

Industry

NAVIGATOR

SUSTAINABLE DEVELOPMENT
STRATEGIES FOR T&D

CONFERENCE 2025

Overview of SEDA & Total Solution

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What is KEPCO SEDA?

KEPCO SEDA is a substation equipment diagnostics & analysis system that engages big data and AI to enhance the operation of substations. It integrates the following data to provide comprehensive diagnostics and analysis:

1. Real-time Data	Collected via sensors installed on substation equipment
2. Offline Data	Acquired through human inspections and pertinent records
3. Data from others	Incorporates weather and disaster data from external institutions

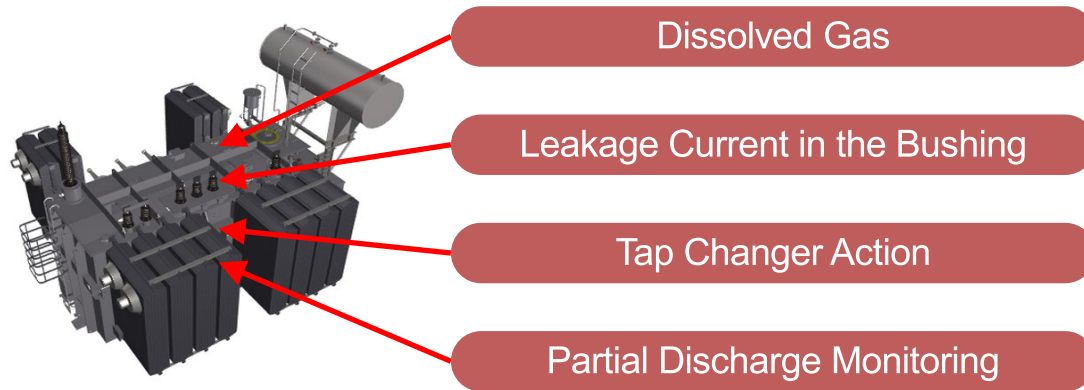


Key Advantages

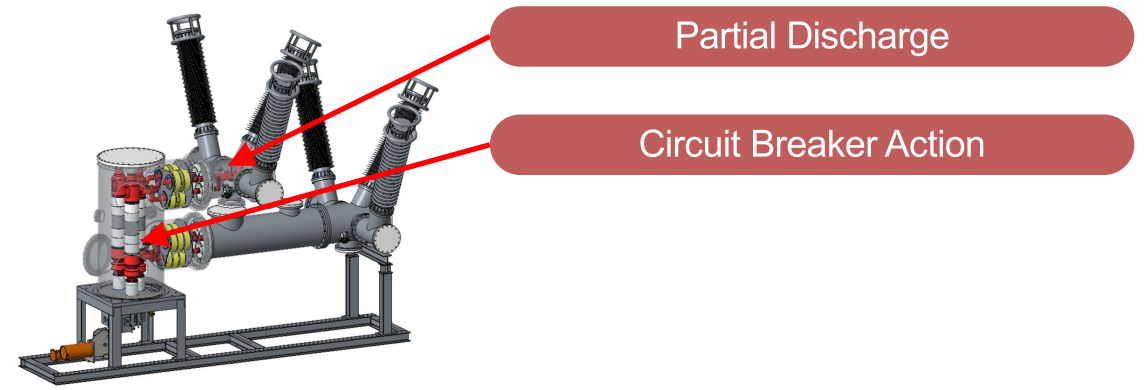
- ✓ Transition from labor-intensive inspections to **data-driven equipment diagnostics**.
- ✓ **Enhanced fault prevention and reduced operating costs** through efficient maintenance and inspection.

1. (Real-Time Data) Diagnosis via Sensor Data

Main Transformer – 4 Sensors



GIS – 2 Sensors



- ✓ **Diagnosing Defect Signals:** Analysis of data from 6 sensors installed on the M.Tr or GIS.
- ✓ **High-Speed Data Transmission:** Sensor data is sent to the servers at KEPCO HQ and regional offices through an ultra-fast network compliant to IEC-61850 for real-time processing.

2. (Off-line Data) Optimizing Data Management with Smart Mobile Inspection

- ✓ **Input and Automated Upload:** Results from periodic off-line inspections (e.g. patrol inspections or local diagnosis data for gas/operation pressure, failures, etc.) are entered and loaded to the system using smartphone apps.
- ✓ **Automated Data Processing:** Data are automatically extracted and transferred.

* Wiseman SS Data management – Data entry examples (Online & Offline)

On-line Diagnosis History

Grade : ● Normal ● Acceptance ● Caution ● Poor ● Critical ● No Data

Class	Grade	Results	Normal	Acceptance	Caution	Poor	Critical
GIS		GIS PD	Normal	○			
	Caution	CB Operation			○		
		Patrol, Inspection	Normal	○			
		PD(OFF)	-				

Off-line Diagnosis History

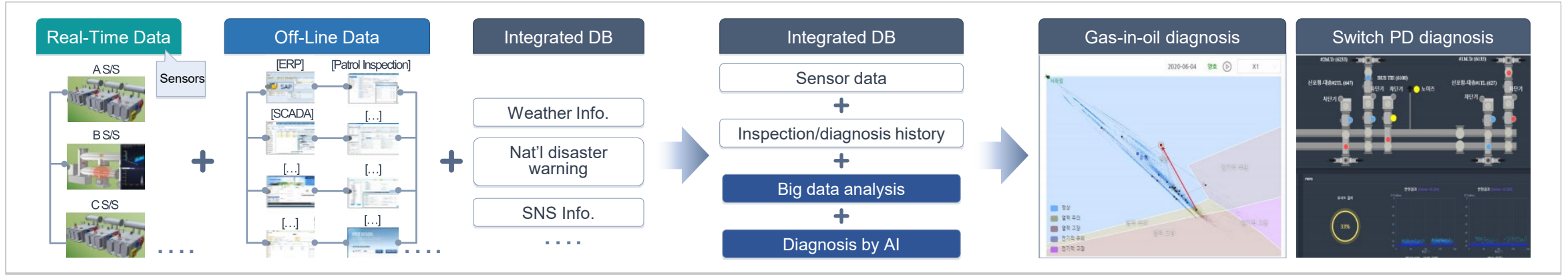
Date	Types of Analysis	Results	Check
2024-03-21	Thermal	Good	Confirmed
2024-03-21	Harmonic	Good	Confirmed

Patrol Inspection

Name	Part	List	Inspection detail	Results	Unit	Patroller	Graphic
154kV T/L	Control box	Gas Pressure	Gas Pressure (#1D/S)	Good		Mr. Park	
154kV T/L	Control box	Exterior	Valves Open/Close Check	Good		Mr. Park	
154kV T/L	Main Unit	Exterior	Damages, Contamination	Good		Mr. Park	
154kV T/L	IED	Display	Normal Operation Check	Good		Mr. Kim	
154kV T/L	Control box	Control Pressure	Oil Pressure Pump Operation Count	636	Count	Mr. Kim	📄
154kV T/L	Control box	Opt Counter	C/B Operation Count	480	Count	Mr. Kim	📄

3. Diagnosis by AI based on big-data and algorithm, with comprehensive UI

KEPCO developed 11 algorithms for transformers and GIS, verified them with the actual data

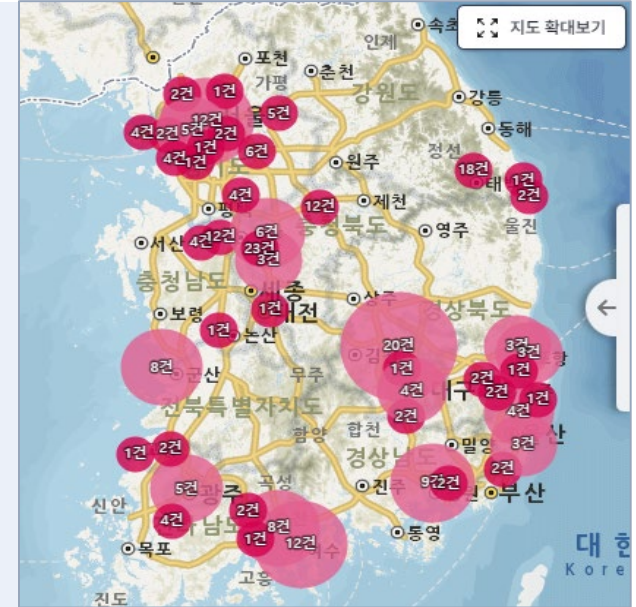


Well-designed user interfaces for effective asset management

구분	구분	변전소	대상설비	전압(kV)	제조사	제년년월	상태등급	DGA(DFT)	DGA	M.Tr PD	OLT	OLT PD	Busing	중단일자	부담전압	제년년월
송배전부송변전	송배전지점	신동부3/S	신동부3/S 765kV #4 M.Tr B-2	765kV	호성	2018.03	Poor	정상	정상	이상	정상	-	정상	-	-	2018.03
송배전부송변전	송배전지점	신동부3/S	신동부3/S 765kV #5 M.Tr A-2	765kV	호성	2018.02	Poor	정상	정상	이상	정상	-	정상	-	-	2018.02
송배전부송변전	송배전지점	신동부3/S	신동부3/S 765kV #5 M.Tr B-2	765kV	호성	2018.02	Acceptance	정상	정상	-	정상	정상	정상	-	-	2018.02
송배전부송변전	송배전지점	신동부3/S	신동부3/S 765kV #5 M.Tr C-1	765kV	호성	2018.02	Acceptance	정상	정상	-	정상	정상	정상	-	-	2018.02
송배전부송변전	송배전지점	신동부3/S	신동부3/S 765kV #5 M.Tr C-2	765kV	호성	2018.02	Acceptance	정상	정상	-	정상	-	정상	-	-	2018.02

Application in Korea

- KEPCO has been managing its assets with SEDA since 2021, and aims to install Wiseman in all substations by 2034
- Better insight into assets with reduced labor cost
- Enhanced asset management efficiency and effectiveness
- More effective asset investment planning



Application in Korea

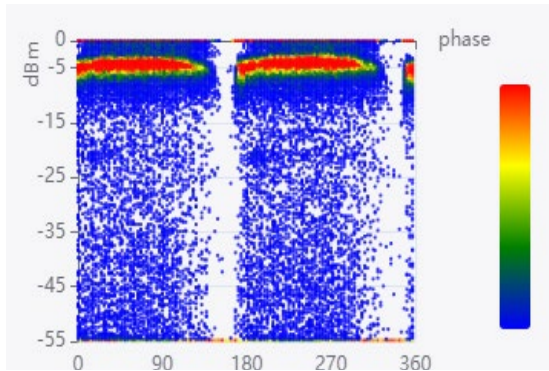
- Integration of KEPCO's algorithm with manufacturer's asset management solutions
- **Additional sensors for:** temperature and pressure; fault current; cable condition; lightning arrester condition and PD at potential transformers



SEDA Implementation: Case Studies and Cost Savings in Korea

Performance Records of Fault Prevention with SEDA

- ✓ **59 cases since 2021:** As of 2023, 20 cases with the GIS and 39 cases with the main transformers
- ✓ **Key case I :** Prevention of fault in a 345 kV GIS connected to Power Plant Switch Yard “A” (January 2024)
 - SEDA detected partial discharge in advance → Emergency action was made and fault was prevented



Economic Effect

Cost savings around USD 15 mil. with prevention of equipment fault and generation suspension

SEDA Implementation: Case Studies and Cost Savings in Korea

Performance Records of Fault Prevention with SEDA

- ✓ Key case II: Prevention of fault in a 345 kV M.Tr installed in 765 kV substation “B” (December 2023)
 - SEDA detected partial discharge in advance → Emergency action was made and fault was prevented



Economic Effect

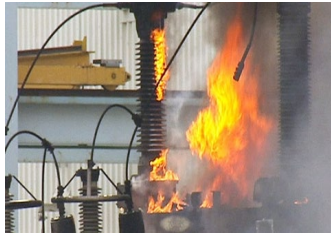
Cost savings around USD 6.5 mil. with prevention of equipment fault

SEDA Implementation: Case Studies and Cost Savings in Korea

Performance Records of Fault Prevention with SEDA

✓ Key case Ⅲ: Prevention of fault in a 154kV M.Tr installed in 154kV substation “C” (February, 2025)

🔥 Due to bushing insulation breakdown → There are cases where it gradually changes into a fire



SEDA detected bushing leakage current in advance
⇒ Emergency action was made and fault was prevented



Economic Effect

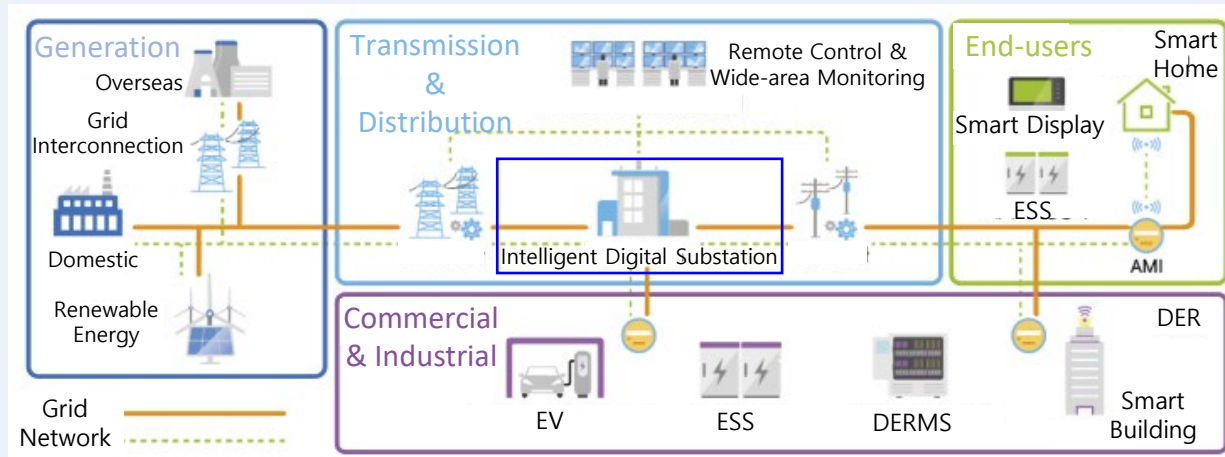
Cost savings around USD 1 mil. with prevention of equipment fault

National Policy Framework Supporting IDSS

(Legal Basis) Smart Grids Development and Promotion Act (Ministry of Trade, Industry and Energy)
(Planning) The 3rd Smart Grid Master Plan(2023-2027), Annual Execution Strategy

What is a Smart Grid?

- ✓ A power grid that enables real-time, bidirectional communication between providers and consumers using ICT
- ✓ Designed to maximize energy utilization efficiency and optimize capital investment in T&D infrastructure

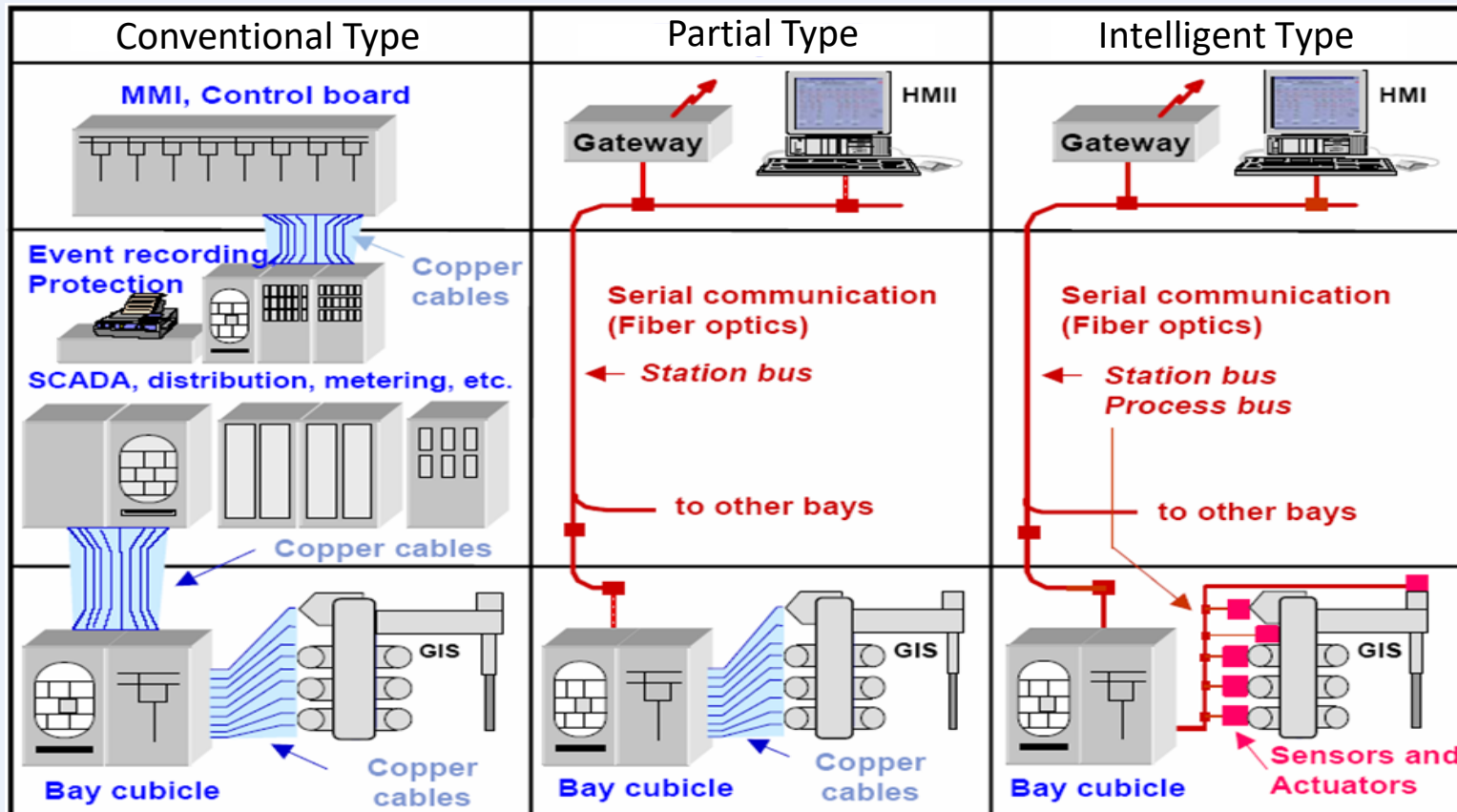


Five Key Strategies:

- Enhance flexibility of power supply
- Establish a smart energy consumption system
- **Digitalize the power grid system**
- Promote micro-grid deployment
- Cultivate an ecosystem for the smart grid industry

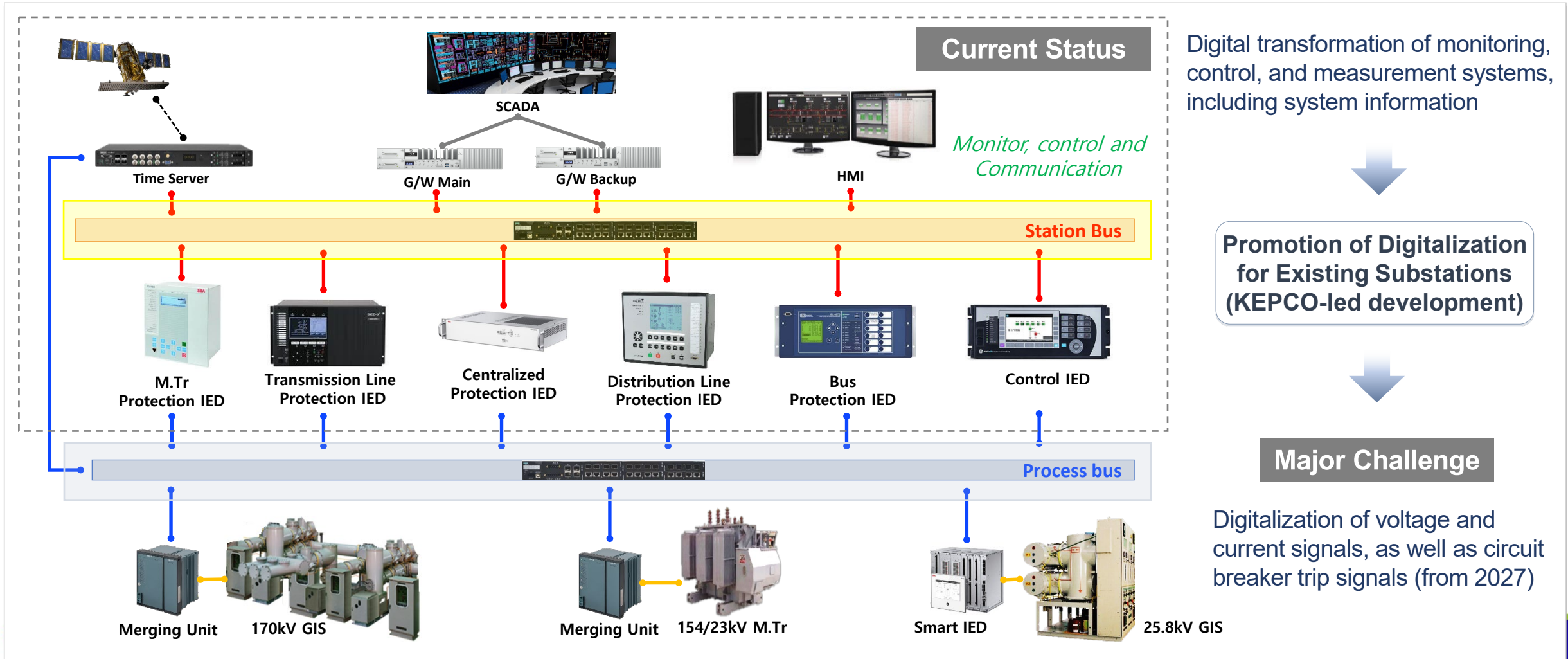
Substation Automation using Communication Technology

- Substation Automation(SA) : A digital communication-based system that reduces operational complexity and prevent faults in substation facilities



- ✓ **Conventional Type**
 - Analog signals transmission by hard-wired cable
- ✓ **Partial Digitalization (Current State, since 2013)**
 - Partial application of digital communication (HMI ↔ IED)
- ✓ **Intelligent Digital Substation (Planned from 2027)**
 - Full application of digital communication

IDSS System Configuration & Deployment Status



Digitalization of Legacy Substation Facilities

- **Development of an SA Information Processing Panel (KEPCO – led)**
 - Designed with economic efficiency, system stability, and ease of operation
- **(Function)** Facilitates digitalization by utilizing existing cabling infrastructure, without requiring retrofitting or additional IED
- **(Application)** Applied to legacy equipment that remains after partial digital upgrades within substations

SA Information Processing PNL

Main PNL



Modules PNL



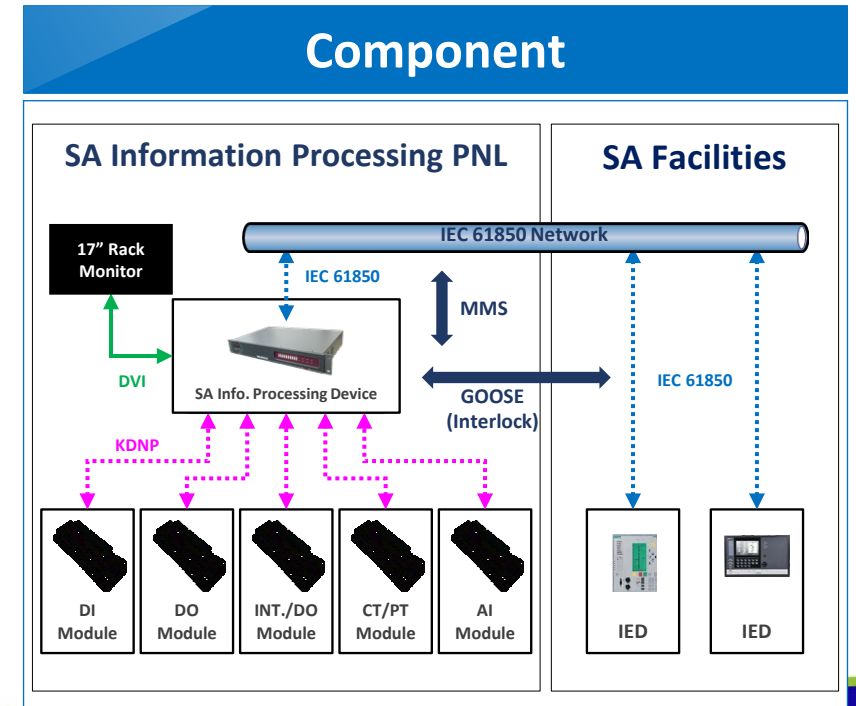
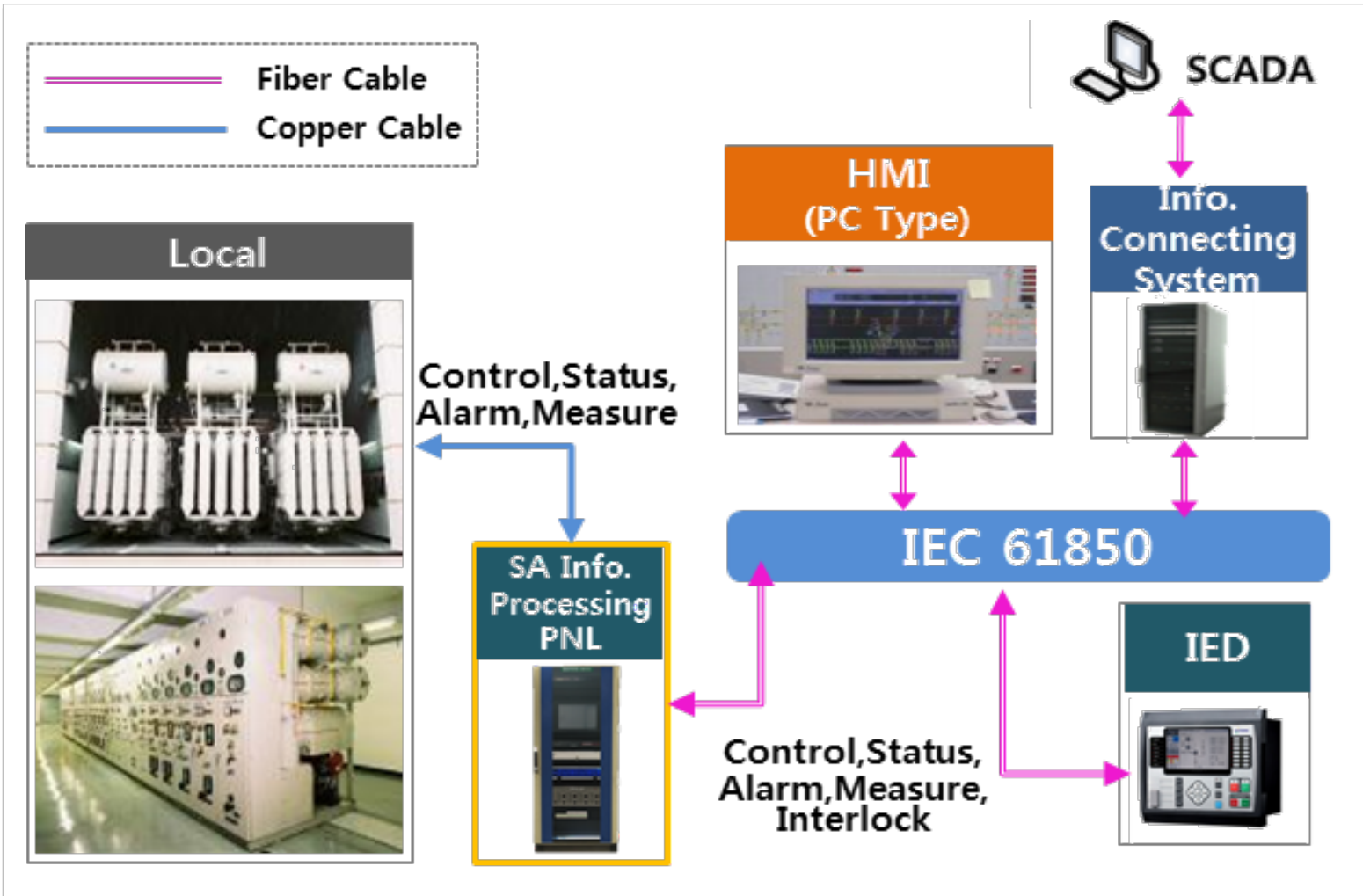
Main Function

- Variety Communication Interface(**IEC 61850**, DNP)
- Processing and Managing Data List / Logic, Int.
- **Redundancy** Communication for System stability

Total Info System



Configuration for Legacy Substation Digitalization



Status of Digital Substation Installation

- **KEPCO aims to achieve complete digital transformation of all 154kV substations by 2035**

Category	~'20	~'24	~'29	~'35
New Substation Construction (Partial Digitalization)	67	125	196	207
Modernization of Existing (Legacy) Substation	54	151	421	686
Total	121	276	617	893

Future Plans

- **Pilot project for digitalization of 345 kV substation in 2025**
- **Demonstration project for fully digital 154 kV substations in 2025**
- **Full-scale deployment of fully digital 154 kV substations starting in 2027**



Why is Substation Modernization Necessary?



- ✓ A comprehensive solution is required to address the declining operational reliability of aging outdoor steel-structured substations
 - Increased risk of failures and outages due to deteriorated equipment
 - Open-air structure is highly vulnerable to environmental factors such as dust, rain, and salt damage
 - Numerous exposed conductive parts pose safety risks during maintenance and inspection
 - Negative visual impact in urban areas, leading to potential public complaints

KEPCO's Modernization Initiative for Aging Substation Facilities

- **(Scope)** Modernization applied to 176 substations
- **(Investment)** KRW 550.3 billion (USD 408 million)

Key Technologies

■ Compact Design for Legacy Outdoor Equipment

- 132 projects implemented
- Substation models were developed through optimal equipment layout planning, in combination with GIS adoption, to maximize land-use efficiency (GIS : Gas Insulated Switchgear)

■ Indoor Substation Design Technology

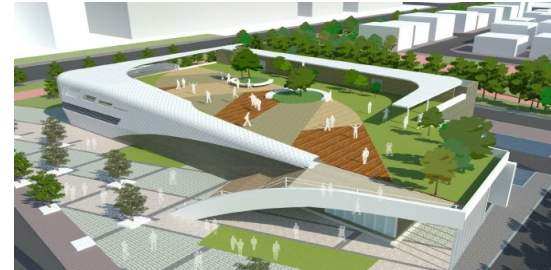
- 44 projects implemented
- Conversion from outdoor into indoor, or underground types to improve safety and operational stability



Case Examples of Modernizing Substations

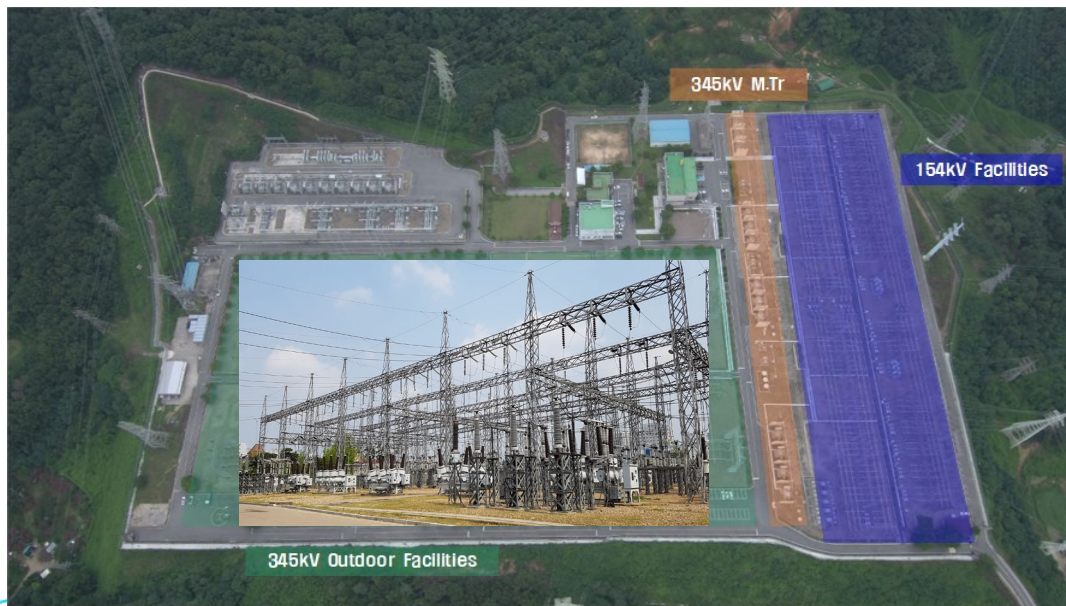
✓ Indoor Substations Conversion

- Enhanced the visual integration of substations into urban environments by transitioning from open-type to enclosed indoor facilities



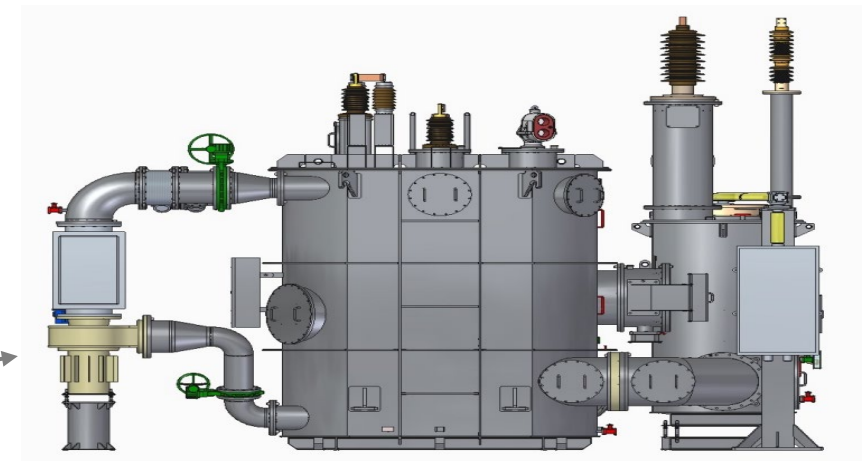
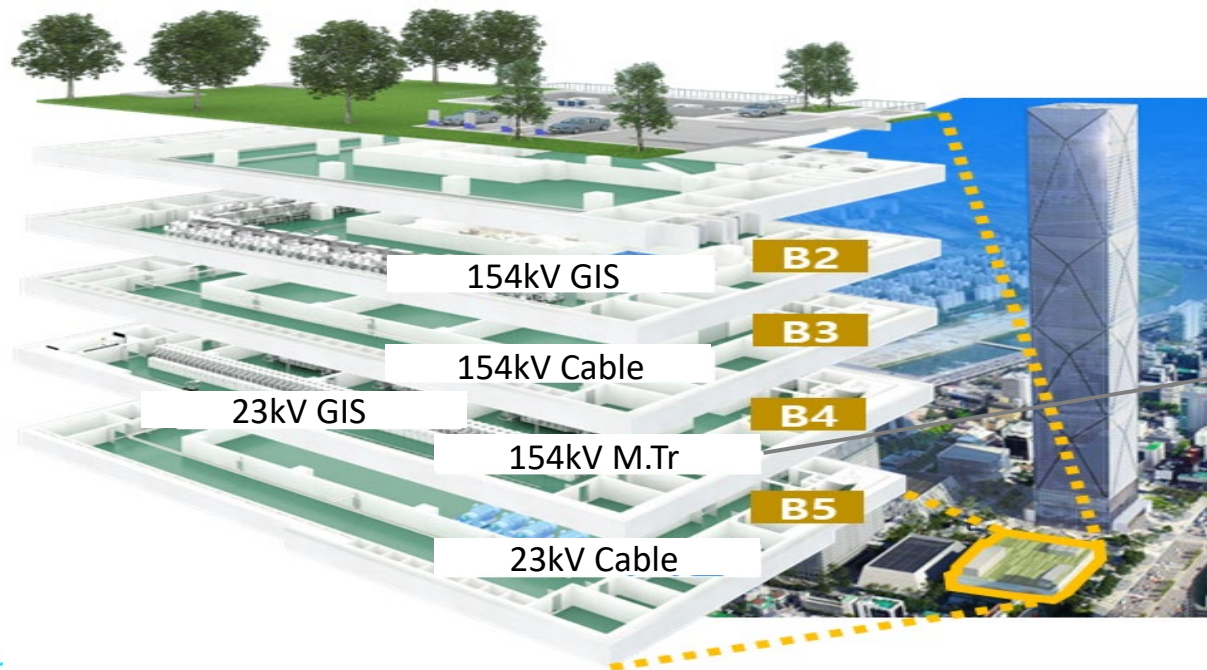
✓ Upgrade to Outdoor GIS-type Substations

- Enhanced land-use efficiency and functionality by utilizing the freed-up space more effectively
- Modernization reduced substation footprint by up to 80 %
- In Korea, these idle spaces were effectively reused for installing reactive power equipment or Energy Storage Systems(ESS)



✓ Underground Substations Deployment

- Enabled above-ground space to be redeveloped into commercial or residential spaces, such as shops or apartment buildings
- KEPCO operates 66 underground substations with 21 years of operational experience

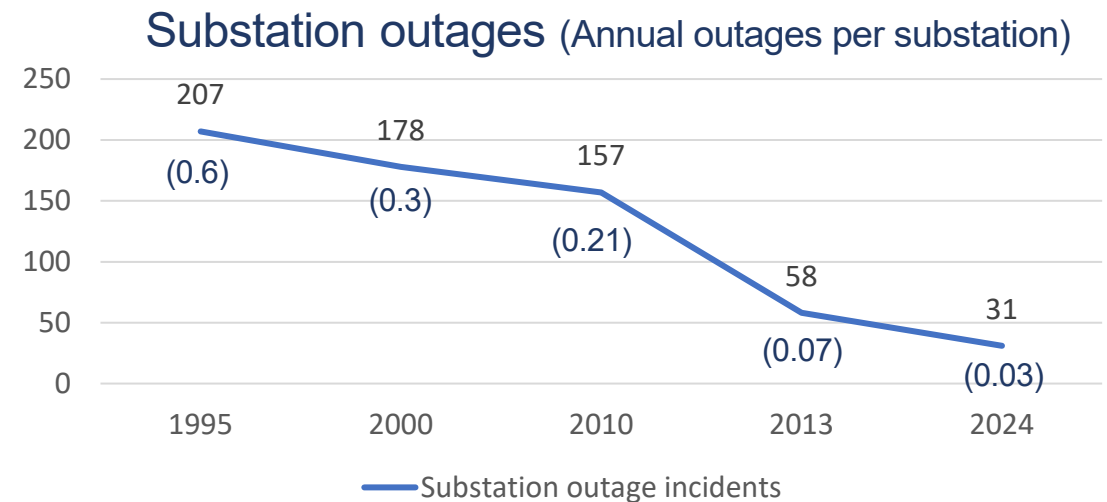
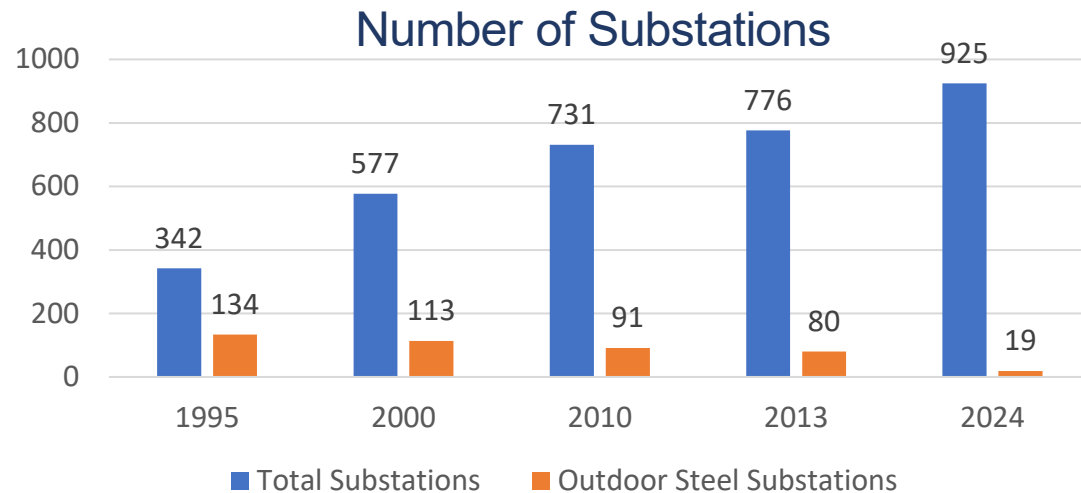


- Fire safety was enhanced through application of transformers using non-flammable insulating gas



Modernization Impact: Substation Quantity vs. Failure Cases

- KEPCO has led a long-term modernization initiative targeting outdoor steel-structured substations
- As a result, the number of substations increased by 2.7 times compared to 1995, while the number of substation outage incidents dropped by more than 85 % over the same period



Future Plans : KEPCO plans to modernize to remaining 19 outdoor steel-structured substations by 2027



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Thank you

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