

A Brief Discussion on Wide Area Security and Stability Control of Power System Based on Response

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Abstract: At present, with the continuous development of China's social economy, the scale of domestic power system has been further expanded, which also makes the structure of China's power grid system gradually become more complex^[1]. Therefore, it is necessary to continuously increase the single unit capacity of power equipment. The purpose is to make the single unit capacity match the operation of power system, so as to improve the operation performance of power system. Besides, it can also increase economic benefits. Based on this, this paper expounds the concept and control mode of power system stability. Then the key technology of wide area security and stability control of power system based on response is analyzed from four aspects. They are wide area dynamic feature information extraction, disturbed trajectory prediction, system stability discrimination and stability control. Finally, the practical application is discussed in detail. It hopes that the power sectors can improve the stability control level of power system wide area security.

Key words: power system, security and stability, wide area control technology, application

1. Introduction

In the current social development, the most important energy is electricity because of that electricity plays a huge role in people's life and economic construction. In addition, the main cause of large area and long time power outage is the lack of stability of power supply system. It will not only cause certain losses to the economy, but also have a serious impact on social development^[2]. Therefore, the research on the security and stability control of power system can make the allocation of power resources more reasonable and improve the transmission capacity of domestic power system continuously.

2. Overview of security and stability control of power systems

2.1 The related concepts of power system stability

On the one hand, the function of power system provides uninterrupted power to users. On the other hand, the function of power system ensures that the power supply has a certain stability in voltage and frequency^[3]. Therefore, the requirement of power system performance should not only have high safety and stability, but also have certain reliability. Specifically, the reliability of the power system mainly provides long-term operation of electricity. And it can continue to provide users with adequate power services. For the security of the power system, it is mainly able to maintain the normal operation of the power system in the event of power supply risk and power failure. In addition, the stability of the power system mainly ensures the continuous and stable power supply.

2.2 Classification of safety and stability control mode of power system

There are different kinds of security and stability control modes in power system because of that the power system has different ways of information collection, transmission and decision-making. First of all, for the local control mode of power system, there is a lack of effective information exchange between plant stations because of that the control device is installed in different plant stations. The local control mode needs to use the switching and judging the existing information of the station to solve the problems of the station effectively. Secondly, for the centralized control mode, it not only has a relatively independent communication and data acquisition system, but also can carry out the overall control of the dispatching center settings. The running state of the system can be detected in time. And the corresponding control strategy can be formulated. The security and stability of the whole system can be improved through the issuance and implementation of control commands^[4]. Finally, for the regional control mode of power system, its main control is the power grid security of fixed area. It is necessary to install control devices in multiple power plants in order to control the stability of the power system in the fixed area. The information between power plants can be exchanged with each other by the transmission and implementation of control commands. And the security and stability of power system in a large range can be controlled effectively.

3. Key technologies of wide-area security and stability control of power system based on response

3.1 Information extraction of wide area dynamic features

The information of wide-area measurement information is large because of that the wide-area measurement information not only has global features and real-time features, but also has certain continuity. When the wide area security and stability of power system based on response is controlled, the most important work is to understand the characteristics of system security issues fully, and to judge and select the wide-area dynamic characteristic information which is in line with the safety and stability of the system from a large number of measurement data. For example, when the power angle stability is judged, the information includes power-power angle characteristic curve, Kinetic energy of generator–power angle curve, and angular velocity–power angle phase trajectory^[5]. At the same time, the bus voltage of the power-current curve and the frequency stability of the frequency trajectory curve should be judged. The control of wide area security and stability is realized.

3.2 Prediction of disturbed trajectories

Disturbed trajectory prediction is mainly used to predict the situation of the system after the security is disturbed. Its purpose is to understand the change trend of the system disturbed by the prediction, and to judge the security and stability of the system in time. The sufficient decision-making time for emergency control of the system is ensured. It should be emphasized that the prediction of the safe and stable disturbed trajectory of wide area measurement information is mainly carried out by two methods. One is the non system mathematical model, and the other is the system model.

3.3 Discrimination of system stability

Fast, reliable and independent of the whole system simulation calculation of security stability discrimination is the key to effectively control the response-based power system across the security stability^[6]. The safety and stability judgment of the whole system simulation calculation which is fast, reliable and independent is the key to control the safety and stability of power system crossing based on response. In the control of wide area security and stability of power system, it is not only necessary to screen the real-time measurement information effectively, but also to judge the power system security stability including transient angle stability, dynamic angle stability, voltage stability and frequency stability in real time. Besides, when the stability of power system is judged, the dominant instability mode

also should be given. It can judge the different analysis methods of safety stability effectively. It can identify the stability of wide area real-time measurement data, and realize real-time decision-making and control of power system security and stability.

3.4 Stability control

The response-based wide area security and stability control should be based on stability prediction. In case of system instability, the stability of the system can be guaranteed by taking control measures in time. Therefore, for the control of security and stability based on wide area measurement information[7], it is necessary to carry out quantitative analysis of the control measures on the one hand and the stability control measures should be optimized and perfected on the other hand. In addition, if the control quantity is insufficient and the stability property changes during the implementation of the control measures, the measures should be taken in time to ensure that the security and stability of wide area based on response can be controlled effectively.

4. Application analysis of response based wide area security and stability control technology in power system

4.1 Construction of wide area security and stability control system for power system

In order to make the power system have the stability of continuous security, it is necessary to put the security of the power system in the first place in the design of the power system planning.

It is necessary to control the safety and stability of power system effectively through the construction of reasonable and preventive control scheduling means. It can effectively prevent turbulence in the power system and avoid the occurrence of large power outages^[8]. At the same time, the power grid structure and security defense system should be constantly improved. The security and stability control system of the power system is a comprehensive system engineering. When it is planned and designed, the structure design of power grid and the operation mode of power system should be considered comprehensively. Only in this way can the security and stability of power system be controlled comprehensively and effectively.

The security and stability control system of the power system not only includes the security of the power system before disturbance, but also includes the design of power system security and stability control system after disturbance. The whole power system consists of three lines of defense, the specific content is as follows^[9].

First line of Defense. It is mainly to cut off the fault components in time by using the relay protection mechanism when there is a safety fault. It can ensure the normal operation of the power system after being disturbed.

Second line of Defense. The main purpose of this line of defense is to prevent the destruction of stability effectively. The system parameters of serious over line are controlled effectively and timely by using the measures such as the stability control device and cutting machine, load shedding stability control and emergency power conditioning. It can ensure that the power grid can continue to operate stably when it is damaged by the fault.

The third line of Defense. This line of defense is mainly for emergency control of system collapse. It carries out emergency control for the power grid when it is unable to operate due to a variety of serious accidents by using the measures including system disconnection and re-synchronization. When the system crashes, it can ensure that the system can continue to supply power

4.2 Analysis of Wide Area Security and Stability Control Process in Power System

The power system has a large range of electrical changes, short duration and more cumbersome analysis and calculation. We should make full preparations before the accident to analyze the security control strategy of power system. It can ensure the safety and stability control effect of power system. In addition, the effective control of power system security and stability is mainly through online and offline ways to solve the problems of short power supply

duration and complicated analysis and calculation. For the online solution, it mainly analyzes the real-time operation status of power grid and the possible faults in the server online decision-making system. It effectively solves the problem that the wide area security of the power system is unstable by making corresponding control strategies[10]. In practice, this method has some difficulties. It is rarely used to analyze and calculate the actual data. For the off-line solution, it is relatively simple in practical application. It can work out the corresponding control strategy by analyzing and calculating the faults that the power grid may encounter in each state. Although this method is relatively simple, there are still great problems in calculation and maintenance, and it is difficult to adapt to the development and change of power grid effectively.

5. Concluding remarks

At present, the wide area measurement system of response measurement device is gradually improved and perfected. Through using the high-speed communication network, wide area control system of the power system based on response has been developed and applied. Therefore, in order to ensure the safe and stable operation of AC / DC interconnected power system in China, it is necessary to study the wide area control technology of power system based on response. At the same time, the super defense line of power system security and stability should be constantly improved and perfected. It can avoid large area blackout of power grid and ensure that the power supply system can operate normally. Finally, it can provide continuous power for users.

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