

Study on the Performance and Influence of Power Electronics in Distribution Network

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Abstract. *The 19th National Congress of the Communist Party of China solemnly announced that China has entered a new era, and all walks of life in our country have made great and excellent progress compared with the past. Since the founding of the People's Republic of China, under the impetus of the continuous and consistently development of economic, technological, and science strength and growth, China has continuously strengthened and promoted the reform of the distribution network and made important progress. Based on this, this paper now expounds the form of power electronics in the distribution network, mainly from the equipment level and system and two aspects of analysis; secondly, this paper analyses the current situation of power electronic equipment in distribution network from the theoretical point of view. Finally, the influence of power electronic transformer on distribution network is studied.*

Keywords: *Power Electronics, Distribution Network; Power Quality; Power System; Equipment Theory Analysis*

1. Introduction

In 2017, Xi Jinping, General Secretary of the CPC Central Committee, President of the State Council and Chairman of the Central Military Commission, solemnly announced that we Chinese people entered a new era, the so-called new era, refers to

the current in china's various industries have shown an important situation of major development and change. Coinciding with the 70th anniversary of the founding of the People's Republic of China this year, since the founding of the People's Republic of China, with the continuous development of China's economy and become the world's second largest economy, the strong promotion of China's scientific and technological strength continues to improve. Under the support of strong scientific and technological level and the guidance of deepening reform, China has been strengthening the optimization and reform of distribution network system in recent years, and now the theory and technology of distribution network system in China have made great progress.

2. The Expression Of Power Electronic Equipment Of Distribution Network

The electronic power in the distribution network has all kinds of forms, which is mainly divided into two kinds—equipment level and system level. Such two levels consist of the distribution network, although it has other components, in this page and essay, we mainly talked about the dominant double kinds. The first equipment level is called the DFACTS device, which distributed power generation and functioned as energy storage grid-connected device and power electronic transformer. System-level, for example, micro-grid, is flexible in DC transmission, AC DC distribution network, energy interconnection distribution network. This article now analyzes some of these types.

2.1 Semiconductor Switches

The first category is the semiconductor switch class. Semiconductor switching electronic equipment often controls the work and stop of the distribution network, and therefore occupies an important position. In recent years, its main materials have included both SiC and GaN. For the former, the main advantage is strong breakdown field strength and thermal conduction, while for the latter, it is often widely used to prepare some originals with frequencies greater than 1MHZ.

2.2 Substation Equipment Class

The second category is the conversion equipment category, as a processing equipment for power, the utility of substation equipment in the distribution network is mainly to change the frequency of a kind of electrical energy. With the continuous innovation of science and technology, especially after long-term development, the power industry has become an important industry, even so, to improve the operation efficiency of the power industry, improve the quality of service, we need to increase its integration with contemporary technology, that is, such as information network technology is a typical product of the current era.

2.3 Power System Class

The third category is the power system class: the structure of the power system is very cumbersome and complex; the power system class mainly divided into system control class and substation control class, relatively speaking, the substation control equipment is only for a specific power transmission equipment control, while guiding the inverter equipment to carry out the normal operation, to achieve the whole system's multi-class functions, that is, such as computing, Drive and protection, etc., and the system control equipment and the various substation control equipment communication association, can ensure the complete control of the entire distribution network effect.

3. Theoretical Analysis Of Power Electronic Equipment In Distribution Network

From the theoretical point of view, this paper mainly studies the transformer structure, the target function and the constraint slubys. The first aspect is the transformer structure.

3.1 Transformer Structure

An important component of electronic power equipment is the electronic power transformer. In addition, the equipment can not only use some advanced technologies to achieve conversion voltage, such as high frequency variable voltage

and transformation technology and other important technologies, in addition to it can also transmit energy.

3.2 Objective Function

The second aspect is the objective function. By reducing the loss, system reactive optimization can be achieved, and the control of voltage error can be achieved, so we must involve the analysis of the target function. However, there are some penalty factors in the target function, through which the voltage can be controlled, so as to manage the voltage control on the node within a reasonable standard range.

3.3 Constraints

The third aspect is the constraint. If we need to make those power electronic assembly settings reactive optimization, it is inevitable that we will try to meet these constraints.

4. Impact Of Electronic Powering On Distribution Networks

The impact of electronic power on distribution network is multi-faceted, mainly concentrated in power quality, system stability, grid structure, control, protection, operation and maintenance and other aspects, this paper is now some of the aspects of the discussion and analysis.

4.1 Power Quality

In terms of power quality, some of the power electronics of the distribution network are designed to improve the quality of electrical energy, such as the FACTSHD device, while the other part of the power electronics will worsen the power quality, especially the generation of harmonic pollution, such as electrical electronic setypes containing rectifiers.

4.2 System Stability

In terms of system stability, the distribution grid, driven by electronic power equipment, has made several major advances relative to our previous traditional distribution network, such as expanding the frequency fluctuation interval, shortening the time spent on transition processes such as stabilizing voltage, and so on.

4.3 controllability

In terms of control, there is no doubt that high controllability is extremely important to our equipment, and on this premise, we can do our best to keep the distribution network safe and efficient, and we can use it widely in real systems.

5. Application of Power Electronic Transformer in Distribution Network

5.1 Optimize Particle Swarm Optimization.

Optimal algorithm is an optimization method, which embodies a global thinking and is mainly based on intelligence. It can refer to the most suitable location or location in a range, and can transform the position of individual particles, so that they can be in the best position as far as possible. In particle swarm algorithm, particle swarm is composed of several particles with different particle positions, which represents the hidden relationship of optimization problems. Each particle can be used as a space point. In order to optimize particle swarm optimization, initial optimization must be carried out, which can provide the application data of particle swarm optimization, including the early position and random velocity of particles. At the same time, the fitness value of particles should be calculated by evaluating an example, and analyzed by comparing the fitness value of the optimal position and the fitness value.

5.2 Virtual Computing

Based on the normal load of distribution network, the calculation results of electronic transformer and suspension voltage transformer are almost the same. The changes of node voltage are different in a certain range. There are obvious voltage deviations. The initial value of the node is set to calculate the power loss by recording the normal load, optimizing the voltage and the voltage after optimization, so that the loss rate of the distribution network can be obtained. Optimizing the distribution network of on-load transformer, we can find that the reactive power optimization results are further reduced. For example, in the research system, we can see that the optimized voltage deviation is significantly lower than that before optimization, and the deviation rate is reduced by about 23%. From this, we can see that the reactive power in the system is reduced by 26%. Therefore, the loss can be reduced by optimization. By analyzing the distribution network including power electronic transformer, we can see that the voltage before and after reactive power optimization is obviously reduced, the maximum value is reduced, about 41%, so power electronic transformer can provide high quality voltage regulation capability.

6. Summary

To sum up, based on the background of China's entry into a new era and the founding of the People's Republic of China for 70 years, it is of great significance to study the performance and influence of power electronics in the distribution network to strengthen and deepen the reform of the distribution network in China. The influence of different power electronic configuration on distribution network is different, which not only affects its function, but also affects its operation. Therefore, we need to start from the actual situation, realistic analysis of the specific situation, so as to deepen the distribution network reform and improve the power electronic configuration.

Power electronic system is one of the important parts of distribution network reform, its importance is more important than Taishan, and science and technology is the first productive force, if we can continue to strengthen the technological strength, it means that we can continue to develop and promote and deepen the distribution network reform, for the development and management of China's power

grid to provide a continuous source of development power, And it is bound to play a great role in promoting China's economic development. In order to strengthen the research and development of power electronic assembly, we can not only inherit the experience of developing our country's previous research and development experience, but also can boldly innovate or learn from the experience of foreign power electronic assembly development experience, it can attack jade, but at the same time, learn from the same time should pay attention to my use.

References

- [1] Wang Yujuan. Application of power electronic transformer in reactive power optimization of active distribution network [J]. China New Communications, 2019, 21 (07): 226.
- [2] Zhao Min, Li Shunxin, Yue Yunli, Li Bo, Dong Shaozheng. Performance and Impact Analysis of Power Electronization in Distribution Network [J]. China's High-tech Enterprises, 2017 (01): 149-150.
- [3] Hu Wangbo. Exploring the interconnection and networking technology of power and electronic equipment in distribution network [J]. Electronic technology and software engineering, 2016 (22): 101.
- [4] Maejima, T., Ishida, M., Yamamura, N.. Improvement of quality of electricity distribution system using matrix converter[P]. Electrical Machines and Systems (ICEMS), 2010 International Conference on,2010.
- [5] Tripoli. Interconnection and networking technology of power and electronic equipment in distribution network [J]. Digital Communication World, 2019 (04): 47+66.
- [6] Zhou Guoping, H. interconnection and networking technology of power electronic equipment in distribution network [J]. electronic technology and software engineering, 2018 (01): 17.
- [7] Zhang Hongyan, Chen Xiaobo. Research on control scheme of self balancing power electronic transformer in distribution network [J]. communication power technology, 2018,35 (03): 94-96.
- [8] Ke Hongyuan. Discussion on interconnection and networking technology of power and electronic equipment in distribution network [J]. Communication World, 2018 (07): 176-177.
- [9] Zhang Hongwang. Interconnection and networking technology of power electronic equipment in distribution network [J]. electronic technology and software engineering, 2017 (03): 240.
- [10] Chen Yong. Interconnection and networking technology of power electronic equipment in distribution network [J]. Electronic technology and software engineering, 2017 (02): 247.
- [11] Sun Bangwu. Application of Power Electronics Technology in Distribution Network [J]. Wireless Interconnection Technology, 2017 (13): 133-134.

- [12] Ni Shilong. Application of Interconnection and Networking of Power Electronics Technology in Distribution Network System [J]. Communication World, 2017 (19): 194-195.
- [13] Liu Runyu. Exploring the interconnection and networking technology of power and electronic equipment in distribution network [J]. Communication World, 2017 (19): 212-213.