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**Code for design of automaticity equipment for power system
security**

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2.0.9 Connection and section connection and section

A connection is the combination of grid elements (transmission lines, transformers, etc.) that connects two parts of the power system. Intermediate power plants and load junctions can also be included in the "connection" concept. A section is one or several connected elements that, when disconnected, divide the power system into two independent parts.

3.1 Years of stable calculation level

3.1.1

The design level year selected for the calculation and analysis of safety and stability should mainly be the project commissioning year; if the project is put into production in stages, it should also include the transition year.

3.1.2

The grid structure used for calculation should correspond to the design level year.

3.1.3

The calculated load should correspond to the design level year. When the load increase has a significant impact on the system stability, it is advisable to conduct a sensitivity analysis of the impact of the load on the system stability.

3.2 Stable computing operation mode

3.2.1

In the stability calculation, the most unfavorable method for safety and stability should be selected for safety and stability verification for specific verification objects (lines, busbars, main transformers, etc.).

3.2.2

The stable calculation can choose the following operation modes.

1 Normal operation mode. including planned maintenance operation mode and possible operation modes such as hydropower generation, thermal power generation, wind power generation, maximum or minimum load, minimum start-up and pumped storage operating conditions according to the load curve and seasonal changes.

2. Post-accident operation mode. After the power system accident is eliminated, the short-term steady-state operation mode appears before returning to the normal operation mode.

3 Special operation modes. large-scale generator sets, main lines, large-capacity transformers, DC unipolar, series compensation and other equipment maintenance, inter-regional exchange power changes and other modes that have a serious impact on the safe and stable operation of the system.

3.3 Fault Types of Stable Calculation

3.3.1

Stability calculations should consider metallic short-circuit faults at the most unfavorable locations for stability.

3.3.2

The fault belongs to the large accident disturbance suffered by the power system, and the large disturbance can be divided into the types listed in Table 3.3.2 according to the severity and occurrence probability.

3.3.3

The types of faults for safety and stability analysis and calculation should be selected from the type I and type II faults listed in Table 3.3.2, and the type III faults listed in Table 3.3.2 can be analyzed when necessary.

3.4 Stable calculation model and parameters

3.4.1

The model and parameters of synchronous generator and control system shall be selected according to the following provisions.

- 1 The synchronous generator should adopt the detailed model of subtransient potential change;
- 2 For synchronous generators that can provide the measured model and parameters, the measured model and parameters should be used;
- 3 For synchronous generators that cannot provide measured models and parameters, typical models and typical parameters may be used;
- 4 The parameters of the prime mover and the speed control system should adopt the measured parameters in principle, and the parameters provided by the manufacturer can be used if they cannot be provided;
- 5 In the planning and design stage or when there are no complete parameters, the larger-capacity synchronous generator can refer to the model and parameters of the same manufacturer and the same capacity unit that have been put into operation.

3.4.2

Commonly used wind turbine models include squirrel-cage asynchronous wind turbines, double-feedback asynchronous wind turbines and direct-drive synchronous wind turbines, and the corresponding models should be selected according to the actual situation.

3.4.3

The load model and parameters shall be determined according to the actual load characteristics of the regional power grid and the procedures used, and shall comply with the following regulations.

- 1 The model of comprehensive load can be represented by the exponential function of static voltage and frequency and choose an appropriate index.
- 2 The model of relatively concentrated large-capacity motor load can be represented by an equivalent induction motor load and a parallel static load on the corresponding 110kV (66kV) high-voltage busbar.
- 3 In the planning and design stage, the load can use the load model with the same characteristics as the area or the constant impedance model.
- 4 When performing dynamic stability analysis, detailed models should be used.

3.4.4

Other equipment parameters should be selected according to the following regulations.

- 1 Existing equipment should adopt actual parameters;
- 2 The design parameters should be adopted for new equipment;
- 3 In the planning and design stage or when there are no complete parameters, it can be considered according to the typical parameters of the same type of equipment.

3.5 Stable calculation of fault removal time and automatic device action time

3.5.1

The fault clearing time in the stability calculation should include the time from when the circuit breaker is fully disconnected and the relay protection is activated (from the beginning of the fault to the sending of the tripping pulse). The cut-off time of line, main transformer, busbar and DC system faults should be carried out according to the provisions in Table 3.5.1.

3.5.2

The reclosing time is the time from the fault removal to the reclosing of the main breaker, which should be determined according to the actual reclosing setting time of the power grid.

3.5.3

The cut-off time of circuit breaker failure protection action is the sum of element protection or busbar protection action time, failure protection setting delay and circuit breaker tripping time. The sum of element protection or busbar protection action time and circuit breaker trip time can refer to the fault removal time listed in Table 3.5.1, and the failure protection setting delay can be selected according to the following regulations.

- 1 The failure protection setting delay of one and a half circuit breaker wiring can be 0.2s ~ 0.3s;
- 2 The setting delay of the failure protection in the form of double-bus connection can be 0.3s~0.5s.

3.5.4

The execution time of the safety and stability control system is the sum of the automatic device action time, channel transmission time, and related circuit breaker trip time (or DC action time), which should be determined according to the actual situation of the system. The execution time of commonly used safety and stability control systems can be selected according to the following provisions.

- 1 Cut off machine, load off can be 0.2s~0.3s.
- 2.The DC power modulation response time is preferably 0.1s, and the DC power boost and