Opportunities and Challenges for Construction of Substation Facilities under the Background of Ubiquitous Energy Internet of Things

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Keywords: Clean and low carbon, The ubiquitous energy Internet of things (UEIOT), Transformation and substation facilities, Operational energy efficiency.

Abstract. Under the background of global clean and low-carbon energy development, it is more important to improve the operational energy efficiency of power grid. By analyzing the ubiquitous energy Internet of things (UEIOT) and its important construction direction, the integration directions of the transformation and substation’s construction are proposed, which provides an important reference for the construction of UEIOT.

Introduction

In the report of the National Grid Congress in 2019, the strategic objectives of "three types and two networks" are put forward. The construction and operation of "two networks" is an important material basis for building a world-class energy Internet enterprise. On the one hand, we should persevere in building and operating strong & smart grid ($s^2$ grid) with UHV as the backbone and coordinated development of power grids at all levels, constantly improve the allocation capacity and intelligence level of energy resources, better adapt to the intensive development of power base and large-scale grid-connected access needs of new energy, distributed energy, energy storage and interactive energy facilities, and meet the increasing diversity service requirements of the people. Building a strong smart grid is an inevitable choice for State Grid social development. It is necessary to strengthen confidence, persevere and accelerate development. On the other hand, we should make full use of modern information technology and advanced communication technology, such as mobile interconnection and artificial intelligence, to realize interconnection and human-computer interaction in all links of the power system, to create UEIOT with comprehensive state perception, efficient information processing, convenient and flexible application, to provide strong data resource support to ensure safe and economic operation of the power grid, improve operational performance, improve service quality and foster strategic emerging industries, and open up a new way for management innovation, business innovation and value creation.

UEIOT

Ubiquitous Association. Ubiquitous Association refers to the information connection and interaction between anytime, anywhere, anybody and anything.

UEIOT for $s^2$ Grid. UEIOT is the concrete manifestation and application of IOTO in the power industry. It connects power users and their equipment, power grid enterprises and their equipment, power generation enterprises and their equipment, suppliers and equipment, as well as people and things, to produce shared data to serve users, power grid, power generation, suppliers and government. It takes power grid as the hub to play platform and sharing role, create greater opportunities for the development of the whole industry and more market players, and provide value services.
Integration Directions for UEIOT with Substation Facilities- Multi-station Unity

The construction of multi-station integration has the advantages of intensive land resources, high energy efficiency, high reliability of power supply and strong economic benefits. The components of multi-station is shown as figure 1.

Analysis of the Basis for the Construction of Multi-station Unity listed as below:

Construction Experience of Intelligent Substation. The degree of technical similarity is high. Intelligent substation adopts advanced, reliable, integrated, low-carbon and environment-friendly intelligent equipment. With the basic requirements of digitalization of information, networking of communication platform and standardization of information sharing, it automatically completes the basic functions of information acquisition, measurement, control, protection, measurement and monitoring. It also supports real-time automatic control, intelligent regulation, online analysis and decision-making, and collaborative interaction of power grid according to needs. Motion and other advanced functions. Its implementation of information digitization equipment is similar to that of data center.

Construction Experience of Electric Vehicle Charging Facilities. The substation plus rechargeable power station mode has been popularized and applied in Shenzhen and other cities. Through the safe, scientific and rational use of the existing space of power facilities, it not only saves urban land resources, but also helps the development of new energy vehicles.

Experience of Energy Storage System Integration Construction. The energy storage device for substation construction can be used as backup power supply for substation and power UPS, as energy storage in substations of wind and photovoltaic power generation facilities and also can realize Electric Load’s "Peak Cutting and Valley Filling" in Substation Power Supply Area. Restricted by the limited land area, it is very difficult to plan and construct the power grid under the traditional mode. Utilizing the space and ground of substation to construct energy storage devices on the power grid side, which can improve the reliability of power supply, reduce the electricity charge of user capacity, and carry out peak-valley arbitrage. This way is also convenient for users to participate in power auxiliary market transactions when conditions are ripe, and it also takes into account the energy storage value of grid side and user side.

Experience in Data Center Construction. Since the 1960s and 1970s, the data center itself has been evolving and the technology has been maturing. With the development of cloud technology, by deploying cloud computing technology in data centers, business senseless migration between multiple data centers can be accomplished, and services can be provided to tens of millions of people at the same time.

Experience in Building Integrated Energy Services. Energy services based on distributed energy originated in the United States in the late 1970s. Most of the new projects are to promote renewable energy such as co-generation, photovoltaic, heat pump, biomass, etc. They are characteristic as that financing quota is larger and business model is more flexible. Integrated
energy services play an important supporting role in improving energy efficiency and realizing large-scale development of renewable energy, which can help enterprises coordinate consumption and comprehensive management of water, electricity, gas, heat, light and energy storage based on intelligent micro-network management and control platform relying on big data technology, and build an energy trusteeship platform can not only meet the energy needs of customers, but also help power supply enterprises to play their resource advantages and exploit the market.

Conclusion
The construction of the UEIOT provides important opportunities for the management, transformation and construction of power substation facilities. It has broad application prospects in expanding new business, improving comprehensive energy efficiency, resource intensive level, power supply reliability and economic benefits.

Acknowledgement
This research was financially supported by the State Grid Jinhua power supply Company Project: Research on Value Enhancement of Transmission and Substation Facilities under the Background of Ubiquitous Power Internet of Things Construction.

Reference


