

INTELLIGENT MONITORING AND ENERGY MANAGEMENT PLATFORM OF NEW ENERGY POWER STATION IN THE ISLANDS

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ABSTRACT

The new energy power station in the islands is the central node with the ocean current energy, wind energy, solar energy, energy storage equipment and other types of new energy power generation confluencing, achieved intelligent monitoring and energy management for new energy power in the islands. Refer three layer and two network architecture of smart substation, presents the islands's new energy power monitoring and energy management platform architecture, describes specific function and implementation method of the new energy power station with process layer, spacer layer and energy management layer. Based on the IEC 61850 (Second Edition) and IEC 61400-25 standard, the new energy power stations in the islands were standardized modelling, to ensure the platform standard and open.

INTRODUCTION

New energy has a series of characteristics with huge reserves, wide distribution, clean and renewable, sustainable development meeting the requirements of human beings, which cause more and more countries and regions concerned in the world widely. The island also contains abundant renewable energy, the new energy power generation will become one of the important means to solve the world's energy shortage with the representative of wind power, photovoltaic, ocean current, wave and tidal power generation in the island.

At present, many developed countries are actively to develop new energy resources in the island, and established a variety of small wind farm, marine power station and small photovoltaic power station, but have not yet carried out all kinds of new energy power generation with island resources comprehensive utilization. The paper presents comprehensive application mode of new energy power generation in the islands is based on ocean current power generation as the "master", small wind power and photovoltaic power generation as "auxiliary", a variety of energy storage equipment as "supplement".

In the power grid of the island with multiple new energy hybrid power generation. The new energy station is the central node to support the grid power quality and reliability. Although in recent years, supervisory control and data acquisition (SCADA) system and energy management system (EMS)^[1] has been widely used in thermal power, hydropower and other traditional power industry, but has not yet been carried out power

monitoring and energy management technology research with large-scale new energy hybrid access in the power grid.

According to contrast three layer and two network architecture of smart substation, develop the new energy power monitoring and energy management platform in the island, which conduct standardized modeling by using IEC 61850 and IEC 61400-25 standard, realize the equipment and information interoperability in the new energy power station, meet the new energy power station data information efficient, seamless integration requirements in the island, provide the support as the advanced applications development of new energy power station in the islands.

PLATFORM ARCHITECTURE

The new energy power generation in the islands has many generation types, current power, wind power, photovoltaic power generation and many types of energy storage equipment which is used to peak-shaving and valley-filling. Various types of new energy power exhibited the different generation characteristics which cause big difference in the new energy model, difficulties in the sharing information, the intermittent, fluctuation characteristics in the new energy power generation, which brings more uncertainty for power grid scheduling and controlling, therefore need to construct a new intelligent monitoring and energy management platform for new energy in the island based on a standard open architecture, realize the new energy panoramic monitoring and integrated scheduling.

The IEC61850 standard as the general substation network communication standards, has a serial of advantages with a high degree of standardization, strong interoperability capability between equipment and equipment, good scalability of the function, high efficiency of system integration, gradually become a seamless automation standard in the power system from the dispatch center to substation, transformer substation and distribution automation, especially IEC61850 (second Edition) increased clean energy areas such as information modeling and communication mapping, can provide standardized modeling for current power, photovoltaic power generation and energy storage device. The IEC61400-25 wind farm standard although is not the architecture of the IEC61850 standard system, but the core elements of the standards is success from the essence and characteristics of the IEC61850, so the use of IEC61850-25 to achieve the standard modeling of wind power in the islands's new energy, which provide a higher starting point for

developing intelligent monitoring and energy management platform of new energy power station in the islands.

Intelligent monitoring and energy management platform contrast the three layer and two network architecture of the smart substation, construction the new architecture of energy power station with the island's characteristic. The three level is the energy management layer, the spacer layer and the process layer. The two network, which namely the energy management communication network and the process layer communication network, as shown in figure 1.

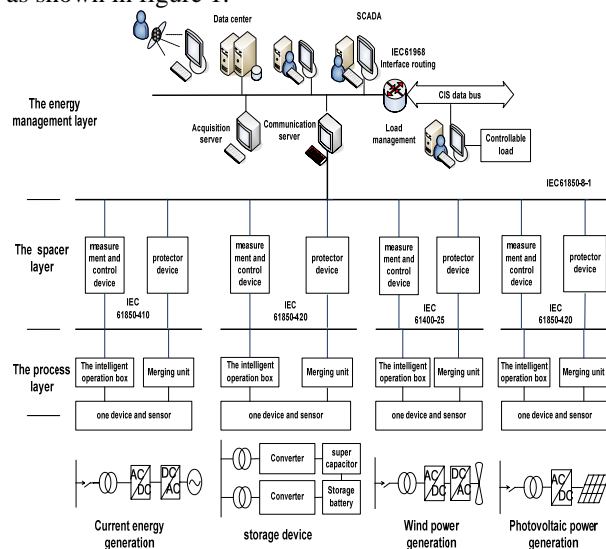


Fig1 Architecture of new energy power station in the Island

The energy management layer mainly includes various types of acquisition server, communication server, data server, workstations and routers. The hardware equipment such as firewall, is the center of regional power grid monitoring and management in the island's new energy power generation, which achievement basic functions with data acquisition and monitoring of the new energy generation, protection and grid-aceed control, new energy output scheduling, power flow control, power grid load coordinated control, which also achievement other extended function such as anti-islanding protection, new energy power generation forecast, new energy and regional power network coordinated control, new energy and energy storage device optimal dispatching, and also can realize communicating with other application system.

The spacer layer mainly refers to the various types protection and measurement control device of new energy power generation, which realize the protection and monitoring function for the interval of new energy power generation equipment and distribution transformer by using the real-time data (including the interval distribution transformer operation data, assembling unit internal operation data and environmental data) form the process layer of the new energy power generation interval. The spacer layer

conduct data and information standardization modeling based on IEC61850 and IEC61400 standards, which achieve the information interoperability, provide the support for SCADA and energy management function in the station.

The process layer is comprising with the merging unit and the intelligent operation box for different new energy power generation equipment in the islands, which installed in all kinds of field. Merging unit is responsible for the collection operation data of distribution transformer and intelligent sensor, the intelligent operation box is responsible for network control of new energy power generation equipment.

THE ENERGY MANAGEMENT LAYER

The intelligent monitoring and energy management platform of new energy power station in the islands should be built in the standard, common's software and hardware platform, with real-time, reliability, availability, expansibility and security, should configure the hardware and software rationality based on the new energy power generation scale, actual demand of electricity load in the island^[2-4].

The design of intelligent monitoring and energy management platform of new energy power station in the islands includes the hardware platform design and software platform design. The software and hardware platform design needs to consider the new energy power generation access scale in the island, Especially need to consider the realization of advanced application function. The hardware platform is the carrier for software platform, the design should be fully taken into consideration the hardware configuration, which not only need to avoid redundant waste, but also need to have enough ability to display the function of the software fully, figure 2 gives hardware architecture of intelligent monitoring and energy management platform.

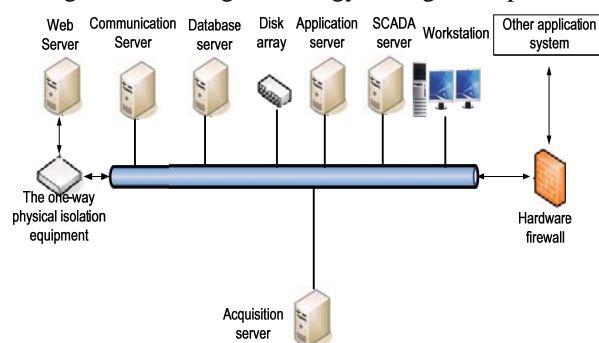


Fig2 Hardware architecture of intelligent monitoring and energy management platform

Figure 2, the acquisition server is responsible for collection real time data of new energy power generation equipment and power system from the spacer layer, then sent to the interval data bus in the master station, gives to the database server, SCADA server and

application server is responsible for data storage and analysis. The master station and external information exchange through physical isolation equipment, such as the Web information, the master station and Web server realize the data flow through the one-way physical isolation equipment. realize the important data filtering between the master system and distribution automation system interaction, through the hardware firewall. The software of intelligent monitoring and energy management platform in the island's new energy power station built in the specific hardware platform, which can be classified as three layer, operating system layer, supporting function layer, analysis and decision layer, figure 3 gives the software architecture of intelligent monitoring and energy management platform.

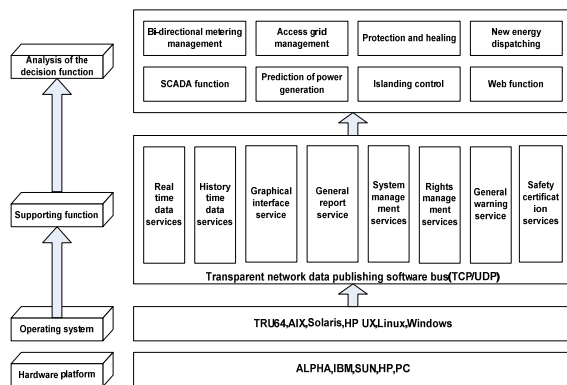


Fig3 Software structure of intelligent monitoring and energy management platform

Operating system layer describes the master station can support multiple types of operating system, including HP UNIX, Linux and Windows, which achieve cross-platform function transplant and application. The support function layer includes real-time data service, history data services, graphical interface services, general reporting services, security services, which is the common module of analysis and decision function. The analysis and decision layer is the concentrated embodiment of the advanced application functions, including the new energy power generation SCADA function, bidirectional metering management, network management, new energy scheduling, anti-islanding protection, source network coordinated control, which can fully display the various functions of intelligent monitoring and power management platform in the island's new energy power station. Due to the adoption of the software layered architecture, software function partition and realization becomes clear, the interface design will be more standardized between the layers and layers.

THE SPACER LAYER

The spacer layer is the core layer for the implementation protection and control of new energy power generation interval. which calculate voltage, current and power measurement parameter based on process real-time data

of the generation interval; judge the fault information based on real-time fault data of the generation interval, send high priority GOOSE trip command to the fault equipment, at the same time the spacer layer is provided communication function with the energy management layer and the process layer, namely finish the network communication function with the process layer and the energy management in synchronous high speed. On this basis, in the network interface with double mouth full duplex mode, thus ensuring the reliability of network communication, effectively improve the information channel redundancy^[5-7].

The spacer layer data modeling and service mapping using IEC61850 and IEC61400-25 standards. Smart substation monitoring standard IEC 61850 second edition adds a new field of energy logic node definition and service mapping which is different from the version first. IEC 61850-7-420 definition the logic node of the distributed energy fields including piston engine, fuel cells, micro gas turbine, photovoltaic systems, cogeneration, wind power plant monitoring communication standard IEC 61400-25 although has not been incorporated into the IEC 61850 series standards, but can be said to the extension for IEC61850 in wind power field. The core elements with succeeding essence and characteristics of the standards are come from the IEC 61850. Therefore data modeling and service mapping with ocean energy, photovoltaic system and energy storage system generation by using the IEC61850 second version, wind power system data modeling and data services by using IEC61400-25 implementation in the island, laid the foundation among equipment and equipment for seamless communication, as shown in figure 4.

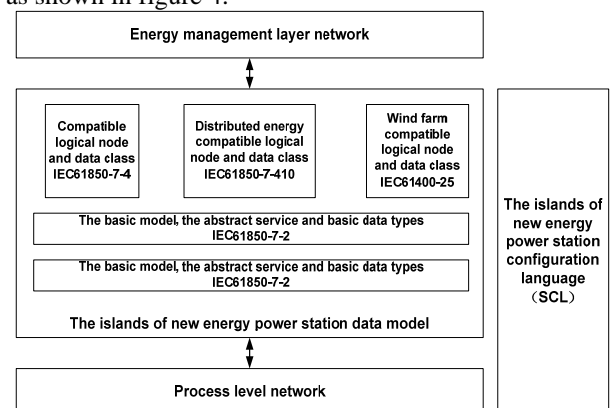


Fig4 Data modeling and service mapping of intelligent monitoring and energy management platform

THE PROCESS LAYER

The process layer is the data information source of the intelligent monitoring and energy management platform of new energy power station in the islands. Mainly including various types the merging unit and the intelligent operation box of the new energy power

generation interval^[8].

Merging unit is responsible for analog signal digital with the distribution transformer side, and pooled from field all kinds of intelligent sensor acquisition of new energy power generation unit (current power generating unit, the energy storage device body, photovoltaic power generation and wind power generation equipment) internal operation data and environmental data, then mosaic data packets, send to the spacer layer protection and control device by using IEC61850-9-2 process layer communication network. The intelligent operation box real-time monitoring the status information of distribution transformer and new energy power generation equipment, and receives GOOSE message from protection and control device in the space layer, Executes the operation for power grid equipment and new energy power generation equipment.

The merging unit and the intelligent operation box adopts miniaturization, low power design, based on embedded hardware and software platform, support for various types of sensor interface data acquisition. Device should have strong resistance ability of electromagnetic interference, adapt to the environment, convenient installation and debugging.

CONCLUSION

The paper focuses on introducing the design thought for the new energy intelligent monitoring and energy management platform in the island and the function implementation for the each layer. The difficulty research result is the new energy power station hierarchical object modeling technology based on IEC61850 and IEC61400 in the island, the standard modeling and information integration technology with oriented service object, data normalization of the new energy source in the island.

Ocean has abundant clean energy resources, the marine resource comprehensive utilization is a useful exploration with new energy power generation in the islands, the multi energy complementary power generation mode has a positive significance of new energy power generation development and utilization in the islands, and has wide application prospect.

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