

ABSTRACT

Mashrapov Bauyrzhan Yerbolovich The thesis «Improving relaying cells of substation integration modules and large-rating motors», presented for the degree of Doctor of Philosophy (PhD) in the specialty 6D071800 - «Electric power engineering»

Topicality

Substation integration and large-rating motor modules are widely used for electric power generating plants and industrial enterprises. Intensive work was carried out to improve the protection of these elements in the 70s and 90s. However, not all problems are solved. For example, arc fault protection, based on the control of non-electric values, received small spread because of certain shortcomings, detailed in the doctoral dissertation of W. I. Nagay. Protection responsive to the change in the electrical parameters, or has an unacceptable time delay (overcurrent protection, logical protection), or disables phase short-circuit (differential busbar protection). In connection with the above improving protection against arcing faults is urgent.

Providing sensitivity and speed, while protecting motor, runs much better. However, by primary protection failure phase short circuit can be switched out or overloaded on the input supply, which can have a big delay. As a result these injuries not only cause considerable damage to the motors, but also damage leads to the power break of other consumer section tires. So it is advisable to install a backup protection of electric motors, which is alluded to more by A.M. Fedoseev in his textbook in 1976. Thus, the application of certain protections as a reserve and the development of new protections are relevant.

Now great attention is paid to material resources saving. In protective relaying savings can be achieved by the use of magnetically sensitive elements (Rogowski coil, reed switches, Hall sensor, etc.) as a current sensor instead of metal-intensive transformers. Magnetically operated sealed switches have been chosen because of their well-known advantages and more developed protection. The use of centralized protection leads also to savings. The rejection of autonomous protection reduces the amount of equipment at the stations and substations, simplifies the unification and maintenance. In addition, centralized protection has more features than stand-alone, in terms of meeting the requirements, as more extensive information is used. Therefore, in this paper, attention is paid to the development of an autonomous motor protection for reed switches and centralized protection devices.

Subject of research – 6-10 kV switchgear and motors cell protection

Objective – development of switchgear and motors cells protection that meets the requirements.

Results of research:

1 Development of algorithms and functioning model of centralized protection devices cells complete switchgear and motors group phase short-circuit. Their operating principle is based on the use of the first Kirchhoff's law and conditions recharge point short circuit motors.

2 Proposed and patented a method and apparatus to protect the cells of complete switchgear arcing fault. They are based on a comparison of the current filters, residual current.

3 Proposed differential-phase motor protection device for reed switches.

4 Proposed and patented the method of back-up protection of motors against phase faults. It is based on controlling the ratio of the currents in phases A, B, C of the motor from its zero terminals and the switch side.

New scientific results: proposed centralized unit cell protection of switchgear assemblies under paragraph 1; methods and apparatus for item 2 and 4, as well as the device under item 3 of the above results.

The practical significance of scientific results: algorithms under paragraph 1 allow you to build high-speed centralized protection of cells complete switchgear and motors; Method 2 gives you the opportunity to build an autonomous cell protection of switchgear assemblies with the required speed and sensitivity. Differential-phase motor protection on the reed switch is capable of duplicating and current transformers and protection installed on the motor. Protection of the motor, which controls the ratio of currents in its phases A, B, C from the zero findings and from the switch can be used as a backup. A method and apparatus are confirmed 5 patents of the Republic of Kazakhstan and the Russian Federation.

The validity of the results is confirmed by well-executed research; validity of the assumptions arising from the foundations used theories and laws; test models developed devices.

The structure of the thesis is determined by the logic of the study, and includes an introduction, three chapters, conclusion and appendix.

Publication. The results of the study are published in 14 scientific works, including 5 publications in journals recommended by the Committee, of which 4 are the innovative patents of the Republic of Kazakhstan, 1 patent of the Russian Federation and 2 patents in an international scientific journal that is part of the database Scopus, 2 publications in scientific journals, part of the database RISC, 4 publications in proceedings of international conferences, including 3 in overseas conference proceedings.