SolarGrid Energy Solutions

Can MMC energy storage provide inertia for the power grid

Overview

Can grid frequency be maintained if there is no inertia?

Ongoing research points to the possibility of maintaining grid frequency even in systems with very low or no inertia. The development of new “grid-forming” inverters enable inverter-based resources to take a more active role in maintaining reliability and could be an integral technology for a purely inverter-based grid.

Does the grid need inertia?

But as the grid evolves with increasing penetrations of inverter-based resources—e.g., wind, solar photovoltaics, and battery storage—that do not inherently provide inertia, questions have emerged about the need for inertia and its role in the future grid.

What is a Modular Multilevel energy storage power conversion system (MMC-ESS)?

If the energy storage PCS and the modular multilevel converter (MMC) are combined to form a modular multilevel energy storage power conversion system (MMC-ESS), the modular structure of the MMC can be fully utilized. This can realize the direct grid connection of the energy storage system and save the investment of the transformer cost [5].

Do inverter-based resources reduce grid inertia?

Although growth in inverter-based resources will reduce the amount of grid inertia, there are multiple solutions for maintaining or improving system reliability—so declines in inertia do not pose significant technical or economic barriers to significant growth in wind, solar, and storage to well beyond today’s levels for most of the United States.

Can a zero-inertia microgrid operate an AC power system?

Zero-inertia microgrids have been in operation for decades, which

demonstrates that inertia is not needed to operate an AC power system (Kroposki et al. 2017). Reliance on inertia is the result of the legacy use of synchronous generators.

Can a grid forming inverter provide a synchronous AC power system?

Because grid-forming inverters can create a waveform at a specified frequency, they can provide the basis of a synchronous AC power system. Grid-forming inverters are already used in many zero-inertia microgrid systems (typically less than 10 MW) that do not use synchronous generators.

Can MMC energy storage provide inertia for the power grid

Helping the UK Power Grid Spin Back its System ...

Jul 24, 2023 · This vital transition from large fossil-fuel plants to renewable energy generation presents a need for innovative solutions that can maintain system ...

Grid-Supported Modular Multi-level Energy Storage ...

May 10, 2023 · At the same time, the energy stor-age technology based on power electronic technology can flexibly match the grid, but the traditional control method cannot use the ...

Coordinated control of grid-following and grid-forming energy storage

Jul 1, 2025 · Grid-following energy storage (GFL-ES) and grid-forming energy storage (GFM-ES) will coexist for a certain period into the future as one of the frequency regulation resources in ...

Inertia and the Power Grid: A Guide

Without the Spin

Jun 16, 2020 · Inertia in power systems refers to the energy stored in large rotating generators and some industrial motors, which gives them the tendency to remain rotating. This stored ...

Inertial imitation method of MMC with hybrid topology ...

For inertial equivalent, the inertial energy in the aforementioned VSG method needs to be provided by an AC power grid, an energy storage system or a wind tur-bine, which requires an ...

Analyzing the inertia of power grid systems comprising ...

Nov 1, 2022 · The global pursuit of low-carbon technologies has led to the rapid development of renewable energy sources (RES), such as wind and solar power. The large-scale integration ...

A Coordinated Frequency Regulation Strategy ...

Jan 24, 2025 · With the increasing proportion of renewable energy in power grids, the inertia level and frequency regulation capability of modern power

systems ...

Grid inertia: why it matters in a renewable world

Oct 25, 2019 · In an electric system, the energy contained in generators and motors at power stations and industrial facilities provides inertia as they rotate ...

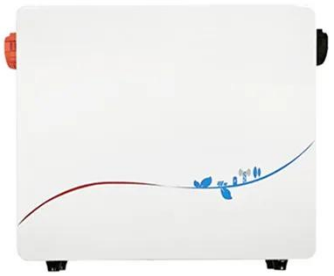
An overview of grid-forming technology and its application ...

Oct 1, 2024 · On the other hand, grid-forming control technology (GFM) can provide voltage and frequency support for the system, and thus becomes an effective measure to improve the ...

Review on grid-forming converter control methods in high ...

Jun 1, 2022 · Grid-forming (GFM) converters can provide inertia support for power grids through control technology, stabilize voltage and

frequency, and improve system stability, unlike ...

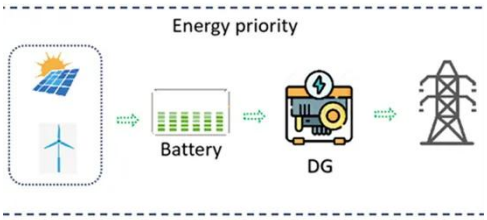


The Power Grid Inertia With High Renewable ...

This review offers an in-depth examination of contemporary and emerging strategies to bolster grid inertia, with a focus on virtual synchronous machines ...

Grid-Supported Modular Multi-level Energy Storage Power ...

May 11, 2023 · Simulation results show that the proposed grid-supported MMC-ESS can suppress power fluctuations, provide frequency support, and effectively improve grid stability.



Coordinated control of MMC-HVDC system

Jan 15, 2021 · To solve this issue, a dc-link inertia control is firstly proposed for a point-to-point modular multilevel converter based HVDC (MMC-HVDC) link,

which enables the MMC-HVDC ...

Grid-connected control strategy of modular ...

Oct 23, 2018 · Modular multilevel converter (MMC) has been applied in high voltage and high power applications widely, because of its superior properties ...

Grid Forming MMC-HVDC for Enhanced Renewable ...

Simulation results based on the IEEE 39-bus system demonstrate that the proposed system enables power sharing between geographically separated grid partitions, effectively reduces ...

Inertia and the Power Grid: A Guide Without the Spin

May 28, 2020 · The power grid is evolving to include ever-higher levels of wind and solar generation--which do not provide inertia, historically a key source

of grid reliability. Should ...

Fuzzy adaptive virtual inertia control of energy storage ...

Dec 1, 2023 · Energy storage systems based on virtual synchronous control provide virtual inertia to the power system to stabilize the frequency of the grid while smoothing out system power ...

Impact of supercapacitor energy storage on transient behaviour of MMC

Aug 28, 2023 · Grid-forming controlled Static Synchronous Compensators equipped with an ancillary energy storage are a promising approach to enhance future transmission grid s

What is inertia? , National Energy System Operator

5 days ago · This makes inertia incredibly important to the stable

operation of the electricity system. Many generators producing electricity for the grid have ...

Quantifying Synthetic Inertia of a Grid-forming Battery ...

Jun 19, 2025 · Purpose The purpose of this publication is to provide technical information to the industry. This publication outlines a methodology to quantify the synthetic inertia from a grid ...

Modular Multilevel Converter Synthetic Iner

In a microgrid with high shares of renewables integrating through MMCs, sub- module (SM) capacitors can be used as energy storage to provide a degree of synthetic inertia for system

Inertial imitation method of MMC with hybrid topology for ...

Dec 9, 2022 · Based on this, the method of using the energy storage in power module capacitor of the hybrid MMC

itself to provide inertia for VSC-HVDC system is proposed in the third part. ...

Frequency support strategy for supercapacitor-energy-storage ...

Feb 3, 2025 · The paper discusses a frequency support strategy based on MMC-HVDC system, considering the frequency variation and rate of change in the receiving-end grid during load ...

Control of MMC-based Grid-Forming STATCOM with DC ...

Jun 29, 2023 · The grid-forming performance demonstrated in simulation results verifies that the proposed control structure and the proposed design method can successfully provide inertia ...

Virtual Synchronous Generator Control of VSC-HVDC System Based on MMC

Jun 17, 2020 · For a VSC-HVDC transmission system based on a hybrid

topology converter of full-bridge and half-bridge, a kind of virtual synchronous generator (VSG) control strategy ...

Review on grid-forming converter control methods in ...

Jul 9, 2022 · Abstract: Grid-forming (GFM) converters can provide inertia support for power grids through control technology, stabilize voltage and frequency, and improve system stability, ...

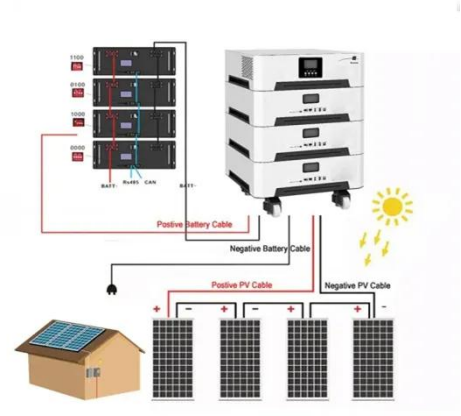
Modular Multilevel Converter Synthetic Inertia-Based ...

Jan 11, 2019 · In a microgrid with high shares of renewables integrating through MMCs, submodule (SM) capacitors can be used as energy storage to provide a degree of synthetic ...

Inertia and the power grid: A guide without the spin

Jun 11, 2025 · The power grid is evolving to include ever-higher levels of wind and solar generation--which do not provide

inertia, historically a key source of grid reliability. Should ...

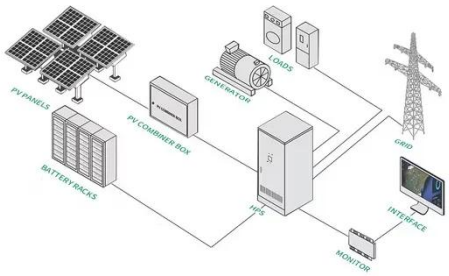


Grid Synchronization of the VSC-HVDC System ...

Dec 19, 2024 · The integration of renewable energy sources is considerably enhanced by these systems, such as offshore wind farms, by efficiently ...

Inertia and the Power Grid: A Guide Without the Spin , NREL

May 28, 2020 · The power grid is evolving to include ever-higher levels of wind and solar generation--which do not provide inertia, historically a key source of grid reliability. Should ...



Modular Multilevel Converter Synthetic Iner

In a microgrid with high shares of renewables integrating through MMCs, sub- module (SM) capacitors can be used as energy storage to provide a degree of

synthetic inertia for system ...

Grid-Supported Modular Multi-level Energy Storage Power ...

May 11, 2023 · The Modular Multilevel Converter Based Battery Energy Storage System (MMC-BESS) can output active and reactive power at the same time. This is suitable for new energy ...

Stability Pathfinders: what they mean for battery ...

How do National Grid ESO's Stability Pathfinders work? How much inertia does Britain's grid need? And how can battery energy storage systems help?

Modular Multilevel Converter Synthetic Inertia-Based ...

Jan 11, 2019 · Modular multilevel converters (MMCs) can be employed serving as an interface between the large-scale renewable generation and

power grids. In a microgrid with high ...

A new enhanced synthetic inertia system for stability ...

By exploiting the inherent capacitive storage capability of MMC integrated with a battery energy storage system (BESS), the MMC-based IC can provide synthetic inertia and damping ...

The road to 100% renewables and the role of ...

Feb 28, 2022 · Battery storage can provide 'synthetic inertia' to replace the real inertia being lost by the closure of power stations and have also been ...

Virtual Synchronous Generator Control of ...

Jun 17, 2020 · This can provide inertia and damping for the grid and can improve the stability of VSC-HVDC system for large-scale new energy

access [1 - 4]. ...

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