





Introduction of National Wind and Solar Energy Storage and Transmission Demonstration Project Yao Hongchun China Electric Power Research Institute

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2. Technical Scheme of the Project



Project Overview

Prominent problems in new energy generation in China

We need to improve power generation characteristics as the new energy sources are currently random, volatile and intermittent.

We need to improve grid source coordination as it's now difficult to do effective forecast, dispatch and control.

The resources have distinct geographical features with reverse distribution against the demand, which calls for effective allocation of the resources.



Project Overview

Overview of the Demonstration Project

➢National Wind and Solar Energy Storage and Transmission Demonstration Project is located in Bashang area within the territory of Zhangbei County and Shangyi County, Zhangjiakou, Hebei Province. It's 20km from Zhangbei County, about 50km from Zhangjiakou and around 200km from Beijing.

≻Planned total capacity: 500MW for wind power generation,100MW for PV power generation,
70 ~ 110MW for energy storage system. For Phase I, the proposed total capacity for wind power generation is 100MW, PV 40MW and 20MW for energy storage system.







Project Overview

Wind-PV complementarities and energy storage analysis

An analysis on wind & PV resources in Zhangbei area tells us that when wind to PV ratio ranges 10:0~10:10, the combined output fluctuates between 30% - 12%. Therefore, to improve the wind-PV complementary properties can help to overcome output fluctuation.

Research indicates that the smaller the wind to PV ratio is, the more significant the energy storage stabilization can be; when energy storage capacity is 20-40MW, the efficiency to stabilize fluctuation reaches the maximum; if energy storage capacity ranges 60-80MW, the stabilizing effect is optimum.



Project Overview

Technical path of the demonstration project





1. Project overview





Technical Scheme

General structure of wind-PV storage and transmission system





Technical Scheme: Intelligent Monitoring System

Schemes for intelligent monitoring system for combined power generation



Rested on control concepts of centralized decision-making and distributed execution. such integrated monitoring system functions realize joint to operation with coordinated multicontrol targets (smooth output, tracking plan, AGC support, load shifting, etc.) under different modes of combination (i.e.. wind, solar, storage, wind +solar, wind + storage, solar + storage, wind + solar +storage) and diverse time scales (steady, dynamic, transient).

Real-time monitoring



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Technical Scheme: Intelligent Monitoring system

Functions of intelligent monitoring system for combined power generation

- Data acquisition and combined monitoring for wind + solar+ storage combination
- Power generation prediction for wind + solar+ storage combination
- Combined control for wind + solar+ storage combination
- Wind + solar+ storage data analysis and evaluation
- Combined optimized scheduling for wind + solar+ storage combination
- Realization of communication with grid scheduling system
- Realization of communication with farm station



Technical Scheme of Project: Wind Farm

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Principle to Select Wind Power Generation Unit Types



Technical Scheme: Wind Farm



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Wind turbine configuration

Demonstration area (50MW)	Display area (50MW)
2.0MW wind turbine (24 sets)	2.5MW wind turbine (15 sets) 1MW vertical-axle wind turbine (2 sets) 3.0MW wind turbine (2 sets) 5.0MW wind turbine (1 set)



Technical Scheme: Wind Farm

Diagrams of technical schemes in wind farm





Technical Scheme: PV Power Station

Configuration of major equipment in PV power station

PV modules

S.N.	Type of module	Capacity (kW)	Mode of installation	
1		35000	Fixed installation	
	Polycrystalline silicon PV module	1500	Inclined uniaxial tracking	
		500	Even uniaxial tracking	
		50	Biaxial tracking	
2		500	Fixed installation	
	Sunpower PV module	500	Inclined uniaxial tracking	
3	Monocrystalline silicon PV module	1000	Fixed installation	
4	Non-crystalline film PV module	1000	Fixed installation	

For PV inverters, 630kW (16 sets) and 500kW (60 sets) are adopted.



Technical Scheme: PV Power Station

Diagrams for technical schemes for PV power station





Technical Scheme: Energy Storage Power Station

Energy storage system improves access capacity related to wind-solar combined power generation from three aspects.

Smooth fluctuation of combined power generation, enhanced controllability and reduced reserve capacity. Tracking planned generation output, improving predictability of combined power generation and decreasing output deviation Participating in peak load shaving of the grid and enhancing dispatchability of the system

Simulated calculation reveals that the basic configuration power for energy storage is ~ 20MW and the capacity is about 90MWh.



Technical Scheme: Energy Storage Power Station

Comparison of the overall performance of energy storage cells

	Price	Reliability risk	Project realizable risk	Safety and environmental risks	Demon result	Technical flexibility	Configuration principle
Sodium- sulphur cell	High	High	Low	Medium	Good	Low	Appropriate proportion
Electrochemical flow cell	High	Low	High	High	So-so	High	Low proportion
Lithium-ion cell	Low	Medium	Medium	Low	So-so	High	High

Through comparative analysis on energy storage systems of the three types of cells in terms of technical risks, technical reasonability and technical flexibility, they have advantages of their own in properties. But in our project, we found that the energy storage system of the lithium-ion cell is the best regarding the overall performance, followed by that of the sodium-sulfur cell; that of the electrochemical flow cell is relatively poor.



Technical Scheme: Energy Storage Power Station

Configuration schemes of energy storage systems

	Output power	Energy storage capacity	Price (10,000 yuan)	Floor area (m²)
Energy storage of lithium- ion cell	14MW	64MWh	24000	7000
Energy storage of sodium- sulpher cell	4MW	24MWh	16000	1000
Energy storage of vanadium redox flow (VRB) cell	2MW	8MWh	6000	2000
Total (rated output)	20MW	96MWh	46000	10000
Total (practical output)	28MW	96MWh	-	-

Features:

> We introduced technologically matured sodium-sulfur cell which helped to reduce technical risks;

- We introduced three types of energy storage cells with diversified energy storage devices, which is conducive to comparative analysis on the performance of different energy storage technologies;
- > The power and capacity configurations can guarantee the application in Phase I project.



Technical Scheme: Energy Storage Power Station

Structure diagrams of energy storage system

We aim to build world-class large-capacity energy storage systems, conduct in-depth study on multiple applications such as smooth output, track dispatch and scheduling curve, and peak load shaving and explore the values of energy storage systems in promoting large-scale new energy grid integration.



intelligent monitoring system for combined power generation





Realizing seamless connection with higher-level scheduling







Lithium-ion energy storage system



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