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The situation and trends of feeder automation in China

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ABSTRACT

State Grid Corporation of China and China Southern Power Grid Corporation put forward the vision of Smart Grid in 2009. Then China launched the second round of distribution automation system (DAS) project. This paper summarizes the DAS in this round, including the project planning, current development and related technical standard. The development situation and trend of feeder automation (FA) technology are focused. The various realization modes and test verification technology of FA are presented in details. With the integration of distributed generation to distribution grid, the trend of Advanced Distribution Automation (ADA) and other techniques such as optimizing operation and practicability of FA in China are introduced.

Contents

1. Introduction

Distribution automation is an important method to improve the reliability, quality and capacity of power supply, and helps to

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realize the efficient and economic operation. It is also one of the important foundations to achieve the goal of smart grid. In industrialized countries, distribution network automation has a history of nearly forty years, especially in recent decades, distribution network automation has become the main task for each electric power company to improve the quality of customer service and increase the enterprise's economic benefit. It has become an indispensable part of modern management for power grid.

With the upgrading of urban and rural power grid in China, the reliability and index of power supply has been significantly improved. The completion of distribution network automation is the only way to continue improving the quality of power supply and service for energy consumers. Distribution network automation refers to the combination of modern electronic technology, communication technology, computer network technology with power system equipment, integrating monitoring, protection, control, measurement of distribution network under normal or emergency circumstances with management of power supply department organically. It can establish a closer and more responsible relationship with the energy consumers, strive to provide the most economical power supply service with higher quality and make the enterprise management more effective.

China first started to carry out the demonstration project of distribution network automation on a large scale in the late 1990s. But many of the distribution network automation systems built in early stage were not working in the way they are supposed to be due to an inadequate comprehension of distribution network automation, the incomplete distribution network framework and equipment, immature technology and product, and lack of administrative measures. The demonstration project was not successful at first. With more than ten years of exploration and practice, distribution network automation has been further understood, and the related technology has also become riper for application. All of these have created necessary conditions for the next step's work. The construction of Smart Grid in China brings vigorous vitality and new meanings for DAS again.

The State Grid Corporation of China puts forward the following overall request. Based on the existing network foundation and utilizing the existing equipment resources, we should build an open distribution network automation system which can meet the requirement of real-time monitoring and information interaction, supporting the access and control of distributed power source and electric vehicle charging station, and can have good interaction with the transmission network and energy consumer. In one word, it devotes to accommodate the construction and development of both strong and smart distribution grid [1]. And the State Grid carries out demonstration project construction actively. The first batch of demonstration project construction for DAS started in 2009, including four power supply companies with good infrastructure such as the urban Beijing, Hangzhou, Xiamen and Yinchuan. And in 2011 another 19 key cities like Shanghai, Nanjing, Tianjin, Xi'an etc. were pointed as the second batch of DAS pilot city [2,3].

According to the 12th Five-Year Plan (2011–2015) of State Grid Corporation of China as shown in Fig. 1, the DAS constructions in core area of 23 key cities like Beijing, Shanghai etc. have been completed in 2011, constructions in other seven key cities such as Jinan, Quanzhou etc. have started (30 in total). In 2012, the DAS projects of 70 cities including Linyi and Urumqi etc. are under construction (70 begins in 2012, 100 in total). In addition, 100 DAS construction projects including the cities of Lhasa, Beijing-Shijingshan, Wuhu, Xuchang, Jilin and Kashi will be carried out during the year 2013 to 2015 gradually (100 begins in 2010, 200 in total) [2,4].

China Southern Power Grid Corporation proposes to make a breakthrough by implementing the DAS and its intelligent

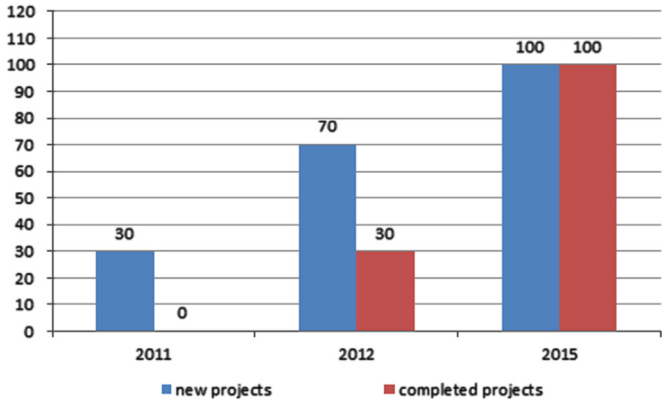

Fig. 1. DAS construction plan of State Grid Corporation of China.

application, then formulate relevant solutions, and comprehensively promote the Smart Grid construction. In 2009 they first chose two major cities Shenzhen and Guangzhou as DAS pilot city, and initial results have been achieved. Then they expanded the pilot city to Zhongshan, Foshan, Guiyang, Nanning, Kuming, Yuxi, Dongguan and other 15 cities [5,6]. Among these cities, the implementation scale of Shenzhen and Guangzhou power supply bureau is the largest. Take Guangzhou power supply bureau as an example, it divided the whole distribution network automation construction into four stages: started in July 2008 and ended in 2013, after which, the automation coverage rate of the class A, B and partial C power supply area in the main city area will reach 100%.

According to the technical report of cities which have completed distribution network automation construction [1,7–10], benefit from the construction, the distribution networks in the supply area have all realized to use multiple power sources as emergency power supply, which improves the reliability of power supply and voltage qualified rate, and reduces line loss per unit, pour brake operation time and fault handing time. To conclude, the DAS construction has got remarkable achievements, and lays the foundation for a successful implementation of the whole planning [3].

Feeder automation system (FA) is a key component for self-healing control under abnormal state of smart distribution grid [11]. Based on summarizing the construction experiences and lessons learned from the previous round, this new round construction of FA in China is highly valued. A large number of new technologies, products, models have been applied to the FA implementation plans, presenting a basic characteristic of practical which is quite different from the previous round.

This paper summarizes the new round of DAS, and briefly reviews the DAS experience and lessons of the previous round, including key standard construction, FA mode, the terminal technology, communication technology, power supply technology and testing technology that are closely related with the FA demonstration project. The intelligent distributed FA mode and test verification technology of FA are discussed in detail.

2. Technical preparation

2.1. Lessons from previous round construction

Since 1998, with a wide range of construction and reform in urban and rural power grid, the DAS technology and its application was raised in several provinces and municipalities. By 2003, more than 100 cities have carried out the distribution network automation system engineering demonstration project [5,6]. Some of