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Methods of recovering energy system

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Abstract

The energy system consists of so many nodes and lines that controlling all of them seems to be impossible. Every day unpredictable changes happen in the system because of regime changing, short circuits, lightning strike, etc. It is very important to operate in such a way to minimize the damage of system elements and permanently supply with energy all users of the electrical net. Therefore, operators have to find the optimal solution of this problem. Every method of searching these unpredictable faults to recover energy system has its own benefits. The key ways of recovering energy system after a crash are examined in the paper.

Keywords: power engineering, energy, energy recovery, stability of electrical regime;

1. Introduction

Energy crash is a disturbance of whole energy system or a great part of it. It can be caused by equipment damage, invalid deformation of the energy quality or break of energy supplying. These accidents cause enormous losses to business because today's modern society depends on the electric energy very much.

2. Ways of energy system recovery based on the graph theory

At this method a special algorithm is suggested. According to it, the structure of a sub-distribution creates a math graph with determinate node coefficients describing terminations, priority of supplying and other important operating parameter. The graph of solution forms according to the depth-searching algorithm. Such features as voltage losses, losses in lines, working capacity of switches influence the final solution of the algorithm usage. The algorithm was modified and such special functions as

1) Minimal number of commutations;
2) Minimal line losses;
3) Saving node voltage and power transferring in lines in the limits of standard;
4) Using of switches which weren't cut were included for satisfying all demands.

Such consequences have appeared due to the great experience of operators working at the distributing substation. They always have to solve such problems basing only on these criteria.

Some success has been reached and optimal solutions have been founded at the testing system consisting of 12 nodes and 3 independent sources. Unfortunately, this method has great time costs and for real sub-distributions, where the number of nodes is more than 100 and the number of commutation elements is more than several thousands, the possibility of online using becomes dissatisfied.

This way was successfully tested at the real sub-distributions consisting of 1000 lines and 1000 graph nodes. The search time on the computer with processor 200MHz is several minutes.

Evidently, this way is worthy of note but the authors marks that founded solution isn't the most reliable and often it can't control network reconfiguration basing on the economic needs and importance of users. [3]

3. Energy system recovering based on methods of artificial intelligence

This way is based on usage of the device of artificial neuron nets (ANN). The key element is a combination of two ANNs, one of them controls input regime information before a crash, and according to it the power will be determined. Another one should find a solution.

Training series is formed from calculation of all major states of sub-distribution. The initial training is performed by standard algorithm of reverse spreading of tolerance and takes much time in offline regime. The solution is revised by the block of calculation and executed if it satisfied all demands. Such way helps to reduce the time of energy system recovering and analyze great enough range of solutions due to approximating features of ANN. During the experiment, it becomes clear that two names (locked and opened) are enough for naming switches. A real sub-distribution was tested, it consisted of 17 generate nodes and 163 load nodes. The average completing time to solve 1230 series was 23 seconds.

Training series is formed in such a way that if a determine information input to outcome neurons relevant to commutation elements then information about the sequence in which they should change their state appears. If the state of a commutation element is not changed then the information about it should appear in the exit. [1]

The system recovery can be complete by several ways, but due to ANN's features two identical starting and two different final data cannot be in the training series. Otherwise, it isn't possible to study ANN with acceptable accuracy.

4. Expert system for energy system recovery

This method is built on the rules based on the taking solutions by operators of substation. It enables to find the solution quickly and clearly for the operator. But the rules created in such way are not flexibility and they narrow the solution region. It can be neglected when the structure of sub distribution is radial with low connections between generate nodes. If to try to circumvent these limitations operators should create many more rules and personalize them to concrete situations and nodes [2]. If the net consists of many lines and nodes, the base of rules losses its clearness and increase the time of solution. And changes in sub-distribution topology lead to necessity of revision of whole base.

5. Conclusion

The problem of energy system recovery is very actual nowadays. It can be connected with increasing of reliability of sub-distribution work, lowering losses from breaking and undersupply of energy and it can be explained with appearance of high-techs.

There are several ways to recovery. But every solution is attached to a concrete method, and it predetermines its own distinctive weakness. The integration of methods permits to make the characteristic of system recovery better.

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