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**Technical provisions for automatic under-voltage load
shedding in electric power systems**

电力系统自动低压减负荷技术规定

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Technical provisions for automatic under-voltage load shedding in electric power systems

1 Scope

This document specifies general requirements, basic principles, setting and configuration methods for automatic under-voltage load shedding in electric power systems.

This document applies to the technical measures for automatic under-voltage load shedding in electric power systems involved in power system planning and design, production operation, and scientific research and manufacturing.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 156, *Standard voltages*

GB/T 14285, *Technical code for relaying protection and security automatic equipment*

GB/T 31464, *The grid operation code*

GB 38755-2019, *Code on security and stability for power system*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB 38755-2019 as well as the followings apply.

3.1 voltage stability

The ability that after the power system is subjected to small or large disturbances, the system voltage can be maintained or recovered to the allowable range without voltage collapse.

[Source: GB 38755-2019, 2.2.2]

3.2 transient voltage stability

The ability that after the power system is subjected to a large disturbance, all the busbars of the system maintain a stable voltage.

[Source: GB 38755-2019, 2.2.2.2]

3.3 long-term voltage stability

The ability that after the power system is greatly disturbed, all the busbars of the system maintain a stable voltage in the long-term process.

3.4 voltage collapse

The process that when the system is in a state of voltage instability, the load continues to try to increase the current to obtain more active or reactive power, resulting in a large-scale voltage drop in the system.

[Source: DL/T 1172-2013, 3.3, modified]

4 General requirements

4.1 According to the requirements for automatic under-voltage load shedding in GB 38755-2019, according to the safety requirements of the power system, users shall cooperate with the implementation of under-voltage load shedding measures. In areas where the load is concentrated, it shall be considered that when the operating voltage is reduced, automatic or manual removal of part of the load shall be considered to prevent voltage collapse. In addition, in areas (or some busbars) where there may be voltage safety and stability problems, the automatic under-voltage load shedding device shall also be equipped.

4.2 The automatic under-voltage load shedding measures shall be able to adapt to the requirements of maintaining the safety and stability of the voltage in this area (or busbar) under different operating modes.

4.3 The automatic under-voltage load shedding measures shall meet the requirements of the power system for maintaining the transient voltage stability and long-term voltage stability of the system.

4.4 The preparation and implementation of the automatic under-voltage load shedding scheme shall be carried out according to the requirements of GB/T 31464. The setting and configuration of the automatic under-voltage load shedding scheme shall be coordinated and completed by the dispatching departments at all levels. The automatic under-voltage load shedding scheme shall be reviewed periodically and when there are significant changes in system conditions. After each serious failure of the system, the analysis and summary work shall be done well.

4.5 The recovery of the load removed by the automatic under-voltage load shedding device shall be carried out according to the dispatch order. Automatic investment means such as self-preparation shall not be used.

5 Basic principles of automatic under-voltage load shedding

5.1 When a fault occurs in the power system, the automatic under-voltage load shedding measures shall be able to avoid the under-voltage process that may exist during the normal fault removal time. Prevent load loss due to device malfunction. The automatic under-voltage load shedding measures shall also be able to avoid the action time of the safety and stability control device of the second line of defense. Reasonably set the action voltage and delay time of automatic under-voltage load shedding measures. When the voltage stability criterion is met after the fault, the automatic under-voltage load shedding device does not act.

5.2 The automatic under-voltage load shedding measures shall be divided into rounds according to the operating voltage. Consider the delay time. They are mainly divided into basic rounds and special rounds. Basic rounds and special rounds shall meet the following requirements:

- a) According to the requirements of GB/T 14285, the automatic under-voltage load shedding measures can be divided into several rounds (levels) according to the operating voltage and delay. The operating voltage value of the first round of the basic rounds shall be lower than the minimum voltage allowed by the system for a long time. The operating voltage value of the last round shall be higher than the critical voltage of the steady-state voltage instability of the system.
- b) The configuration of automatic under-voltage load shedding measures shall follow the principle of stratification and zoning. Solve the problem of local grid voltage stability. According to the specific situation of the voltage stability problem in different areas, reasonably set the operating voltage and delay time of each round. There shall be no skipping moves in each round. Considering some unpredictable situations, special action rounds with long delay shall be added, so that the voltage of certain areas (busbars) in the power grid will not be suspended at a low level for a long time. The action voltage of the additional long-delay special round can be repeated with the basic round or slightly higher than the basic round.
- c) Aiming at the problem of transient voltage stability, the basic number of rounds of the automatic under-voltage load shedding device set in the system can be set to 2~5. There is also a special round with long delay. For the long-term voltage stability problem, the rounds and action delays can be appropriately increased. It is recommended that the basic round voltage level difference is (2%~5%) UN, (where UN is the nominal voltage of the system, and its value conforms to the specified value of GB/T 156). The action delay of each round is 0.2s~5s. The

analyzed.

5.9 The device with automatic under-voltage load shedding function shall be configured independently. Technical performance and other indicators shall meet the standard requirements of relevant devices. They shall not be mixed with equipment such as plant computer monitoring system.

6 Setting and configuration of automatic under-voltage load shedding measures

6.1 Basic contents

Calculate according to the relevant requirements such as failure type and detailed model specified in GB 38755-2019. Determine the load shedding round, voltage action setting, delay and load shedding amount of automatic under-voltage load shedding. Meet the needs of the safe and stable operation of the power grid.

6.2 Setting of automatic under-voltage load shedding measures

6.2.1 The trajectories of voltage changes with time under fault conditions are obtained by dynamic simulation in time domain. Set the automatic under-voltage load shedding scheme.

6.2.2 The area with high load shedding sensitivity shall be preferentially selected to install automatic under-voltage load shedding device.

6.2.3 When setting the voltage action value of each round, the effective value of the installed bus voltage shall be used as the voltage measurement value of the automatic under-voltage load shedding device. If there is a situation in which the main transformer or the busbar runs in different partitions in the substation, the busbar voltage that can reflect the voltage level of the partition shall be selected. The setting range of the setting value is related to the operating characteristics of the power grid. In areas where the normal operating voltage is higher, a higher setting can be used.

6.2.4 Determination of the action voltage level difference between each round. The action voltage level difference of the first few rounds can be selected to be smaller, so as to quickly suppress the voltage drop. The action voltage level difference between the later rounds can be slightly larger. The action delay can also be slightly longer to prevent over-cutting of the load.

6.2.5 Automatic under-voltage load shedding shall avoid system short-circuit fault and load feedback. Conduct reliable release of blocking after fault removal.

6.3 Configuration process of automatic under-voltage load shedding device

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