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Substation Digital Twin System

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PART. 01

Background

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Digital Twin System

Definition

- **VR-based Substation Scene Construction**
- **Real-time Monitoring Data Mapping**

Background

- **Digital power grid strategy**
- **Construction of ubiquitous power IoT**

Features

- **3D Panoramic Modeling**
- **Smart O&M Support Platform**
- **Lifecycle Operational Visualization**

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PRS-7021
Substation Digital Twin System
变电站数字孪生系统

欢迎登录

登录

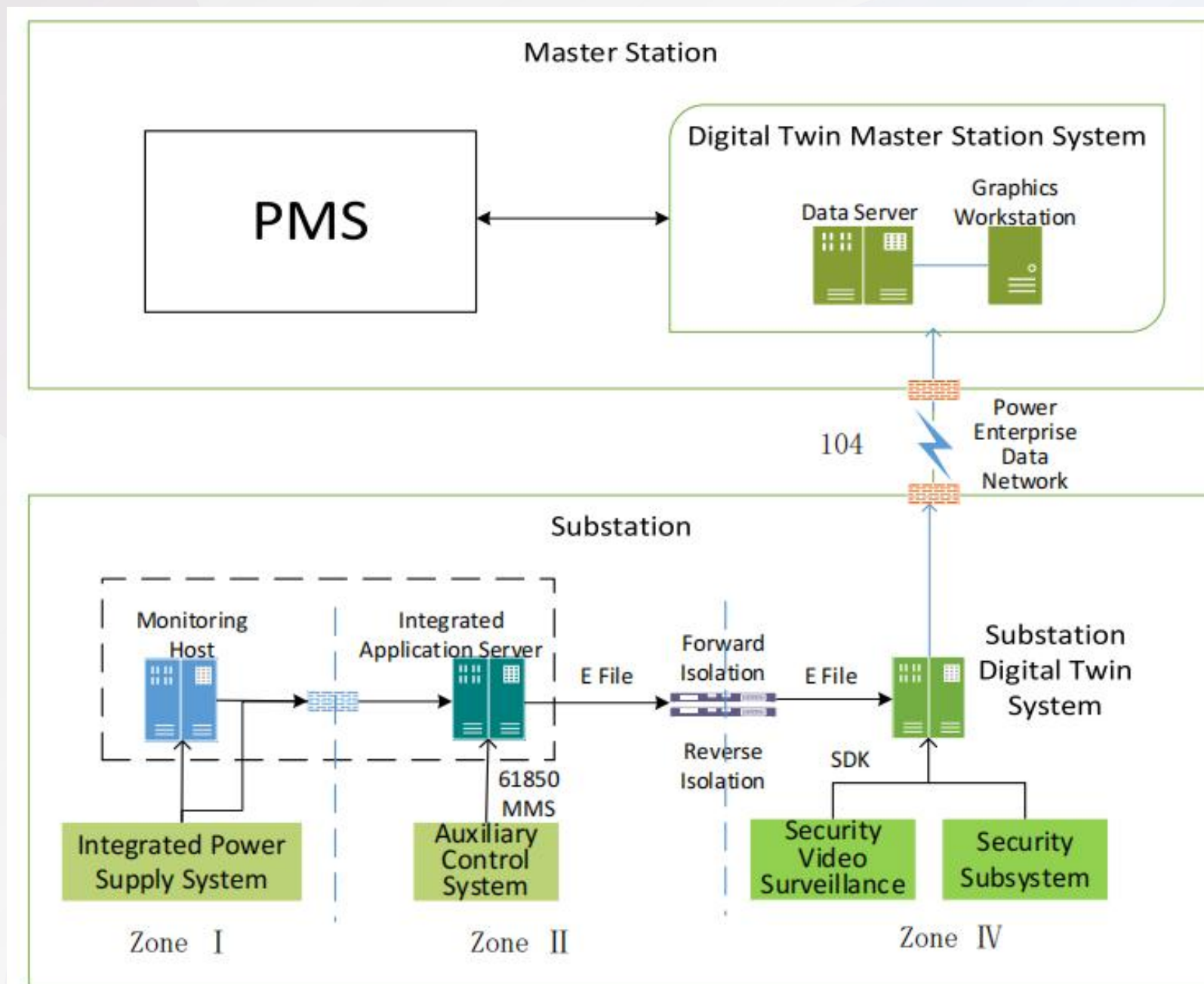
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PART. 02

Solution and Functions

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No.	Data Source	Collected Data
1	Security Zone I	<p>Primary equipment data: Position status data, mechanism monitoring data, measurement data, equipment actions and alarm information, etc.</p> <p>Secondary equipment data: Protection action signals, pressure plate status, equipment operational status, self-checks, lockouts, time synchronization status, communication status, and alarm signals, etc.</p>
2	Security Zone II	<p>Security device data: Electronic fence, infrared beams, dual-sensor detector alarm information, etc.</p> <p>Firefighting equipment data: Current fire alarm signals from smoke/temperature sensors, temperature-sensitive cables; operational status of firefighting devices (facilities) such as fire alarms, activation, feedback, supervision, shielding, faults, etc.</p> <p>Environmental monitoring data: Operational status/fault alarms of HVAC equipment (ACs, fans, dehumidifiers); temperature, humidity, SF6 concentration, water-leak alerts, etc.</p> <p>Online monitoring data: Transformer oil temperature, oil level, oil chromatography, core/clamp grounding current; arrester leakage current, insulating gas density, switch contact temperature, etc.</p>
3	Security Zone IV	<p>Real-time video streams: Captured by substation cameras.</p>

No.	Name	Equipment model	Unit	Quantity	Key functions
1	Substation Digital Twin System	PRS-7021	Set	1	Load the 3D digital model of the substation to achieve a three-dimensional panoramic display of substation assets; acquire real-time monitoring data from the substation's integrated monitoring system and auxiliary control system, enabling synchronized display of substation monitoring data and the 3D digital model.
2	Integrated Application Server	PRS-7000	Unit	1	Collect all monitoring data from the main control and auxiliary control systems, and transmit it in the form of Data E files to the substation digital twin system in Security Zone IV.

**3D Design
Technology**

Based on engineering information and geographic data, the integrated application of 3D modeling technology and digital collaborative design technology enables full-process 3D visual design and unified information management for power transmission and transformation projects.

**3D
Visualization
Technology**

Build a substation BIM information model to achieve functions such as moving, zooming, rotating, layering, and analytical browsing of the 3D model.

**Big Data
Processing**

Big data collection, storage & management, analysis & mining, and visualization technologies are applied to construct a big data visualization platform.

**Mobile
Terminal
Technology**

Encryption technologies are used for secure authentication, task assignment/receipt, and field record uploads, supporting on-site personnel in standardized, paperless operations



3D Model Browsing

- 3D Model Display
- Ledger Information Display



- Support model movement, zooming, rotation, and selection functions
- Enable layered and categorized viewing of models
- Allow viewing of management parameters, design parameters, and measurement information for 3D components

3D subsystem monitoring



- Primary Equipment Subsystem
- Intelligent Equipment Subsystem
- Security Protection Subsystem
- ...



- 🍃 3D model
- 🍃 3D component ledger information
- 🍃 Alarm information
- 🍃 ...

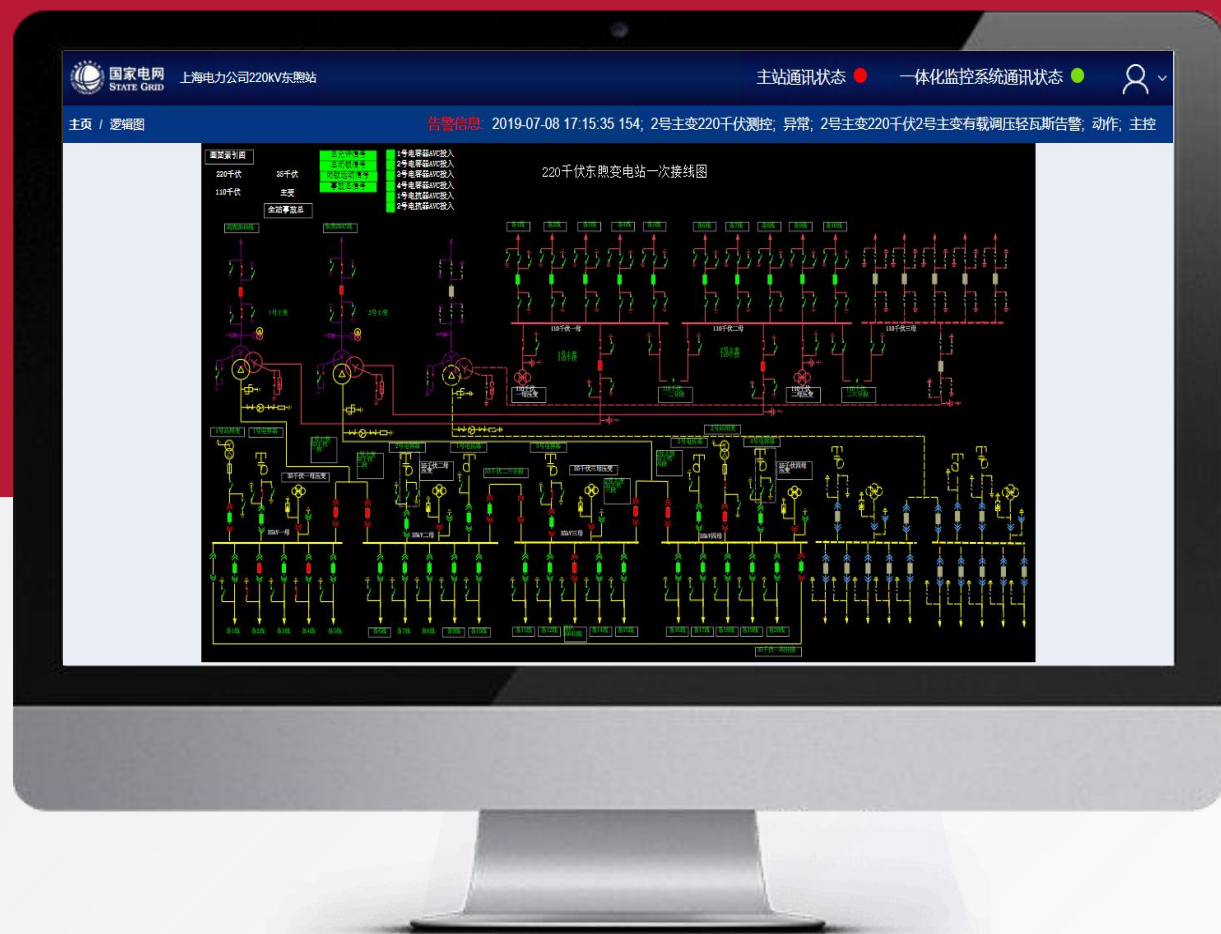


Live video monitoring

- Link to video system to retrieve on-site image information



- 🍃 Navigation pane view
- 🍃 Click on specific point camera to view



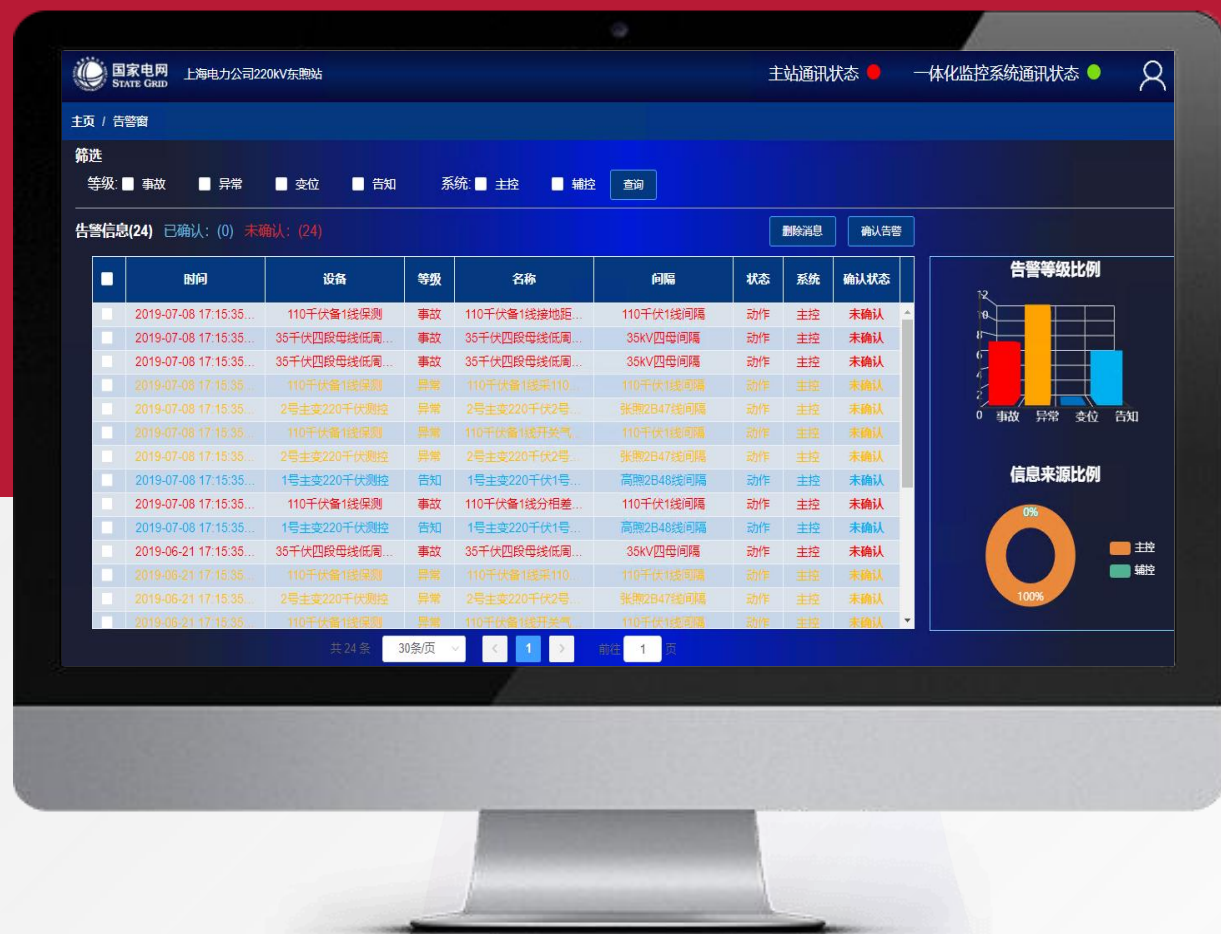
Logic diagram display

➤ Substation 2D logical main wiring diagram



Real-time display of **primary equipment status** (e.g., switch/disconnector open/close positions) in substation

Alarm Management



- Alarm Information Display
- Alarm Information Statistics
- Classification Filtering
- Manual Operations



- 🍃 **Hierarchical Display:** Accident, Anomaly, Position Change, Notification
- 🍃 **Classification Statistics:** Statistics by confirmed/unconfirmed status, different alarm levels, and proportions of alarm sources
- 🍃 **Classification Filtering:** Supports retrieval by alarm level, system type, etc.
- 🍃 **Manual Operations:** Provides alarm confirmation and deletion functions



Historical Alarm Query

- Historical Alarm Information Display
- Categorized Search
- Historical Alarm Information Statistics



- 🍃 **Hierarchical Display:** Accident, Anomaly, Position Change, Notification
- 🍃 **Categorized Query:** Search by time period, equipment type, alarm level
- 🍃 **Information Statistics:** Supports statistical analysis of queried historical alarms, including alarm level, alarm source, daily alarm trend analysis, etc.



Intelligent Inspection

- Alarm and Inspection Robot Linkage
- Real-time Mapping of Inspection Data to 3D Equipment Scenes
- Visual Management of Inspection Process



- 🍃 When anomalies or accidents occur, **robots** are triggered to perform **inspections**.
- 🍃 During robot inspections, data is transmitted in real-time to the digital twin system and mapped onto the **3D equipment model**.
- 🍃 The robot's inspection progress is visualized in the **3D virtual environment**, providing **clear visibility** of equipment operational status.

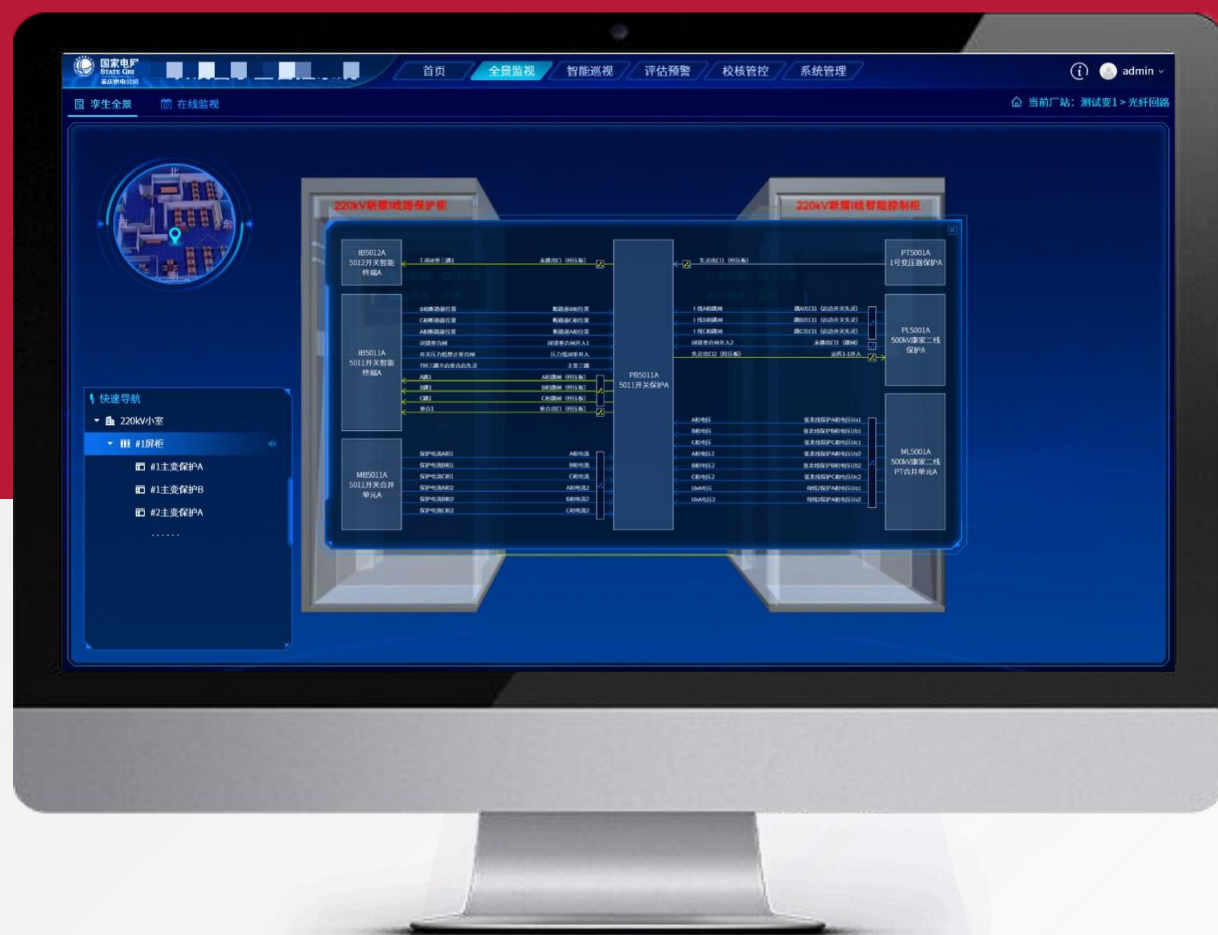


Proactive Early Warning System

- High-voltage equipment early warning
- Secondary equipment early warning
- Cable monitoring early warning
- Arrester monitoring early warning
- Power quality monitoring early warning
- Environmental monitoring early warning
- Security system early warning

- 🍃 Based on monitoring data, achieves active **early warning** for equipment, environment, and security systems.
- 🍃 **Visual alerts**: Flashing indicators, color changes
- 🍃 **Notification** methods: Mobile APP push notifications





Mobile Work Operations

- "One-Click" Access to Equipment Documentation
- Rapid Query of Equipment Defects
- Instant Notification of Equipment Anomalies or Failures



- Integrates with mobile applications to provide **mobile-assisted support** for maintenance operations.
- **Instantly retrieve** equipment status, asset records, 3D spatial models, signal and control circuit diagrams, and other information
- **Quick access** to equipment defect records, ensuring clear traceability of historical defect information and improving maintenance efficiency.
- When detect equipment anomalies or fault alarms, **immediately send notifications** to mobile terminals, allowing maintenance personnel to promptly respond to abnormal conditions.



Simulation Training

- Inspection drills
- Equipment operation drills
- Fire drills
- Distance measurement
- Examination system



- Based on substation BIM models, simulation technology, 3D rendering technology and computer vision technology are used to build a **three-dimensional virtual scene of substations**.
- Combined with wearable devices such as VR glasses, it achieves **visual realism** and **sensory immersion**.

PART. 03

Application Effectiveness and Cases

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Digital Handover

	Current situation	Substation digital twin system
Information Integrity	Design data, construction, and later operational management remain isolated; manual data transfer leads to loss	Design, construction, and operations are interlinked; digital data transfer ensures full integrity
Information Sharing	Incomplete data, inconsistent formats, poor cross-department sharing	Complete, traceable, standardized data with high interoperability
Data Development	Manual duplicate entries	Shared information drastically reduces redundant data work

Value Proposition:

- ◆ Based on substation BIM technology, construct substation digital twin system, achieving digital handover from construction to operation and maintenance.
- ◆ Make it possible to manage the substation using digital means.

O&M Visualization

	Current situation	Substation digital twin system
Primary/Auxiliary Info	Independent monitoring	Centralized monitoring
Data Monitoring	Focus on operational data, neglect equipment info	Centralized monitoring of both operational data and equipment info
O&M Experience	2D logic diagrams (non-intuitive)	3D virtual environment (intuitive equipment operation)
O&M Information	Manual entry	One-click reporting

Value Proposition:

- ◆ Comprehensive Data Collection and Monitoring
- ◆ Integrate static models with dynamic data, enabling O&M personnel to grasp substation operations through a 3D virtual environment, significantly enhancing monitoring capabilities.

Equipment Visualization

	Current situation	Substation digital twin system
Equipment Records	Manual Lookup	One-Click Access
Design Drawings	Manual Review	One-Click Access
Spatial Layout	Manual Review	3D Dynamic Visualization
Historical Defects	Manual Lookup	One-Click Access

Value Proposition:

- ◆ Establish Equipment Data Management Center
- ◆ "One-click" quick access improves maintenance efficiency and reduces labor costs

Big Data Platform

	Current situation	Substation digital twin system
Data Integration	Isolated systems with poor integration	Organically integrates BIM models, monitoring data (primary/auxiliary equipment), and video data

Value Proposition:

- ◆ Establish a comprehensive visualized platform integrating smart substation environments, equipment, and monitoring data
- ◆ Provide foundational support for multi-dimensional data mining and intelligent analytics of substation operations

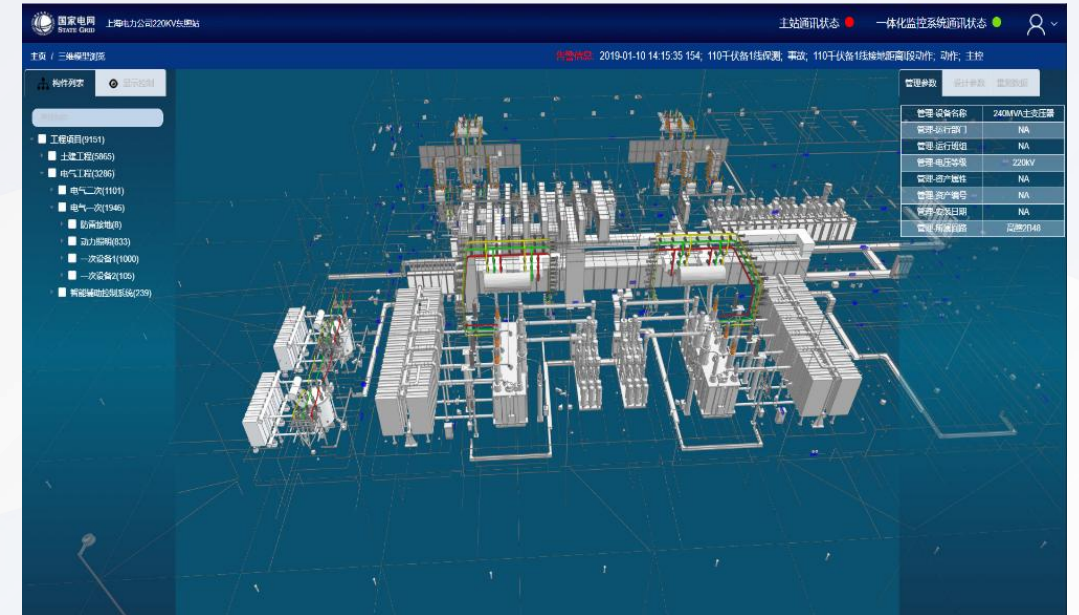
Over the past five years, CYG Sunri's Digital Twin System has been successfully applied in more than **40 projects**. Below is a partial list of contracts and performance records:

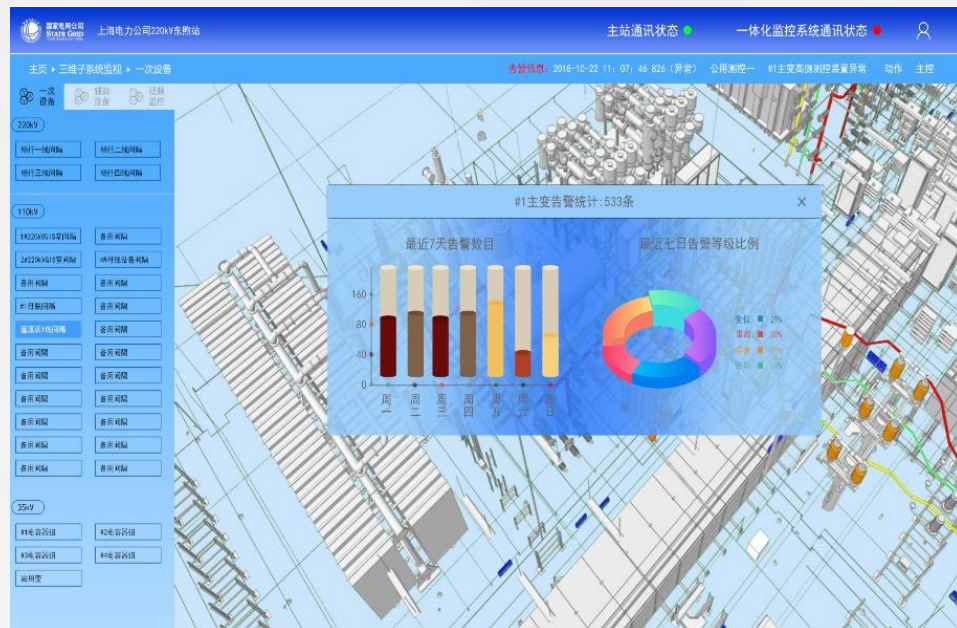
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上海市 电站状	220KV杨 智能变申	上海市 程智能
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合同编号	合同编号	合同编号
合同编号	合同编号	合同编号
工程名称	工程名称:	工程名称
买 方	买 方:	买 方
卖 方	卖 方:	卖 方
签订日期	签订日期:	签订日期
签订地点	签订地点:	签订地点

合同编号 (买方): SCSHWZ00HTMM2204207
合同编号 (卖方):
工程名称: 上海浦东洋基 (电气) 110kV输变电工程智能变电站状态监测, 在线监测集成系统采购合同
买 方: 国网上海市电力公司
卖 方: 长园深瑞继保自动化有限公司
签订日期: 2022-12-23
签订地点: 上海





No.	Project Name
1	Shanghai Pudong 220kV Nicheng Substation Digital Twin System
2	Shanghai Pudong 110kV Xingjing Substation Digital Twin System
3	Shanghai Pudong 110kV Yuren Substation Digital Twin System
4	Shanghai Pudong 110kV Gongwei Substation Digital Twin System
5	Shanghai Songjiang 110kV Huatie Substation Digital Twin System
6	Shanghai 220kV Nanhui Substation Digital Twin System Project
7	Shanghai Shinan 110kV Ping'an Digital Twin Project
8	Shanghai Wanxiang 220kV Substation Digital Twin Project
9	Shanghai Urban 110kV Tangshan Substation Digital Twin Project
10	Shanghai Jiading 110kV Huangjia Substation Digital Twin Project
11	Shanghai Nanhuiwen 110kV Transmission Project Digital Twin System
12	Shanghai Shibeil 110kV Taozhu Substation Digital Twin System
13	Shanghai 220kV Shengxin Substation Digital Twin System Project
14	Shanghai Shibeil 110kV Luochuan Substation Digital Twin System
15	Shanghai Pudong 110kV Yangji Substation Digital Twin System Project
16	Shanghai 220kV Lvzhou (Zhujiajiao) Substation Digital Twin System Project



Deep professional deposits

Comprehensive library of experts

Customized solutions and development capabilities

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