FIRST - Class

Innovating for Tomorrow's Energy Landscape: F.I.R.ST Technologies at the Forefront of the AI-driven, Carbon-Neutral Transition

2025. 9.

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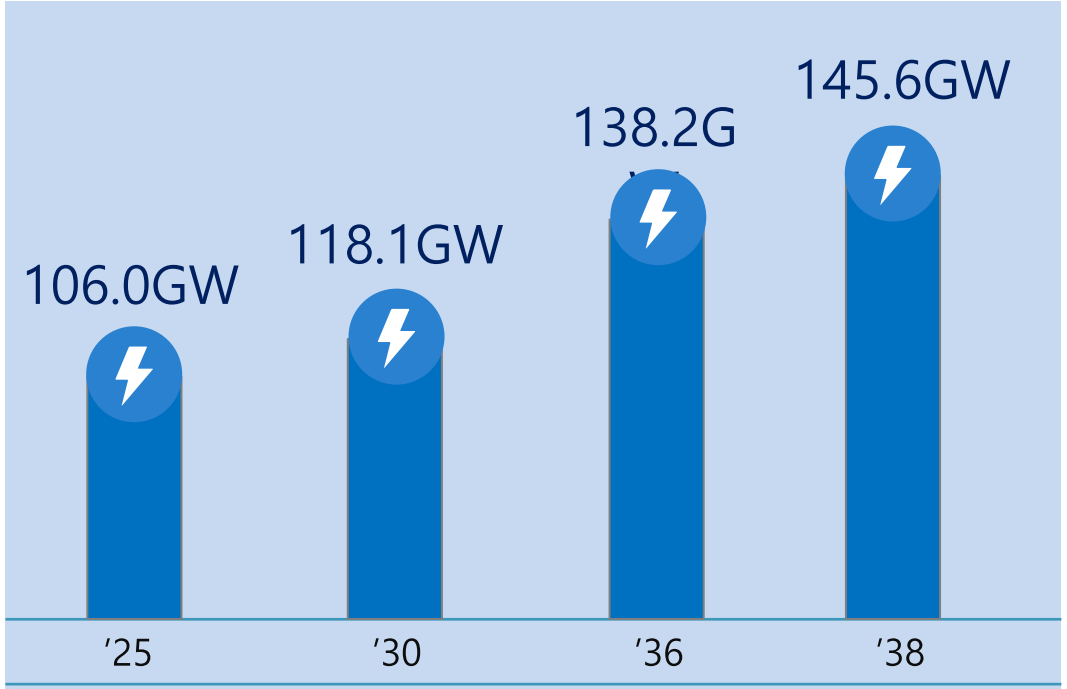
Contents

I. Overview

- ❖ Surging power demand from data centers and semiconductor clusters, etc.
- ❖ Difficulty in building new large-scale power grids due to social & environmental issues

⇒ Timely establishment of national backbone power grids is necessary !

Surging power demand



Based on peak power

Difficulty in building new power grids

Electricity business	Target	Expected Completion	Delay months
500kV East coast-Singapyeong HVDC	'19.12	'26.06	78
345kV Bukdangjin-Sintangjeong	'12.06	'24.12	150
345kV Dangjin power plant-Sinsongsan	'21.06	'28.12	90
345kV Sindangjin-Bukdangjin	'21.06	'26.12	66

Cases of power grid construction delays(KEPCO)

➡ **Ultimately, the core issue is the Power Grid !!**

II. FIRST Technologies

Development of 'FIRST Technologies' for the fundamental resolution of future power grid challenges.

Flexibility
in power grid

Technologies
Integration

Grid
Resilience

Sustainable
energy
Transition

『Enhancing the Flexibility and Resilience of the future power grid, coupled with the Integration of diverse power and energy technologies for a Sustainable energy Transition』

III. Main Research Contents

Technologies for enhancing power grid flexibility to rapidly respond to changing electricity demand and supply conditions

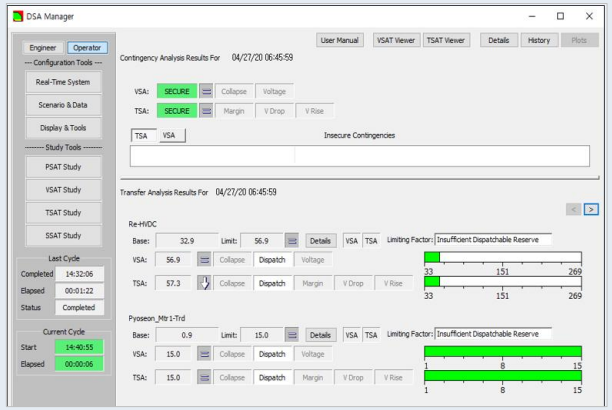
Key Achievements

Localization of HVDC Conversion Technologies

- Localization development of **200MW ±120kV BTB converter stations as large-scale facilities**
- Installation and field test of Yang-ju converter station(’24)

Online Grid Congestion Assessment

- Development of an **online transient stability analysis system** for the Honam region (DSA Manager)
- Assessment of renewable energy generation limit for grid stability

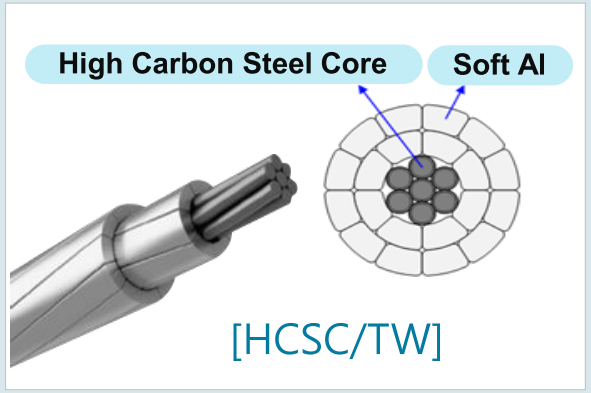


Technologies for enhancing power grid flexibility to rapidly respond to changing electricity demand and supply conditions

Research Status

Increasing Transmission Capacity

- Development and application in real grid of new large-capacity transmission wire (HCSC/TW) ⇒ 150% capacity increase compared to ACSR
- Field test of DLR(Dynamic Line Rating) technology



Mitigation of Generation Constraints

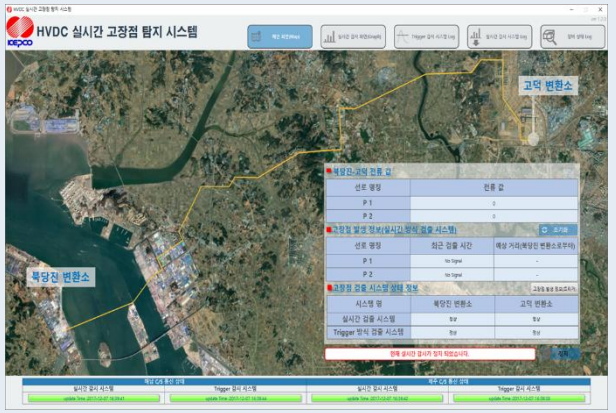
- Development of generation constraint evaluation system based dynamic stability
- Revision of the operation standards (Joint research with U.S. EPRI)

Increasing complexity of the future power grid → **New Technologies Integration** in various fields

Key Achievements

Commercialization of Fault Location Detection

- **Fault location detection tech.** within 1% error rate (Previously 2~3%)
- Utilization of the Bukdangjin-Godeok HVDC in the real grid
- EPRI tech. sales and contracted research (500 million KRW)



Renewable Energy Forecasting & Control

- Implementation and operation of a **renewable energy forecasting & control system** (LRMS*)
- Applied to Gwangju-Jeonnam headquarters by KEPCO

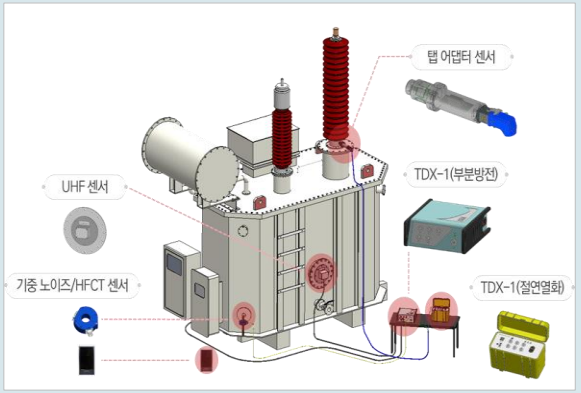
* LRMS : Local Renewable energy Management System

Increasing complexity of the future power grid → **New Technologies Integration** in various fields

Research Status

Preventive Diagnostics (Substation)

- Establishment of comprehensive diagnostic acceptance test procedures
- Development of bushing online diagnostic devices (U.S. tech. sales)
- Commercialization through the utilization of substation equipment test site (the Gochang Power Testing Center)



Preventive Diagnostics (Transmission)

- Development of AI-based partial discharge diagnosis technology
- Establishment of an underground transmission condition assessment system (UPHAS*)

* UPHAS : Underground PD & Health index Assessment System

Technologies for strengthening power grid resilience to enable rapid restoration in case of power supply interruptions due to natural disasters, technical failures, etc.

Key Achievements

High Resolution Power Grid Monitoring & Control

- **Establishment of a power grid monitoring system in Jeju Island (J-WAMS)**
- **Achievement of 100% online observability for grid variables**

Real-time Power Grid Analysis

- **Establishment of full-scale transmission system modeling and HVDC/ FACTS control & protection system test procedures based on HILS***
- **Development of real-time power grid analysis technology**

* HILS : Hardware In the Loop Simulation

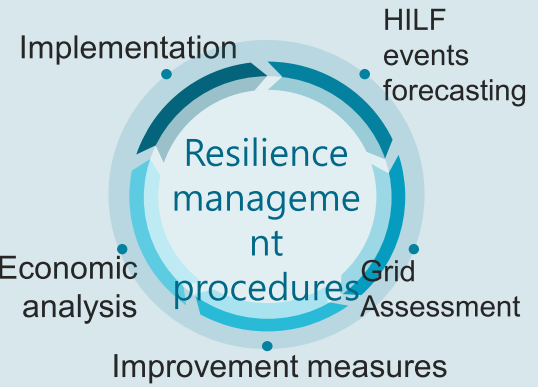
Technologies for strengthening power grid resilience to enable rapid restoration in case of power supply interruptions due to natural disasters, technical failures, etc.

Research Status

Improved Seismic Performance

- Establishment of **seismic standards for transmission and distribution facilities** (Earthquake magnitude 6.3 → 6.6)
- Application of seismic reinforcement technologies (765kV substation facilities, etc.)

Resilience Assessment & Management



- **HILF* events forecasting** such as extreme weather conditions and cyber-attacks, etc.
- Establishment of resilience assessment & management procedures in power grid

* High Impact, Low Frequency

Technologies for transition to sustainable energy sources to mitigate climate change and enhance energy security

Key Achievements

Electromagnetic Environment Analysis

- Commercialization and grid application of AC/DC integrated electric environment analysis S/W (’23)
- 300 cases performed on overhead & underground transmission lines

Eco-friendly Transmission Towers

- Development of Eco-friendly transmission slim towers
- Establishment of design technology for Eco-friendly 500kV HVDC transmission towers

Technologies for transition to sustainable energy sources to mitigate climate change and enhance energy security

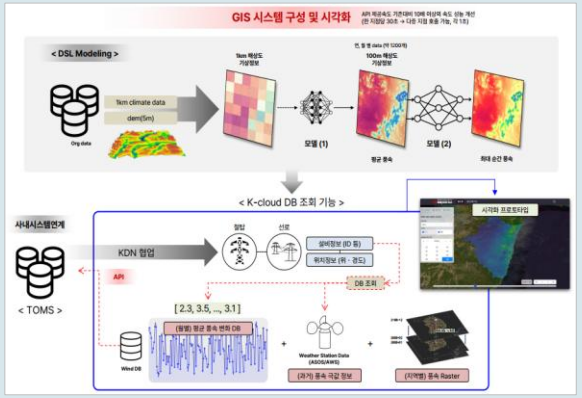
Research Status

Eco-friendly Power Facilities

- Development of Eco-friendly 50kA/4,000A E-GIS applied with C_4F_7N gas mixtures
- Reduction of 88,000 tons in carbon emissions (~'29)

Preparing for Climate Change

- Establishment of transmission facility design standards to reflect climate change
- Development of prediction maps for short/long-term wind speed change



IV. Future Plans

Images of the Future Power Grid & 2050 Carbon Neutrality Achievement using AI (Gemini 2.5)

Leading advanced future power grid establishment through

‘F.I.R.ST Technologies’