Analysis of Distributed Power Access on Distribution Network Fault Location and Voltage Quality

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Abstract. Distributed Generation (DG) has a certain impact on distribution network fault location and voltage quality during the access process, which is worth studying. In this paper, the impact of distributed power on the two is discussed separately, and further technical analysis is carried out with an example.

1. Introduction
Distributed power access has a great impact on distribution network fault location. It can analyze some distributed power sources that do not meet the criteria of judgment, and also meet the voltage quality requirements. This technology breaks through the traditional fault location strategy, establishes the relationship between power network fault handling and the impact of voltage quality in the process of fully considering distributed power supply, and implements regulation to ensure high voltage quality of the distribution network.

2. Impact Analysis of Distributed Power Access on Distribution Network Automation Fault Location
Distributed power access has a significant impact on distribution network automation fault location. It mainly affects short-circuit current. If analyzed according to DG and different distribution network interfaces, distributed power can be converted into different types of motor power. Specifically, it mainly analyzes the rated current based on the short-circuit of the grid connection point. At the same time, it also applies to the squirrel cage asynchronous generator to analyze the attenuation of 3-10 cycles in the generator and observe the process of attenuation to a value of 0. If the short-circuit current of the distributed power source itself is formed by the doubly-fed generator, its crowbar circuit will generate a certain amount of load current, which will lead to Rotor winding short circuit. The short circuit current characteristics of the doubly-fed generator will also be close to that of the squirrel cage generator, resulting in the infinite steady-state short circuit current approaching 0\cite{1}.

On the other hand, to ensure that the power supply of the converter in the distribution network can be connected to the three-phase voltage source converter smoothly, the direct current control method can be used. When short-circuit occurs at the grid connection point, it's DG can effectively provide...
short-circuit current rationalization control current range of about 1.2-1.5 times the rated current. In this regard, the fault information of the distribution terminal of the converter power supply running in the distribution network can be analyzed, report and adjust its threshold, the worst condition can be directly determined, and the power adaptability range of the converter can be calculated [2]. In this process, the sensitivity factor Ksen can be analyzed by using the traditional fault location rule status, which generally ranges from 1.2 to 1.4. It is adjusted as follows with the distribution terminal fault current information reporting threshold Iset:

\[ I_{set} = I_{SC}^{*} / K_{sen} \]

The above current information adjusting and reporting threshold can be used to analyze the distribution power access with larger capacity, establish distribution automation system, and then realize the effective improvement of the system fault location system. In the application of the 《Technical Regulations for Distributed Power Access to Grids》, a set of unconscious distributed power systems needs to be established. At the same time, combined with feeder fault, the analysis of power grid disconnection is carried out. In addition, the off grid characteristics and reclosing coordination mechanism of distributed generation are proposed to effectively eliminate the influence of distributed generation in short-circuit current, and the fault treatment strategy of distribution network is improved, and the following four technical points are proposed[4]:

Firstly, it is necessary to ensure that the load quick closing is used as the feeder switch, the outgoing circuit breaker of substation has the function of over-current protection and one-time quick reclosing, and the reclosing delay time is controlled within 4 s.

Second, when the fault occurs, it is necessary to analyze the circuit breaker in the substation, and propose the optimization mechanism of overcurrent protection action trip.

Thirdly, when the distribution network fault is handled for 2 s, the distributed generation on the feeder is adjusted to make clear the technical system of grid off grid characteristics.

Fourth, an instantaneous fault optimization mechanism is established to restore the full feeder power supply, and a distributed power supply is established and incorporated into the power grid. If permanent faults occur, the problem of circuit breaker tripping in substation needs to be analyzed. The influence of distributed power supply is eliminated mainly through the secondary collection function of distribution automation system to ensure that the traditional fault location of short-circuit current is in place. Here, the traditional fault location rules of short-circuit current can be referenced for fault location.

Combined with the above improvement strategies, the status of distributed power supply with any capacity is analyzed, and an applicable mechanism is established to avoid changing the hardware content of distribution automation system and ensure that the software used for fault handling can be changed in place. Furthermore, it is necessary to ensure that the overlap stations and the disconnection characteristics of the distributed power supply cooperate with the fault location method [5].

3. Impact Analysis of Distributed Power Access on Distribution Network Voltage Quality
Distributed Power Access's Deviation Impact on Distribution Network Voltage Quality is achieved mainly through the establishment of model analysis, such as Node \( k \) without distributed power access, simultaneous voltage deviation \( \Delta U_k \):

\[ \Delta U_k \% = -\frac{\sum_{i=0}^k R_i \sum_{k=1}^n P_{L,K} + X_i \sum_{k=1}^n Q_{L,k}}{U_N^2} \times 100\% \]

Connect to the power grid with distributed power, and reduce the voltage loss in the line by outputting active and reactive power, which is opposite to the load flow direction based on the current flow direction. Distributed power node \( k \) and voltage deviation \( \Delta U_k \) are established, and load and
distribution conditions are established to ensure that the feeder voltage deviation is guaranteed when the distance between the fast line and the bus is in place and the distributed power supply is reintegrated. Finally, make sure that it exceeds the upper limit of rated voltage to establish a distributed power supply to connect to the power grid and meet the voltage deviation constraint [6].

Constraint models for not exceeding voltage deviation and voltage fluctuation are established in conjunction with distributed power grid access, as shown in Figure 1.

Figure 1. In this case simply justify the caption so that it is as the same width as the graphic.

As shown in Figure 1, the distributed power supply in the shadow area is analyzed, the content of power supply is coordinated and controlled to meet the basic requirements of voltage quality. Real-time monitoring is carried out with the help of distribution automation system, and the voltage quality of access point is found to meet the requirements. In the analysis of distribution automation main station, it is necessary to propose corresponding processing strategies, build remote control mechanism, and rationally adjust the active and reactive power in distributed power supply [7]. During the adjustment process, it is necessary to measure the access point voltage, set up a real-time monitoring technology system for distribution automation system, optimize the control power content, and ensure the quality of distributed power application.

4. Case Analysis of Distributed Power Access
Assuming a 10kV distribution network is used in a city, it establishes the "hand-in-hand" structure of distribution network lines, establishes two feeders to maintain power supply distance of 3km, optimizes the line node lines to access 3MVA load, and ensures the short-circuit capacity of the system to exceed 500MVA, so as to establish distributed photovoltaic power supply [8].

An inverter-type grid-connected structure is built for distributed photovoltaic technology mechanism to optimize the maximum power supply distance (adjusted to more than 6km) after load switching. At this time, the intervening distributed power capacity in the line is controlled with the system short-circuit capacity parameters to ensure that its capacity is within 3.7MVA and meets the technical requirements of traditional fault location rules. The distributed photovoltaic power access
mechanism can be used to ensure the variation of photovoltaic output power. Moreover, the maximum output power is optimized to ensure that the maximum output power value = 2 and the power factor range is controlled from -0.95 to 0.95. In this stage, the effect of reactive power should be ignored, and an active source should be established in the distributed photovoltaic power supply to ensure that the standard limits of voltage deviation and voltage fluctuation quality are optimized and that the access capacity of each line's distributed photovoltaic power supply is controlled within 16MVA. This ensures that with the help of distribution automation system, coordinated control can be optimized to meet the voltage quality control requirements [9]. In combination with the above content, the city distribution network line is established according to the actual situation, ensuring that the given distributed photovoltaic power access capacity is analyzed, and ensuring that the software and hardware systems of distribution automation system are upgraded and transformed in place. At the same time, it must meet the requirements of fault location and voltage quality for distributed power supply access. Establish the distribution terminal fault current information threshold reporting and setting in place. In this process, when the reporting and adjusting threshold is above 1.1kA, the optimal power supply distance around the two feeders is above 10km, and the distributed photovoltaic power supply is connected to each line to ensure its capacity is above 6MVA. Here, we can continue to consider distributed power supply and access the most critical case of feeder end connection, ensure that the limit capacity of distributed photovoltaic power on each line is analyzed, ensure that its value does not exceed 5MVA, ensure that no distribution automation system is used for coordinated control optimization, and ensure that the voltage quality requirements are met [10].

5. Conclusion

To sum up, in the distribution automation system, it is necessary to access its distributed power supply in order to ensure that the feeder has a larger distribution adaptability range than the overhead feeder, and to set up the grid-connected distributed power supply structure of inverters to effectively improve the adaptability of the distributed power supply. In addition, in order to cope with large-scale operation of distribution network access technology with distributed power reasonably, the distributed power disconnection characteristic combined with reclosure can be used to improve fault handling. This can change the level of software and hardware in distribution automation system, analyze the upper and lower limits of distributed power capacity and voltage deviation, and optimize the status of power supply area. The main purpose is to effectively control the voltage quality of the distribution power access point, ensure that the voltage quality level of the access point is optimized through the monitoring and control of the distribution automation system, improve the value of the distribution power access function, and optimize the overall operation level of the power grid project.

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