Impacts of Grid-connected Photovoltaic Generation on Distribution System

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Abstract. Sunlight is constantly changing during the year, including a certain regularity random variation due to weather changes and the result. Thus, by the light on the photovoltaic power generation system is also in flux. Incorporated into the distribution network after PV, the network will change the trend, causing node voltage changes, and the impact on the voltage regulator. With the development of photovoltaic technology and grid technology, more and more incorporated into photovoltaic power distribution network, to the distribution network of operational control brings various effects. This paper analyzes the impact of PV grid distribution network voltage regulation, and summed up the resolve PV grid distribution network Voltage on approach.

Introduction

With the increasing human consumption of fossil energy, fossil energy and the negative effects on the environment caused by increasing energy constraints to economic and social development is also increasingly evident. Therefore, the active development and utilization of new renewable energy become a national basic energy policy. Among the many new energy inside the solar adequacy of its breadth, cleanliness, renewable and technology development, won the favor of many countries. The main advantage of the new forms of renewable energy, distributed generation (Distributed Generation, DG), the development and utilization of solar energy also belongs to this form, the main way is distributed PV (Photovoltaic, PV) power generation.

PV industry can eventually develop, depending on whether the application of photovoltaic power generation broad and effective. In the remote western region of China, independent photovoltaic power generation system directly to the load can solve the problem of local long-term power shortage. But in order to ensure the reliability of power supply load, and the drive level and the purpose of the development of photovoltaic industry development of photovoltaic industry, the photovoltaic power generation and network is the most effective way to use photovoltaic, which is the mainstream of photovoltaic power generation. For PV grid and grid-connected photovoltaic power plants generally called, can be divided into centralized and distributed PV power plants PV power plant, the former mainly in the transmission network grid and a larger capacity, the latter mainly decentralized access to distribution network and the capacity is small, such as photovoltaic roof, building photovoltaic (Building Integrated PV, BIPV) and so on.

Effect of PV Grid Voltage and Adjustment in Distribution Networks

Previous studies showed that after PV grid voltage distribution network mainly produce three effects: First, the increase in voltage distribution network, and second, causing voltage fluctuations or flicker, the third is to change the voltage distribution. Photovoltaic and distribution network after network will continue to change the trend line, the node voltage fluctuates. With the increasing penetration of PV may occur and grid-connected photovoltaic phenomenon rallied community within a large area, so that the voltage adjustment becomes difficult, easily lead to excessive voltage, making it difficult to ensure the quality of power supply. And with changes in solar radiation, the need for frequent voltage adjustment operation, the life of the voltage adjusting device is reduced. Traditional

distribution network regulator relies on HV / MV substation load tap master regulator (On-Load Tap-Changer, OLTC) transformer regulator and MV / LV substation unloading select the secondary side to the regulator, automatic voltage Regulator (Automatic Voltage Regulation, AVG) provide line drop compensation (Line Drop Compensation, LDC) to dynamically corrected OLTC voltage reference value set point, so as to maintain the standard within each feeder voltage supply range.

When PV is not in grid, the current flows from the main substation feeder line end voltage of maximum, minimum appeared at the head-end transmission lines and power receiving end. When the PV grid, voltage characteristics are difficult to predict because of uncertainty by many factors, such as changes in solar output capacity, changes in operating conditions and other PV, so parameters Vp and R is difficult to set. In addition, the photovoltaic grid power supply part of the load, so HV / MV transformer secondary side of the measured load current IT load than those powered solely by the current transformer when the load is smaller, OLTC as a situation when there is no solar load reduction process, AVG will control correction MV bus voltage, making it smaller than the voltage value when no PV, but this time, the load is not connected PV node voltage will drop, there may be a low voltage it is difficult to meet the supply standard.

From the analysis of PV grid voltage distribution network and adjust the impact point of view, to reduce or eliminate the negative impact of PV on voltage, to take the appropriate measures. Can take to prepare its grid PV system design and grid control strategies on the appropriate measures, and for already grid PV system, you need to resolve in terms of the system, configure the appropriate reactive power compensation element or optimize existing the surge strategy.

Effect of PV Grid Distribution Network Protection

At present, China's distribution network and many more web-based radiation pattern. In the absence of PV grid, the radial distribution corresponds to a single power supply network, when a short circuit fault, the direction of the short circuit current is single. When incorporated into the distribution network of photovoltaic, making the power distribution network into multiple networks, short-circuit current distribution, size, and orientation are different from before. And the original distribution network protection is based on the size of the short-circuit current to configurable and non-directional, so the action will be affected by solar power. PV grid system itself consists of a stationary power electronics and other components, without rotating elements, so unlike conventional generator having a rotational inertia, when the external distribution network failure, showed transient process is extremely short. Moreover, photovoltaic grid systems have some own characteristics, in the distribution network failure, the impact of protection is also different from traditional generators.

Distribution network in more than 80% of the fault belongs to the transient short-circuit fault, the use of automatic reclosing enables rapid recovery of normal power supply, reducing power outages lines, greatly improve the reliability of the system, but also because of their agency to correct breaker bad or protection malfunction caused nuisance tripping. After PV grid, if it islanding protection with automatic reclosing operation time with properly, it will bring to the automatic reclosing following effects: (1) the automatic reclosing failed. Photovoltaic power in the circuit breaker off, it may continue to provide short-circuit fault current, the fault cannot be properly extinguish the arc, leading to automatic reclosing coincide failed. (2) Cause Asynchronous closing. When the fault point downstream PV access, disconnect the circuit breaker, an island photovoltaic system frequency and frequency deviation of the distribution network that the two are not synchronized, then if automatic reclosing actions will result in asynchronous closing, produce great impact on current or voltage may cause malfunction feeder protection, and automatic reclosing lose the ability to quickly recover transient fault; the same time, the impact of the current distribution network may have and photovoltaic devices in the system causing fatal damage . 3) Increasing the automatic reclosing waiting time. To avoid the same period reclosing, reclosing should coincide islanding protection after the protective action of PV photovoltaic downstream exit, so that the automatic reclosing coincide wait prolonged effect quickly restore power.

For the impact of distributed power distribution network protection, at home and abroad have carried out many research-related aspects, made a lot of new protection or protection strategies to ensure access to the distribution network after Distributed Power protection is still an accurate and fast, sensitive and selective action. As a distributed power source, these solutions are equally applicable to the case of PV grid.

Multi-agent technology, the distribution network equipment elements are divided into three agents: relay agents, agents and other distributed power equipment components agents (including CT agent, circuit breakers and other agents). Between these three agents communicate with each other, according to their message, such as the value of the measured electrical device measuring the amount of photovoltaic networking status, opening and closing state of the breaker, relay operating status, etc., after a series analysis judgment, the use of logic functions in case of failure of the corresponding relay. The multi-agent distribution network protection control system is divided into three layers: The first layer is a control agent, and the second layer is to protect the coordination and networking topology agent, and the third layer is the measure, state detection and protection agency, among a proxy form orderly whole, each agent can be based on local information both independently established functional tasks, it can also communicate with other agents, information sharing, in order to achieve the objective of protecting the whole system.

Impact of PV Grid Distribution Network in Other Areas

PV grid will bring the following effect on the distribution network dispatching automation: (1) the impact of information monitoring: The inverter grid PV systems may produce a DC component, affecting the normal operation of the grid with the measuring element and so on so that the information collection and transmission distortion dispatching automation system, the subsequent judgment and actions of the system. (2) On the metering and billing of users: installation of photovoltaic systems and network users, and power grids have two-way flow between the energy measurement also need to tag direction. The choice of the measuring meters and installation, also need to be considered. In addition, PV systems feeding into the grid and the user to take power from the grid, due to the different cost of power generation, need to consider different price billing. (3) the impact on the operational control of: Access will automatically adjust the voltage distribution network of photovoltaic power impact, when the distribution network fault, PV also access distribution network automation system for fault diagnosis, fault location , fault isolation, feeder automation, and other adverse effects, has to be analyzed in the third chapter. For PV output of non-unity power factor and network, will affect the distribution network reactive power compensation capacitor switching balance and strategy, it is necessary to choose an effective and feasible method for a new distribution network optimization and reactive power compensation strategy.

Summary

With the advancement of national policies and photovoltaic power generation and network technology of distributed photovoltaic power generation and network of support and encouragement, there will be more and more incorporated into the distribution network of distributed PV. Clean distributed photovoltaic power generation, renewable, flexibility, ease of distribution network when the supply pressure and environmental pressure to show a huge advantage, and led to the current downturn in the photovoltaic market also play an important role. But as a new form of power generation, photovoltaic power generation itself has some features will be incorporated into the distribution grid have different degrees of impact on the existing distribution network of operational control, especially with the increasing penetration of PV grid large, with the impact on the grid increases. Therefore, it is need for PV grid distribution network caused by the impact on research, and to improve the ability to receive solar power distribution network as much as possible.

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