Fault location model of distribution network based on dynamic matrix

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Keywords: fault overcurrent; fault location; distribution network; algorithm

Abstract: Accurate fault location is of great significance to maintain the reliability of power supply in distribution network system. There are various research methods for fault location in distribution network. However, the access of various distributed power sources (photovoltaic, wind turbine, etc.) to distribution network has become a trend in recent years. The access of these "non-traditional" power sources has changed the power flow distribution of traditional distribution network from one-way to multi-direction, thus changing the fault signal intensity of distribution network, making the original fault location method no longer suitable for distribution network fault location with distributed power sources. This paper presents a distribution network fault location algorithm and its program implementation. It solves the problem of fault location at all points on the line. The algorithm has a small amount of calculation and a fast calculation speed. According to the fault overcurrent information obtained by feeder terminal unit (FTU), the information matrix is calculated to the information judgment matrix. The fault area can be directly identified by the information judgment matrix.

1. Introduction

With the development of smart grid project, a large number of field monitoring terminals, such as FTU, are installed in the ring cabinet and on the line pole switches, which create conditions for improving the reliability of power supply. After the fault occurs, the fault can be located quickly and accurately by using the short-circuit current information provided by the terminal equipment FTU. Reference [1] gives a matrix algorithm for fault location. The algorithm multiplies the network description matrix and fault information matrix to determine the fault point after normalization. The amount of calculation is relatively large. Literature [2] proposes a fault location algorithm based on network structure. The principle of this algorithm is simple, intuitive and can meet the real-time requirements, but it can not diagnose the fault at the end of feeder. In summary, a feeder fault location algorithm is proposed in this paper. This algorithm can not only solve the problem of fault location at feeder points, but also has less computation and fast processing speed.

2. Fault Location Method

The system adopted in this method includes current transformer, distribution terminal, photoelectric conversion unit, information acquisition unit, data analysis unit, fault grade judgment unit, fault location module, alarm device and fault display unit; the output terminal of the current transformer is connected with the input terminal of the information acquisition unit through the photoelectric conversion unit, and the output terminal of the current transformer is connected with the input terminal of the information acquisition unit through the data analysis unit. The input end of the barrier level judgment unit is connected, and the output end of the fault location module is connected with the input end of the fault location module. The output end of the fault location module is connected with the alarm device and the fault display unit respectively. The output end of the distribution terminal is connected with the input end of the information acquisition unit, including the following steps:

(1) Current transformer acquires current information from the power grid, converts the acquired signal to optical signal through photoelectric conversion unit and sends it to information acquisition

  DOI: 10.25236/csam.2019.066

unit.

(2) The information acquisition unit collects the original current data information of the distribution terminal, and sends the data information together with the collected current information to the data analysis unit.

(3) The data analysis unit compares the collected data and obtains the corresponding data level of the optical signal.

(4) The fault location module collects the fault grade and fault analysis information after discrimination, and carries on the analysis and location according to the received data information, and displays the information after location through the fault display unit.

(5) When the fault level exceeds the preset range or the fault location module can not find the fault location, the alarm device will alarm.

The step (5) also includes the following steps: when the data collected by the data analysis unit exceeds the data level, the alarm device alarms.

It realizes the effective monitoring of the operation status of the secondary equipment of the whole station, effectively reduces the manual inspection items, reduces the time of power outage for equipment maintenance, and improves the reliability and work efficiency. At the same time, it can accurately judge whether the power system has fault or abnormal conditions, so it can reliably relay the power system protection.

3. Functional characteristics

1) The equipment adopts ultra-low frequency signal injection method, which has strong resistance to capacitive interference. Accurate positioning.

2) By injecting the detection signal into the fault phase of the line, the single-phase grounding fault point is determined, which reduces blindness and shortens the fault detection time.

3) When the line is in normal operation, the load current of the line can be detected.

4) The error of single-phase grounding fault point should not exceed 1 meter.

The device uses STM32 with Cortex-M3 core as the main control chip. It has high integration, strong anti-interference ability, fast running speed and low power consumption.

5) Operators are far away from high voltage. Inspectors operate on the ground through insulating poles, which is safe and reliable.

6) Inside the device, there is a power supply, which needs no additional power supply and is easy to use.

7) The device has low power consumption and long service time.

4. Implementation Method

A comprehensive fault location method for intelligent distribution network includes the following steps: first, the intelligent terminal detects whether the distribution network is in normal operation or not, and then enters the peer-to-peer network protection program; second, the intelligent terminal locates the fault according to the peer-to-peer network protection algorithm, and then uploads voltage and current data to the master station and the fault location node of the intelligent terminal. Step 3: Receive the voltage and current data sent by the intelligent terminal through the main station, and use clonal immune algorithm to locate the fault of the main station; Step 4: Compare the fault location results of the main station with the fault location results of the intelligent terminal, verify the consistency of the two fault location results, if not, set the "location inconsistency sign" If the fault state disappears, the fault location of the smart terminal is correct, the fault isolation is successful, and step 8 is entered. If the fault state still exists, the "location inconsistency sign" is checked. Step 6: If there is no fault in the main station and intelligent terminal positioning, step 7; Step 6: According to the fault location results of the main station, control the corresponding intelligent terminal tripping for fault isolation; If the fault state disappears after fault isolation, the main station fault location is correct, the fault isolation is successful, and step 8; If the fault status continues, then proceed. Step 7; Step 7: Control the trip of the circuit

breaker at the outlet of the substation of this line; End; Step 8: Transfer the non-fault power loss load through the main station; End.

5. Examples

The fault locating method of distribution network in this embodiment includes current transformer 1, distribution terminal 3, photoelectric conversion unit 2, information acquisition unit 4, data analysis unit 5, fault grade judgment unit 6, fault locating module 7, alarm device 8 and fault display unit 9. The output terminal of current transformer 1 is connected with the input terminal of information acquisition unit 4 through photoelectric conversion unit 2, and its output is connected with the input terminal of information acquisition unit 4. The data analysis unit 5 is connected with the input terminal of the fault grade judgment unit 6. The output terminal of the fault location module 7 is connected with the input terminal of the fault location module 7. The output terminal of the fault location module 7 is connected with the alarm device 8 and the fault display unit 9 respectively. The output terminal of the distribution terminal 3 is connected with the input terminal of the information acquisition unit 4.

The photoelectric conversion unit 2 is used to convert the acquired electrical signal into an optical signal, and store and transmit the converted optical information. Fault location module 7 is used to detect the fault signal and make statistical analysis of the fault signal to determine the location of the fault point, and temporarily store the fault location point.

The specific steps of the method are as follows:

S1: Current transformer 1 acquires current information from power grid, converts the acquired signal into optical signal through photoelectric conversion unit 2 and sends it to information acquisition unit 4.

S2: The information acquisition unit 4 collects the original current data information of the distribution terminal, and sends the data information together with the collected current information to the data analysis unit 5.

S3: Data analysis unit 5 compares the collected data and finds a value that is consistent with or close to it, so as to get the corresponding data level of the optical signal, and transmits the identified fault level and the data of the fault analysis process to the fault location module 7.

S4: Fault location module 7 analyses and locates the fault location information according to the received data, and displays the location information through the fault display unit.

S5: When the fault level exceeds the preset range or the fault location module 7 can not find the fault location, the alarm device alarms. When the data collected by the data analysis unit exceeds the data level, the alarm device alarms, indicating the importance and urgency of the fault.

It realizes the effective monitoring of the operation status of the secondary equipment of the whole station, effectively reduces the manual inspection items, reduces the time of power outage for equipment maintenance, and improves the reliability and work efficiency. At the same time, it can accurately judge whether the power system has fault or abnormal conditions, so it can reliably relay the power system protection. It should be recognized by ordinary technicians in the technical field that the above embodiments are merely for illustrating the present invention and are not used as a limitation of the present invention, as long as the appropriate changes and changes made to the above embodiments fall within the scope of protection required by the present invention within the scope of the substance and spirit of the present invention.

6. Summary

After single-phase grounding occurs in small current grounding system, the fault signal is weak and the structure of distribution network is complex. Therefore, fault location is a recognized problem, which requires special fault detection technology. In the past, the research work mainly focused on the line selection technology, and achieved rich research results. However, it is still very difficult to find fault points on the basis of selecting fault lines. Accurate fault location can help staff to detect faults more easily and conveniently, so it is of great and far-reaching significance to

carry out research work in this field. Based on the development trend of smart grid construction in China, in order to solve the problem of single-phase grounding fault location in distribution network, improve the shortcomings of traditional symbolic location method, realize accurate fault location when fault information is unreliable, and save cost in hardware implementation, this paper proposes a fault location method for distribution network based on fault direction measurement. Firstly, the fault orientation measure of a single measurement point is constructed to indicate the fault orientation of a single measurement point and quantitatively evaluate the obvious degree of fault characteristics. The neutral point potential offset after single-phase grounding fault in distribution network is analyzed. The zero-sequence equivalent network model is established. The relationship between zero-sequence current and three-phase load current is analyzed. The fault direction measurement of fundamental zero-sequence current is constructed with load current as reference. The transient charging and discharging circuit model of phase capacitor after single-phase grounding fault is established. The transient current characteristics of each section of fault phase in the transition process are analyzed. The fault direction measurement of transient phase current is extracted by phase space reconstruction method. Secondly, a multi-index decision-making model for single-phase grounding fault location is established. The fault location problem of single-phase grounding is described by multi-index decision-making problem. The fault direction measurement is the decision-making index, and the state of the line segment in the system is the decision variable. With historical information and fault feature information as decision-making knowledge, the credibility theory is introduced to set priority values, and the fault direction information uploaded from each measurement point is processed and utilized comprehensively, then a unified objective function is established and solved. Finally, simulation and experimental verification are carried out. A single-phase-to-ground fault model of distribution line is constructed under the simulation environment of Matlab. Considering the factors affecting the characteristics of single-phase grounding fault, such as fault closing angle, fault location, transition resistance, line length and so on, a large number of simulation experiments are carried out to analyze and process the data. The single-phase grounding fault location method is verified by the static simulation system of distribution network. The simulation and experimental results show that when single-phase-to-ground fault occurs in neutral ungrounded distribution system, this method can accurately and reliably judge the fault section and has good fault tolerance ability.

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