Case Study

Jinko ESS's BESS Application of AC-Coupled GWh-Scale Project

340.2 MW / 1.61GWh Li-ion BESS+PV Project in Chile

Project Overview

Located in north-central Chile, the project sits in one of the world's most solar-rich regions, where photovoltaic generation accounts for a rapidly growing share of the energy mix. While this exceptional solar resource creates strong renewable potential, it also introduces significant grid integration and operational challenges.

Under these conditions, the customer required a large-scale, highly reliable energy storage solution capable of addressing complex grid demands and extreme environmental conditions simultaneously, while ensuring safe and stable long-term operation.

To meet these requirements, Jinko ESS delivered a utility-scale, AC-coupled energy storage solution with a total capacity of 340.2 MW / 1.61 GWh, deployed across four sites. The system enables large-scale photovoltaic generation to be stabilized, dispatched and safely integrated into the grid, while supporting long-term, reliable operation under some of the most demanding environmental conditions globally.

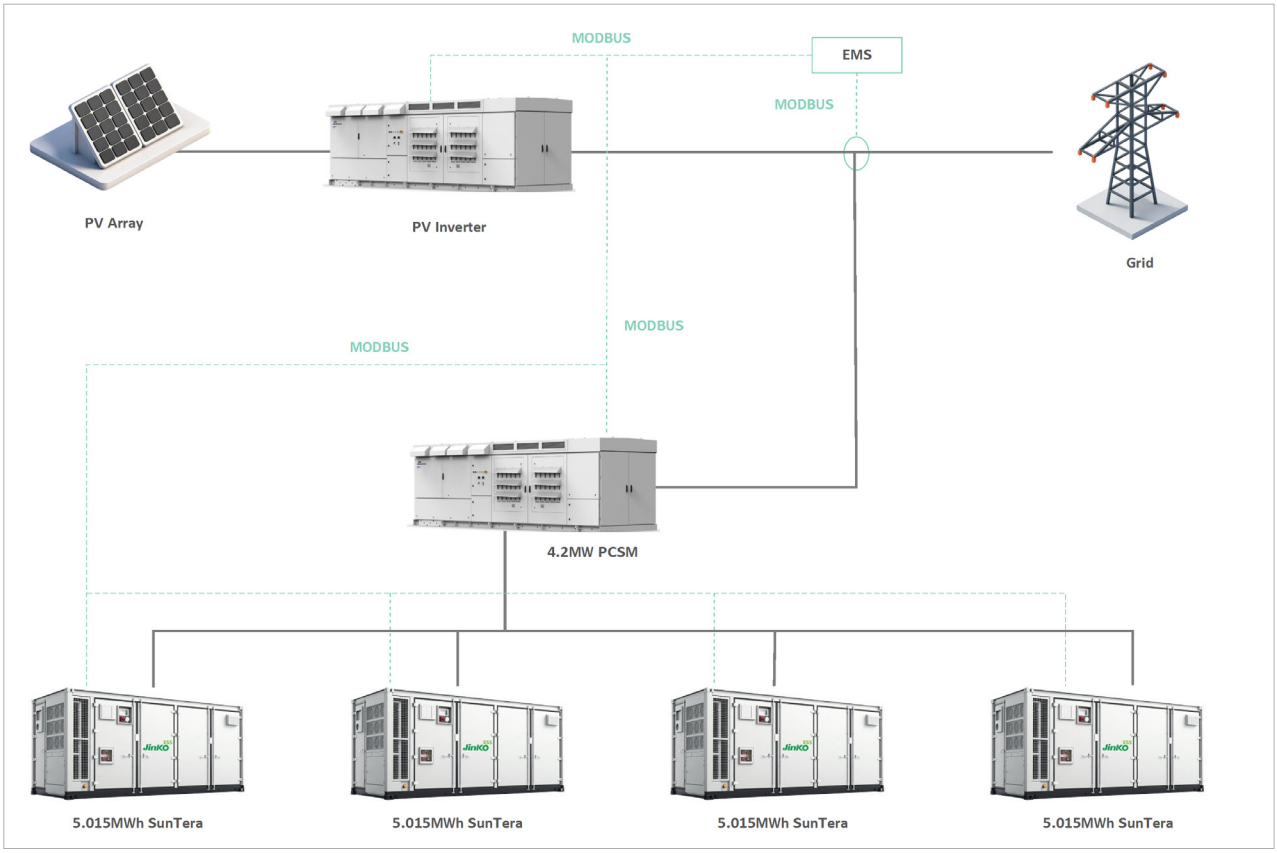

Fig. 1 System Diagram of the AC-coupled Project

Key Challenges

The project faced a combination of grid-level, environmental and safety-driven challenges.

From the customer's perspective, these challenges required an energy storage solution capable of going beyond standardized configurations to ensure grid stability, extreme environmental resilience and safe operation at GWh scale.

Grid stability and renewable integration

The mismatch between daytime PV generation peaks and evening load demand led to surplus energy during the day and supply gaps at night. This resulted in extreme price spreads, grid frequency and voltage fluctuations, and limitations on further renewable integration.

Extreme environmental conditions

The site conditions posed severe challenges to long-term system reliability:

· Located in a high seismic zone, requiring top-tier seismic resilience.

· Exposed to strong wind-driven dust and sand, increasing the risks of corrosion and thermal management challenges.

· Subject to seasonal periods of relative humidity reaching 100%, posing a high risk of condensation and electrical faults.

Stringent safety requirements at GWh-scale

The deployment of a GWh-scale lithium battery system required the highest level of fire protection and early-warning capability to mitigate low-probability, high-impact risks.

Large-scale, multi-site delivery and commissioning complexity

The project spans four sites with GWh-scale deployment, significantly increasing the complexity of system integration, commissioning coordination and delivery scheduling. Without early validation and standardized integration, large-scale, multi-site projects can face extended commissioning timelines, on-site integration risks and inconsistent system performance.

The Solution

To address the project's grid integration needs and extreme site conditions, Jinko ESS delivered a turnkey, AC-coupled energy storage solution, combining a robust system architecture with deep grid-code compliance, harsh-environment adaptability and multi-layer safety protection:

AC-coupled system architecture for scalable deployment

The project adopted AC-coupled architecture, with the BESS Plant independently connected to the PV plant substation. This configuration enables flexible deployment and coordinated control, while supporting utility-scale expansion across multiple sites. The total project scope reaches 340.2 MW / 1.609 GWh, deployed across four sites.

Utility-scale platform engineered for safety and harsh environments

Jinko ESS supplied a utility-scale energy storage platform designed for long-duration operation under extreme environmental and safety requirements. The platform integrates:

· High seismic resilience in compliance with IEEE 693 High Level;

· Robust protection against wind-blown dust and sand;

· Adaptive operation under up to 100% humidity, mitigating condensation risks through intelligent thermal management.

In parallel, a multi-layer safety architecture—including in-house BMS logic, thermal runaway early warning, smoke detection, and an active ventilation plus Novec-based fire suppression strategy aligned with NFPA 69, UL 9540 and UL 9540A—ensures a high level of safety for GWh-scale deployment.

AC-side integration for long-duration, grid-adaptive operation

The solution integrates industry-leading 4.2 MW Power Electronics PCSM All-in-One Skids, each interfacing with four battery containers to form a 0.2 C long-duration configuration optimized for energy shifting applications.

Combined with millisecond-level dynamic response, the system executes grid commands for frequency regulation and voltage support with high accuracy and stability.

Integration validation and delivery assurance at scale

To reduce delivery and commissioning risks across multiple sites, factory-level pre-integration testing was conducted prior to shipment. The Communication, control and protection logic between battery containers and PCSM units were fully validated, enabling plug-and-play commissioning on site.

In addition, Jinko ESS collaborated with project partners to optimize PV–storage coordinated control strategies, ensuring smooth power output and reliable operation from initial energization through long-term operation.

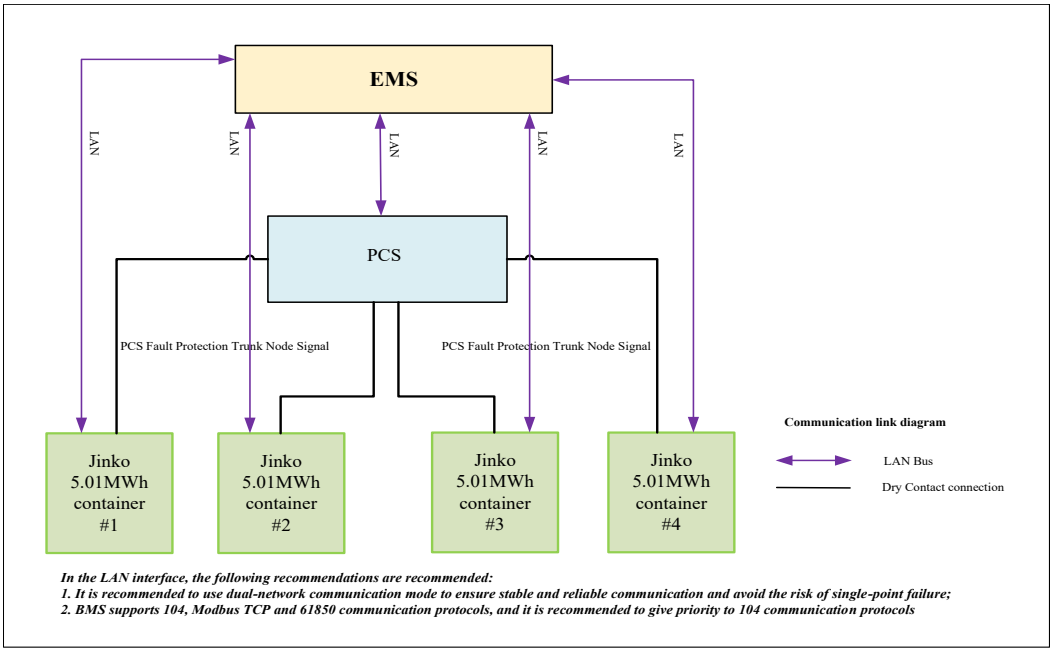

Fig. 2 Communication Topology

Operating Logic

The storage system operates as a grid-supporting and long-duration energy shifting resource, aligned with Chile's high-solar generation profile:

· Daytime operation: During periods of high solar output, the energy storage system charges from surplus PV generation, reducing curtailment and smoothing grid injections.

· Nighttime operation: Stored energy is discharged during periods of higher demand, reducing peak-to-valley differences, improving dispatchability and supporting grid frequency and voltage stability.

In parallel, the system actively participates in grid ancillary services, executing fast and precise responses to grid regulation signals.

Customer Benefits

Following commissioning and operation, the project delivers clear value to the customer across grid performance, reliability, safety and lifecycle economics:

Improved grid stability and renewable utilization

The energy storage system smooths PV output, reduces peak-to-valley spreads and enhances controllability and dispatchability, enabling large-scale solar generation to be integrated and dispatched more effectively under grid constraints.

Verified reliability in extreme environments

Validated operation under high seismic risk, strong wind-driven dust/sand exposure and seasonal humidity up to 100% strengthens long-term availability and reduces environment-driven failure risks in harsh site conditions.

Balanced safety and efficiency at GWh scale

A multi-layer safety protection system combines in-house BMS logic, an early warning system, and a certified advanced fire suppression strategy to ensure high safety margins, while liquid cooling supports stable operating temperatures and overall system efficiency.

Reduced delivery and commissioning risk

Factory-level pre-integration and end-to-end validation enable more standardized, plug-and-play on-site commissioning, lowering integration uncertainties and schedule risks across four-site deployment.

Lower lifecycle cost

Robust system design, validated integration and reliable operation reduce on-site commissioning workload, simplify O&M activities and improve total lifecycle economics.

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