A. Title Page

Investigating the Heuristic Methods and for Transmission Planning

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B. Restatement of problem researched or creative activity

Generally, network planning methods may be grouped into two categories: heuristic and mathematical optimization methods with the steady-state security criteria framework as a common denominator [1]. In a way, all expansion-planning methods are heuristic in their substance. “Heuristic” is the way to solve unknown problems by producing candidate solutions and checking them with predefined criterion [2]. In this regard, the major purpose of heuristics method is to generate many candidate solutions and to obtain the acceptable one by eliminating the others according to previously defined criterion.

C. Brief review of the research procedure utilized

We compared the traditional methods, the so-called heuristic methods of network planning. Our purpose is to shed some light from the different angle to The examining of the traditional planning method could recall the traditional planning method for the use in network expansion planning under the novel circumstances brought by the new technology and reconstructed electric power markets.
On the basis of overall effectiveness index and methods of successively selecting the most effective candidate line in expanding the network.

The steps of whole process are explained as follows [1].

Step 1: Initialize the system with the data of nodal load distribution, generator output, parameters of candidate lines, existing network configuration and parameters, transmission line capacity. The vector θ can be obtained. Build the initial network nodal impedance matrix X.

Step 2: DC power flows are computed.

Step 3: Line overloads are checked.

Step 4: The lines that do not satisfy step 3 are put in an overloading set.

Step 5: The overall effectiveness index for each candidate line is computed.
Step 6: The candidate line with the largest effectiveness index is added to the system. The changes in X and θ can be computed.

The successive backward method assesses the effect of a line on the system by the amount of transmitted current [1]. Therefore, taking into account the investment influence factors and regarding the line carrying the largest amount of current as an effective line, we define the line effectiveness index. Assuming the investment is proportional to the current carrying capability.
Step 1: Initialize the system with the data of nodal load distribution, generator output, parameters of candidate lines, existing network configuration and parameters, transmission line capacity. The vector θ can be obtained. Build the initial network nodal impedance matrix X.
Step 2: DC power flows are computed.
Step 3: Candidate lines are arranged in ascending order of their effectiveness indices in order to analyze and eliminate the lines with the lowest effectiveness index.
Step 4: The elimination of line L is a tentative step. Therefore, the vector θ is updated without modification of the nodal impedance matrix X.
Step 5: Modify θ and overloads may be checked.
Step 6: If there is no overloading or disconnection, only the nodal impedance matrix X needs to be modified because the new state vector and line flows have been obtained. On the other hand, if there is overloading or disconnection, the nodal impedance matrix X needs not to be modified and the θ should revert to that before the elimination of line.
Step 7: Analysis on the other candidate lines is then carried out until all candidate lines have been checked.

D. Summary of findings

The 18-bus system shown in Fig. 1 is used to compare the performance of the successive expansion method and the successive backward method, the solid line means the existing system and dash line represents the candidate lines.

In the first case, we applied successive expansion method. The following six lines should be added to remove all overloads (in the order of addition): 21, 19, 13, 18, 19, 14. In the second case, successive backward method is used to illustrate the procedure of transmission system expansion. It indicates that there are 22 candidate lines in the systems which have been deleted. They are: 6, 7, 7, 17, 23, 20, 23, 20, 21, 25, 19, 15, 15, 22, 9, 22, 9, 24, 16, 12, 27, and 18. A total of 6 candidate lines are retained: 13, 14, 18, 19, 19, and 21.

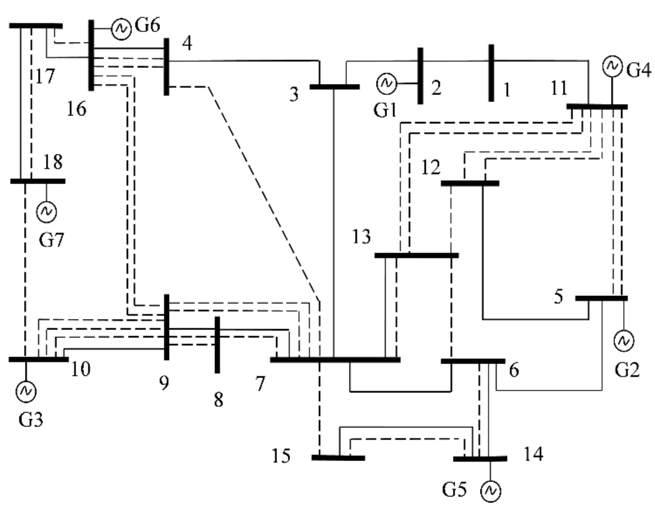

Fig. 1. One-line diagram of the 18-bus system.

E. Conclusions and recommendations

It should be pointed out that the use of the sensitivity analysis method to select effective lines does not reflect the actual relationship between line investments because the planning decision is an integer type decision and the relationship between the line investment cost and transmission power is not a simple linear function. Therefore, such methods can only give relative effectiveness and cannot accurately give an expansion scheme with overall considerations of the problem concerned. In future work different weights could be assigned to candidate lines according to different operation modes so that optimal schemes can be obtained.

Reference

[1] X. Wang and J.R. McDonald,: Modern Power System Planning. London/UK: McGraw-Hill, 1994.

[2] A. Barr,and E.A. Feigenbaum, The Handbook of Artificial Intelligence. USA: William Kaufmann Inc., 1981.