

05

Typical Solutions

GRID-FORMING BESS SOLUTIONS

The system integrates two 1250kW PCS units and one transformer into a Grid-forming MV Turnkey Station, serving as the energy conversion stage that transforms battery storage energy into grid-forming support capability. Considering the 300% overload capacity for 10 seconds, a corresponding number of battery containers are configured to form a 2.5MW grid-forming BESS unit. Multiple grid-forming BESS units are integrated in parallel and centrally dispatched to function as grid support nodes with capacity matching traditional synchronous generators.

- Multiple grid-forming BESS units, combined with a grid-forming BESS coordinating control cabinet, form a station-level grid-forming BESS solution.
- The grid-forming BESS coordinating control cabinet integrates EMS, PMS, rapid station-level coordinated control, synchronizing devices, anti-islanding devices and other equipment, allowing flexible configuration based on station-level functional requirements.
- The grid-forming BESS coordinating control cabinet supports the connection of hundreds of grid-forming BESS units.
- Unified dispatch enables the construction of hundred-MW level grid-forming BESS power station.

Typical Configuration of Grid-forming BESS Power Station

Name	Name	Number	Notes
Typical Solution 1	100MW/400MWh	1	Single grid-forming BESS unit of 2.5MW/10MWh
1.1	Grid-forming MV Turnkey Station	40	Single MV Turnkey Station includes two 1250kW grid-forming PCS units
1.2	Battery Container	80	Single battery container of 5MWh
1.3	Grid-forming BESS Coordinating Control Cabinet	1	Integrating EMS, PMS, rapid station-level coordinated control, synchronizing devices, anti-islanding devices and other equipment, allowing flexible configuration based on station-level functional requirements.
Typical Solution 2	150MW/300MWh	1	Single grid-forming BESS unit of 2.5MW/5MWh
2.1	Grid-forming MV Turnkey Station	60	Single MV Turnkey Station includes two 1250kW grid-forming PCS units
2.2	Battery Container	60	Single battery container of 5MWh
2.3	Grid-forming BESS Coordinating Control Cabinet	1	Same as 1.3



GRID-FORMING BESS SOLUTIONS



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01

Application Scenarios

GRID-FORMING BESS SOLUTIONS

Constructing the power conversion system (PCS) with the characteristics of a voltage source, centered around the grid-forming technology, and simulating the characteristics of a synchronous generator through grid-forming control, enables the BESS system to provide voltage and frequency support capabilities to the power grid. The main application scenarios are as follows:

Grid Integration and Island Operation of Renewable Energy in Desert/Gobi/Wilderness Areas:

Renewable energy sources are widely distributed in these regions, with weak system strength and low power supply reliability. An integrated solution centered on constructing grid-forming BESS provides frequency and voltage support, while also offering conventional BESS functions such as peak shaving and smoothing the output characteristics of renewable energy.

Renewable Energy Base Power Transmission via Flexible HVDC:

When flexible HVDC is used for power transmission from pure renewable energy bases, the sending-end converter station employs grid-forming BESS technology to control the voltage frequency and amplitude of the renewable energy base's collection bus, providing stable support for the renewable energy base.

Flexible HVDC Connected to Weak Systems:

When system strength is too low, the operational characteristics of flexible HVDC may be affected. In the event of grid frequency disturbances, grid-forming BESS can actively support the grid, resolving stability issues in flexible HVDC systems when system strength is reduced.



BESS Power Station



Grid-forming PCS

02 Core Functions

GRID-FORMING BESS SOLUTIONS

Transient Support:

When grid voltage experiences angle or amplitude jumps, grid-forming BESS provides active and reactive power support to maintain stable equipment operation, with a fault reactive response time of less than 10ms.

Inertia Response:

When the power system frequency changes rapidly, grid-forming BESS naturally adjusts active power based on the rate of frequency change, with an inertia time constant configurable between 1-20.

Primary Frequency Regulation:

In grid-connected operation, grid-forming BESS can coordinate with the BESS control system or autonomously adjust power output in response to system frequency variations.

Damping Control:

When low-frequency oscillations occur in the grid, grid-forming BESS can regulate active power through damping control to suppress oscillations.

Black Start:

When the power source side is in a complete blackout state, multiple grid-forming PCS units can start in parallel with zero-voltage synchronization, achieving oscillation-free operation and circulating currents below 5%.

Voltage Regulation:

In grid-connected operation, it can coordinate with the BESS control system or autonomously adjust reactive power in response to system voltage changes, enabling active voltage regulation.

Grid-Connected/Island-ed Mode Switching:

Capable of operating in both grid-connected and islanded modes, with fast, smooth, and seamless transitions between the two modes.

Relay Protection Compatibility:

The transient output of grid-forming BESS matches the transient characteristics of synchronous generators, ensuring correct operation of protection elements and accurate phase-selective tripping during faults.

03 Technological Advantages

GRID-FORMING BESS SOLUTIONS



Efficient & Compact

ANPC topology, maximum efficiency **> 99%**, intelligent air cooling, industry-leading power density



Safe & Reliable

IP65 high protection level, multiple software and hardware protection



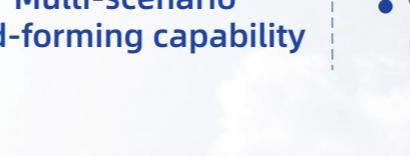
Flexible & Fast

Supporting flexible switching between grid-following and grid-forming modes, charge-discharge transition time **≤ 20ms**



Station-level grid-forming & Full-scenario operation capability

- Supporting the parallel operation of large-scale centralized grid-forming BESS and building hundred-MW level grid-forming BESS power stations
- Supporting the entire station's grid-connected, off-grid, and the switching operation



Multi-scenario grid-forming capability

- Short-term **300%** overload
- Inertia support and primary frequency regulation
- Voltage support and regulation
- Adaptability to weak systems
- Entire-station black start



3. Battery System

4. Grid-forming PCS

04 Specifications

GRID-FORMING BESS SOLUTIONS

Product Model	CSD-5831F-A	CSD-5831F-B	CSD-5831F-C
DC Side			
Rated DC Power	750kW	1250kW	1500kW
Maximum DC Power	842kW@long-term 2250kW@10s	1403kW@ long-term 3750kW@10s	1684kW@ long-term 4500kW@10s
Rated DC Power	842A@ long-term 2250A@10s	1403A@ long-term 3750A@10s	1684A@ long-term 4500A@10s
Maximum DC Bus Voltage	1500V		
Working Range of DC Side Voltage	1000V-1500V		
Number of DC Input Circuits	1	1 or 2	1 or 2
AC Side (Grid-Connected)			
AC Output Power	750kVA @45°C 825kVA @30°C	1250kVA @45°C 1375kVA @30°C	1500kVA @45°C 1650kVA @30°C
Maximum AC Power	825kVA @ long-term 2250kVA @10s	1375kVA @ long-term 3750kVA @10s	1650kVA @ long-term 4500kVA @10s
Maximum AC Current	690A @ long-term 1883A @10s	1151A @ long-term 3138A @10s	1381A @ long-term 3765A @10s
Rated Output Voltage	690V		
AC Voltage Range	621-759V		
Rated Grid Frequency	50/60Hz		
Total Harmonic Distortion of Current	< 3% (Rated Power)		
Power Factor	> 0.99 (at >20% Load) / -1 (Leading) ~1 (Lagging)		
Reactive Power Range	-100% ~ 100%		
AC Side (Off-Grid)			
Rated Output Voltage	690V		
AC Voltage Range	621-759V		
Voltage Unbalance Degree	< 2%		
Total Harmonic Distortion of Voltage	< 3% (Linear Load)		
Rated Output Frequency	50/60Hz		
Dynamic Voltage Transient Range	< 10% (when the load changes suddenly from 20% to 100% or from 100% to 20% under the condition of a balanced resistive load)		
Efficiency			
Maximum Efficiency	> 99%		

Product Model	CSD-5831F-A	CSD-5831F-B	CSD-5831F-C
System Parameters			
Connection Mode	Three-phase three-wire		
Isolation Mode	Non-isolated		
Overload Capacity	1.1 times for longer-term operation, 1.2 times for 1min, 1.3 times for 10s		
Allowable Ambient Temperature	-35°C~60°C (Derated operation when the temperature is > 45°C)		
Allowable Relative Humidity	0~100% (Without Condensation)		
Maximum Operating Altitude	500m (Customize for above 300m)		
Noise	80dB		
Dimensions (Width × Height × Depth)	1080×2400×1250mm	2100×2450×1150mm	2160×450×1150mm
Overall Weight	1400kg	280kg	280kg
Protection Level	IP65		
Cooling Method	Intelligent Forced Air Cooling		
Communication			
Communication Interface	RS485, CAN, Ethernet, Optical Port		
Communication Protocol	CAN, Modbus, IEC61850, GOOSE		



5. Grid-forming PCS