Analyze And Study The Safety Measures And Visualization Technology Of Intelligent Substations

Mingli[1], Shuai Wang[1], Jiayang Sun [1], Xuyu Gao [2]

[1]State Grid Shandong Electric Power Company Heze Power Supply co.,ltd ze he, 274000, China

[2]Shandong AnXinYuan Information Technology Co., Ltd, Jinan 250100, China

Keywords: Intelligent Substation; Safety Measures; Visualization Technology

Abstract: As people's production and living demand for electrical energy is gradually increasing, in order to meet their needs, advanced technology is used in the construction of substations, and the level of intelligent and modernized substations is increasing. In recent years, the scale of power grid construction in my country has gradually expanded, and the coverage area of the power grid is relatively wide. Substations are an important part of the power system, and their load of information is large. Therefore, the requirements for substation construction are increasing. The intelligent substation can use the network to share resources, which has the characteristics of high integration, stability and reliability. This article explores the safety measures and visualization techniques of smart substations.

Introduction

Electric power resources have become an important resource that affects people's daily lives, businesses, and social and economic development. The substation is an important place for AC voltage and current in the power system to receive and distribute electrical energy [1]. It can be seen that the substation is an important place to meet people's daily life and produce electricity demand. Today, with the rapid development of science and technology, the use of modern and intelligent technologies in the construction of substations is of great significance to give full play to the role of intelligent substations.

1. Overview of smart substation

The intelligent substation is mainly composed of intelligent high-voltage equipment and a unified information platform for the substation. Intelligent high-voltage equipment mainly involves: intelligent transformers, intelligent high-voltage switchgear, electronic transformers, etc. The intelligent transformer and control system are connected by the communication optical fiber, so that the staff can grasp the transformer status data and operation data in time. If the transformer operation mode changes, you can determine whether the tap needs to be adjusted according to the system voltage, power and other data; if the transformer equipment fails, an early warning will be issued and status parameters will be provided to the staff to reduce transformer operation management costs and reduce potential safety hazards, improve the stability of transformer operation [2]. Intelligent high-voltage switchgear refers to the switchgear department and control equipment with high performance, and is equipped with electronic equipment, sensors and actuators. The main functions of the substation unified information platform are: horizontal information sharing and vertical information standardization. Horizontal information sharing refers to providing unified information for the upper-layer applications of the management system; vertical information standardization refers to supporting the transparency of its upper-layer applications for each layer.

Intelligence is humanization, that is, scientific and reasonable adjustment of substation operation data to meet user power demand, improve substation production efficiency, and promote the stable development of the power industry.

2. Safety measures for smart substations

There will inevitably be hidden safety hazards in the operation of smart substations. If targeted safety protection measures cannot be taken, the operation stability of the substations will be affected. Therefore, we need to select appropriate protective measures according to the actual environment and conditions to ensure the stable operation of the intelligent substation.

2.1 Safety measures for trip protection

Tripping is a common problem during continuous operation of substations. The occurrence of a trip accident will affect the operation efficiency and stability of the substation. At the same time, it will cause human, financial and material losses to the substation. Therefore, in order to ensure the stable operation of the substation and improve the operation efficiency of the substation, it is urgent to solve the trip problem. At present, the number of smart substation constructions is gradually increasing, and most of the smart substation constructions use protection system tripping methods [3]. First, select the unconventional transformer + local integration unit + GOOSE trip. Secondly, choose conventional transformer + local merge unit + GOOSE trip. Finally, select conventional transformer + conventional sampling + GOOSE trip. Using different devices, the specific mode is also different. However, it plays an important role in aspects such as equipment protection. The intelligent principle of the mechanical equipment of the intelligent substation is to use intelligent technology to transmit relevant information and simulate output signals to achieve the purpose of solving equipment problems. The intelligent substation equipment also contains many optical cable devices, so its information and analog signals propagate faster, and the security is relatively high. The key technology of the intelligent substation is the GOOSE technology, which is based on high-speed network communication and provides multiple nodes for the purpose of solving the problem of substation tripping. By adopting these measures, it is possible to achieve real-time monitoring, forecasting and early warning while improving the level of intelligence of mechanical equipment, and improve the management level and operational safety of substations.

2.2 Main transformer protection safety measures

In the maintenance of substations, safety should be emphasized, so the staff must check in detail whether the main transformer safety protection is complete according to the regulations. During the maintenance process, the following maintenance measures shall be taken: the electronic transformer and traditional sensors shall be used to check the safety protection facilities of the main transformer. After using the above two types of equipment to complete the inspection, the main transformer protection and maintenance work needs to be done. According to the actual situation and conditions, inspect the defects of the merged unit on a certain side. Organize and analyze the existing problems and adopt targeted protection strategies for the actual problems [4]. In order to ensure that the main transformer protection safety measures are targeted and effective, the staff must conduct functional tests in advance to ensure that the main transformer protection safety measures can fully exert their due effects.

2.3 Line safety protection measures

Line safety is an important factor that affects the operation stability and safety of substations. At the same time, line safety is also an important factor that affects the level of substation intelligence. If the line safety cannot be guaranteed, it will cause great losses to the substation. Therefore, when inspecting the related equipment, the staff needs to check the line safety in detail. During the inspection process, the following inspection methods can be adopted: First, the electronic transformer is used to check the line safety. Staff can use intelligent electronic equipment to check the line. Secondly, use traditional transformers or combined with intelligent electronic equipment and traditional transformers for line safety inspection. This is very important to ensure the test results and the safety of the line. Finally, the line protection device is insufficient. The staff adopts the protection and exit GOOSE operation on the bus to ensure the safety of the line. After merging the units, the circuit is opened, and then, for example, the pressing operation is performed, and the

input optical fiber is taken off the line protection backplane SV.

2.4 Safety measures for bus coupler protection

When carrying out protective measures on the mating couplet, it is necessary to ensure that the relevant operations are carried out in the state of power failure of the equipment. The main safety measures for bus coupler protection are as follows: the staff uses electronic transformers and traditional transformers, and then protects the bus coupler, and uses intelligent terminals to strengthen the overhaul work, and then quits GOOSE and starts the failure receiving soft pressure plate. Workers need to remove the input fiber on the basis of busbar protection, and then merge the unit section to open the loop. All busbar protection measures need to be carried out on the basis of power failure of the equipment. If the equipment is not powered off according to the regulations, the busbar protection measures need to be changed.

2.5 Busbar protection safety measures

Bus protection safety is also an important part of the maintenance work of intelligent substations, which is of great significance for improving the efficiency and operation efficiency of substations [5]. Under normal circumstances, during the busbar protection process, the following measures need to be taken: the staff needs to strengthen the maintenance and verification of the busbar protection, and then analyze the 220kv busbar protection processing defects. Relevant experiments are required in this session. For smart substations that have been built and put into use, the process of busbar protection safety measures and their impact on substation production efficiency and economic benefits need to be analyzed in detail. Usually, all busbars are not overhauled in detail.

3 Visualization technology analysis of intelligent substation

3.1 Visualization of security measures status confirmation

The purpose of the status confirmation visualization is to clarify the status of the upper-level equipment maintenance status pressure plate. The device on the receiving side of the GOOSE message adds an instruction for the maintenance status of the sender according to the GOOSE link, that is, to set a system for confirming the maintenance status of the sender and the receiver. Use the display device on the receiving side to display the relevant data information, and set the GOOSE link maintenance status indication in the menu to ensure that the GOOSE information is accurate. If the receiving side device does not have the display function, it is necessary to set the LED indicator according to the regulations, and use the indicator to display the GOOSE link maintenance status [6]. In addition, for equipment that is difficult to upgrade and rebuild, staff can use the network message analyzer and fault recorder to understand the GOOSE inspection status sent by the device under inspection.

The main current safety measures for smart substations are: First, use MMS to read and confirm the internal information sent by GOOSE and received by GOOSE. Second, according to the principle of GOOSE message overhaul, use message analysis software or analyzer to confirm GOOSE message. Because the analysis and judgment of GOOSE messages are difficult, and the status reading of the GOOSE sending and GOOSE receiving platen is not intuitive, it is necessary to use the safety confirmation status confirmation visualization technology to improve the operation efficiency and stability of the intelligent substation.

3.2 Safety measures loop visualization

Safety measures loop visualization refers to the use of graphics to display the status of the maintenance device's maintenance platen and GOOSE's platen status on the basis of ensuring the normal operation of the intelligent substation are very important.

In order to achieve the goal of visualizing the loop of safety measures, it is necessary to use advanced technology to establish intelligent data sets and report control blocks. For example, the data collection name is set to dsCmdInfo, and the report control block is a cached report. Staff can add special signals such as "receive phase A trip command", "receive phase B trip command" and

"receive phase C trip command" in the GOOSE output control block, and then integrate the model into the intelligent terminal. Set another data set, whose name is dsHardConInfo, and the report control module is the cache report. Workers can add the signal of the control circuit disconnection in the GOOSE output control block, namely: TWJ, HWJ, and integrate this model with the intelligent terminal. After the model is established, the GOOSE loop status alarm information needs to be collected, and the Baoxin substation is used to connect the intelligent substation measurement and collect the MMS information uploaded by the measurement and control equipment, the system can analyze and study the collected MMS information, and obtain the feedback signal of the intelligent operation box After that, the GOOSE loop status alarm information in the MMS information is transmitted to the reporting master station for processing, and the information is displayed using visualization technology.

The actual operation of the pressure plate will affect the safety measures of the intelligent substation. The realization of the visualization of the safety substation safety measures loop needs to involve the visualization of the state of the pressure plate, and the use of the monitoring host to realize the purpose of the visualization of the pressure plate. The monitoring host can realize the function of summarizing the status of the equipment pressure plate and comprehensively displaying the connection information of the virtual terminal. Through the pressure plate visualization function, the operation and maintenance personnel can accurately understand the operation of the substation equipment, which is beneficial to improving the efficiency of substation maintenance.

3.3 SCD file visualization

The operation and maintenance depth of the smart substation is affected by the substation configuration description file. The substation configuration description file details the data information related to the operation safety and stability of the smart substation. For example: (1) Primary equipment model and electrical topology information of substation. (2) Functional view. (3) IED view. (4) Communication view. (5) Product view. (6) Data flow.

Although the intelligent substation can realize the reuse of a variety of information, it can use light to replace the traditional cable and free the function of the device from the constraints of the hardware loop. The part of the conventional secondary circuit hardware is replaced, so that the design, construction and maintenance plan based on the original equipment and circuit need to be changed urgently. In order to ensure the quality of maintenance work, it is necessary to ensure that the changes of all equipment configuration files of the substation are visible and controllable, and this needs to ensure the safety and effectiveness of the substation SCD file.

In addition, the substation maintenance process may involve the modification of the SCD file of the entire station, the modification and upgrade of the substation equipment program. At this stage, the training personnel shall be responsible for the management of the SCD files of the whole station. If there are errors in the SCD file management of the whole station, it will cause great losses to the substation. Therefore, it is necessary to build a visual SCD file management mode, use the error check code technology of the data communication industry, select the part of the SCD file that affects the operating efficiency and stability of the entire station, and then form the cyclic redundancy check code, which is also the SCD file Visualize important content and important links. To ensure the security of SCD files, the accuracy of SCD files needs to be guaranteed.

In order to achieve the SCD file visualization goal, it is necessary to build a real-time protection management and control module. It is responsible for collecting the verification code of the configuration information in each IED, and comparing and analyzing whether the collected verification code is the same as the verification code managed by the protection management control module. If the two are found to be different, an alarm must be issued immediately, and the operation and maintenance personnel are responsible for handling it.

3.4 Visualization of the control loop

The control loop visualization mainly involves two types of action visualization and operation status visualization. Action visualization is to analyze the protection displacement information in the entire protection action process in detail, and reproduce the entire process according to the order

in which the displacement information occurs. Operating status visualization refers to the visualization of the running status of GOOSE information flow between global or local protection equipment in the substation.

The main contents of the control loop visualization module are: analysis of the time sequence of action displacement information and GOOSE information flow, visual display according to the time sequence of occurrence, and GOOSE link displacement information according to hierarchy. Collect the information of the measurement and control equipment, mark the state of the equipment's hard nodes, and make statistics and analysis based on the recorded switching actions of the master station to determine the actual situation of the tripping coil.

The network communication status from the substation station to the substation station, that is, from the protection equipment to the station control layer substation, from the station control layer substation to the remote information center. The realization of the network communication status from the substation station to the substation station needs the support of the communication model between the equipment, sub-stations and main station. Relevant file information can be recorded in the file in detail by the protection device, and the master station can obtain these files through the sub-station.

The virtual terminal visualization is an important part of the control loop visualization. The virtual terminal visualization can realize the device control loop visualization, which is of great significance for improving the work efficiency and quality of the relay protection management personnel and operation and maintenance personnel.

Conclusion

In short, the substation is an important part of the power system, and the operation stability and safety of the substation will directly affect the quality of power supply. With the development of science and technology, intelligent technology is widely used in substations. The construction of intelligent substations is very important for improving the level of intelligence and modernization of power systems. Substation relay protection is an important link in the construction and management of smart substations, which will affect the operation quality and future development of smart substations. We need to do a good job in line protection, main transformer protection, bus coupler protection, etc., use visualization technology to improve the safety protection level of intelligent substations, and promote the safe and stable operation of intelligent substations.

Acknowledgements

Research on key technologies of all-round centralized visualization and active auxiliary operation and inspection in intelligent station.No.:SGSDHZ00JXJS1900446 Project unit: State Grid Shandong Electric Power Company Heze Power Supply Company

References

[1] Zhao Zhongliang. Safety Measures of Intelligent Substation and its Visualization Technology[J]. Power System Equipment, 2019, 000(010):209-210.

[2] Zeng Jianping, Liu Zhifei, Zhong Zhuhui, et al. Discussion on the Secondary Safety Measures and Commissioning Schemes for the Interval Expansion of intelligent Substations[J]. Hunan Electric Power, 2018, v.38No.239(02):47-50.

[3] He Chun, Li Xin. Research on Safety Protection Measures of Relay Protection in Smart Substations[J]. Electrical Engineering Technology, 2019, 000(005): 99-100, 103.

[4] Yin Xiangguo, Yang Zheng, Zhang Bin, et al. Research and Application of Visualized Operation and Maintenance System for Intelligent Substation Protection Equipment [J]. Hebei Electric Power Technology, 2019, 038(001):30-33.

[5] Liu Xiaohui. Research and Application of Visualized Operation and Maintenance System for Intelligent Substation Protection Equipment[J]. Digital Users, 2019, (19): 160.

[6] Wang Jianping. Research on Fault Visualization Technology of Relay Protection Devices in Intelligent Substations[J]. Computer Products and Circulation, 2018(11):66.