storage Systems Handbook for Energy Storage Systems 3 1.2 Types of ESS Technologies 1.3 Characteristics of ESS ESS technologies can be classified into five categories based on the form in which energy is stored. ESS is defined by two key characteristics ??? power capacity in Watt and storage capacity in Watt-hour.



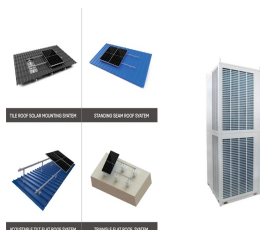
BESS Battery Energy Storage System BMS Battery Management System Br Bromine BTM Behind-the-meter CAES Compressed Air Energy Storage CSA Canadian Standards Association CSR Codes, Standards, and Regulations DOD Depth of Discharge EOL End-of-life EPRI Electric Power Research Institute ERP Emergency Response Plan ESS Energy Storage System



Energy Storage System Guide for Compliance with Safety Codes and Standards PC Cole DR Conover June 2016 Under the Energy Storage Safety Strategic Plan, developed with the support of the calculations, test results, certifications or listings, and other information to support a statement or



Battery Energy Storage System Incidents 1 Introduction This document provides guidance to first responders for incidents involving energy storage systems (ESS). While the main document for development of the pre-incident plan is the ERP, the UL 9540A test results and HMA may provide useful additional information for the plan and associated



BATTERY ENERGY STORAGE SYSTEMS from selection to commissioning: best practices to design a solid Quality Assurance Plan (QAP) for select, manufacture, test, ship and install a Battery Energy Storage System (BESS). The content listed in this document comes from Sinovoltaics' own BESS project experience and

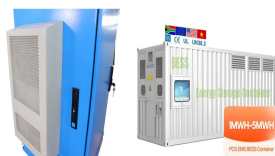
ENERGY STORAGE SYSTEM TEST PLAN



The UL 9540A Test Method, the ANSI/CAN/UL Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems, helps identify potential hazards and vulnerabilities in energy storage systems, enabling manufacturers to make necessary design modifications to improve safety and reduce risks.



Performance evaluation of the ESS does not rely on integral safety features or the battery management system; UL 9540A: Test Levels. The following table and diagram demonstrate the performance criteria of each level and when additional testing is required. Safety Standards for Lithium-ion Electrochemical Energy Storage Systems; Introduction



A Battery Energy Storage System (BESS) significantly enhances power system flexibility, especially in the context of integrating renewable energy to existing power grid. It enables the effective and secure integration of a greater renewable power capacity into the grid. BESSs are modular, housed within standard shipping containers, allowing for



Provide a plan to scale the system to cost-effective price points Achieve energy storage efficiencies greater than 85 percent Key Milestones Proof spin tested (September 2011) Test Devices Inc. San Diego Gas and Electric PROJECT DURATION 3/1/2010???12/31/2014 BUDGET



Plan to collect data from an SNF dry storage system containing high burnup fuel.³ The Test Plan for the HDRP outlines the data to be collected; the high burnup fuel to be included; and the storage system design, procedures, and licensing necessary to ???