Intelligent Anti Misoperation System for Power Grid Dispatching of Regions and Counties

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Abstract. With the power system of large capacity, large units, high voltage development trend, dispatching operations becoming more frequent, complex, and probability of mistakes are increasing. For the existing grid dispatching integrated system loss of anti-error function, single dispatching function, low efficiency, according to the existing conditions of Anshun Power Supply Bureau, the Intelligent anti misoperation system for power grid dispatching of regions and counties is designed, introduced the technologies such as the intelligent anti misoperation analysis, automatic process control, and interactive constraint, the system has the advantages of scientific, reasonable and efficient, and providing the technical support for anti misoperation of regions and counties.

1. Introduction
As the power grid control and command center, power grid dispatching agencies is to protect the national and regional power grid system safe and stable operation of the core link [1]. In order to improve the level of power grid construction effectively, promoting the interconnection, automation, information integration of power grid dispatching, realizing the standardization and integration of power grid dispatching system, the integration of county regulation and control system is producing [2, 3]. But the existing grid dispatching integrated system has problems of anti-error function losing, single dispatching function, low efficiency [4, 5], unable to adapt the power system of large capacity, large units, high voltage development trend. In the face of complex grid dispatch operations, can not carry out the technical error prevention effectively, rely on the dispatcher's personal qualities and work experience too much, and affect the efficiency of system seriously.

Therefore, the paper studied on the comprehensive anti misoperation of power grid dispatching under the integrated regulation environment of regions and counties, designed and developed the intelligent anti misoperation function, according to the actual operation and management demand of Anshun Power Supply Bureau, and introduced the technologies such as the intelligent anti misoperation analysis, automatic process control, and interactive constraint, which completed the establishment of the comprehensive anti misoperation system under the integrated control mode, and thus provides the technical support for the realization of intelligent anti misoperation of power grid dispatching, and real-time fault identification and processing, as well as the intelligent development of the integrated regulation mode.
2. Functional requirement analysis of system
The integrated regulation system of Anshun Power Supply Bureau has the automatic functions of remote communication, remote measurement and remote control, which can carry out real-time data acquisition, static security analysis of power grid stability, and accuracy calculation of the collected data, but lack the functions such as real time anti misoperation and intelligent billing. Therefore, the main demand of the comprehensive anti misoperation system of power grid dispatching under the integrated regulation environment of regions and counties is proposed, based on the actual situation of the integrated regulation system of regions and counties in Anshun Power Supply Bureau.

2.1. Intelligent Anti Misoperation Function
In the power grid dispatching process, there are misoperation because of human errors in the billing work of dispatchers and operation of on-site operators, which can result in abnormal work. Therefore, in order to avoid misoperation or reduce the probability of misoperation, it is necessary to introduce the intelligent anti misoperation function [6], to prompt the operator to continue or not in the presence of general accident, or to major direct lock and prohibit operation for heavy operation accidents. The process of intelligent anti misoperation is shown in Fig 1:

![Figure 1. The process of intelligent anti misoperation](image)

2.2. Intelligent billing function
Although the dispatching operation bill can be billed by using the application software in the integration regulation system, it needs to be judged by the experience of dispatchers, while wrong operation bill because of judgment errors will lead to mis operation, so it is necessary to introduce the intelligent billing function [7]. Intelligent billing refers to the function that the computer automatically generates the instruction bill of the corresponding operation equipment and operation purpose according to the mouse's operation instruction of the dispatcher, without any need for typing. The specific process of intelligent billing is shown in Fig 2:

![Figure 2. The specific process of intelligent billing](image)
3. The structure of intelligent anti misoperation system

In terms of the integrated regulation mode of operation and management, the applied research is carried out according to the existing operation mode of Anshun Power Supply Bureau, and the anti misoperation locking structure with three layers of the regulation center, operation team and transformer substations, is adopted by considering the client / server structure mode. The intelligent anti misoperation system of the integrated regulation is realized with functions of different levels in the same data system, as well as the goal of reducing cost and maximized function realization, based on retaining the anti misoperation system and lock devices of the original transformer substation, while the ground line management device and the remote control locking device are added to improve the anti misoperation locking function of the transformer substation [8, 9]. The anti misoperation system structure in the integrated control mode is shown in Fig 3, and the anti misoperation system structure of the controlled station is shown in Fig 4.

**Figure 3.** The anti misoperation system structure in the integrated control mode

**Figure 4.** The anti misoperation system structure of the controlled station
Among them, the anti misoperation server adopts the method of centralized screens, which can centrally manage, count and inquire the data of all the controlled stations; The anti misoperation workstation of the regulation center can receive a regulation order from the regulation system to simulate and preview for verification, and generate the order to the monitoring seats or the anti misoperation workstation of patrol maintenance center after the judgment of anti misoperation; The anti misoperation workstation of the patrol maintenance center adopts the computer as the operation interface, to centrally display the status and operation mode of the primary equipment of each sub workstations; The lock devices of the intelligent locking unit in the process layer of the digital station is connected to the regulation center server through the intelligent anti misoperation device of the station end, so that the remote operation of the regulation center and substation monitoring system has the locking function of hard node of remote control circuit, which can effectively avoid the influence of software and hardware faults and all kinds of disturbance.

4. Interface realization of intelligent anti misoperation
The intelligent anti misoperation system integrates the system interface supported by the integrated regulation technology of regions and counties, billing system interface of dispatching operation, issuing system interface of regulation order, centralized five-anti substation and its system interface, of which the system interface structure is shown in Fig 5. The system association can be realized through the system integration interface, as well as data sharing, and effectively delivering and executing of the instructions, which is beneficial to grasp the operation situation of power grid voltage and automatic control system, optimize and perfect the automatic voltage control, and realize the intelligent analysis of voltage quality, for promoting the integrated regulation mode into the intelligent direction.

![Figure 5](image)

**Figure 5.** Interface realization of intelligent anti misoperation

5. Design and implementation of intelligent anti misoperation system

5.1. Software structure of the intelligent anti misoperation system
The software system construction is carried out for achieving the regional power grid regulation and anti misoperation system with functions of different levels in the same data system, including database layer, service layer, clients of different application layer, interface adapter, network communication bus and various types of maintenance tools, of which the relationships are shown in Fig 6.
Through the construction of hardware equipment such as the master regulation station server and clients and software equipment such as regulation and anti misoperation system and operation billing expert system, the anti misoperation workstation is established in the regulation work hall to realize the dispatching anti misoperation function, based on the server data of the regulation center, and the anti misoperation workstation is established in monitoring work hall to realize the operation monitoring and anti misoperation function; At the same time, the data of centralized control centers such as Yaopu, Liangsuotun, Anzhi, and Ancheng, the operation right is handed over to the regulation center, and the original control centers are connected to this system as a patrol maintenance center; Then other centralized control centers are gradually connected into, to improve the operation mode; The data of each sub stations are improved, mainly to achieve sending real-time state of temporary ground wires.

5.2. The system implementation
The intelligent anti misoperation system with integrated regulation of regions and counties, adopts the advanced artificial intelligence technology, computer network technology, database technology and object-oriented technology, and fully considers and integrates the current situation and future development trends of automation technology, which realizes the organic fusion of the related systems of the integrated regulation of regions and counties, and can be effectively used in the management of regulation stations at all levels, centralized control stations, and substations, as well as the automatic generation and management of operation bills; The information of various aspects and methods of functional systems related to power grid operation and anti misoperation locking, are integrated together, to realize online management of the whole operation process, of which the design of main functional modules is shown in Fig 7.
6. Conclusion
The intelligent anti misoperation system of power grid dispatching is composed of the functions such as reminding of various daily anti misoperation, substation integrated management and operation order management, anti misoperation rules management, real-time monitoring of anti misoperation rules, and anti misoperation monitoring of substations, which can make the administrators of dispatching and substations directly obtain all kinds of anti misoperation alerts through the system, and the timely delivering of information resources, provides timely and accurate anti misoperation information for dispatcher and site personnel in substations. The development and application of the system can improve the intelligent level under the integrated regulation mode, make the dispatching, monitoring and on-site operation work more safe and effective, and promote the development of the integrated regulation mode into the intelligent direction, which can also prevent the occurrence of false power grid dispatching and misoperation accidents, and guarantee the safe and stable operation of the power grid.

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References
[1] Sueyoshi T, Goto M. Environmental assessment by DEA radial measurement: U.S. coal-fired power plants in ISO (Independent System Operator) and RTO (Regional Transmission Organization). Energy Economics, 2012, 34(3):663-676.
[2] Zhao J, Ji K, Sun D, et al. A key technology scheme of pilot projects for provincial and local integrated power grid dispatch. Automation of Electric Power Systems, 2012.
[3] Gong-Xin L I, Zhou X M, Chen Z Y. Regional Power Grid Dispatch and Control Integrated Backup System Based on Cloud Computing Technology. Electric Power Information & Communication Technology, 2016.
[4] Yang Z, Li J, Li M, et al. Application Analysis of Power Grid Dispatching Automation System. Electrical Engineering, 2016.
[5] Z. Li, Y. Sun, Y. Li, et al. Fast Query Method of Common Information Model Files in Power Grid Dispatching and Control System. Dianli Xitong Zidonghua/automation of Electric Power Systems, 2017, 41(9):116-122.
[6] Pasam G. Assessment of Secured Voltage Stability Power Margin of Indian Southern Power Grid Using Integrated and Intelligent Methods. International Journal on Recent Trends in Engineering & Technolo, 2012.
[7] Lei W U. Research on the Key Technology of Intelligent Power Dispatching Based on State Estimation. China Electric Power, 2016.
[8] Gui-He D U, Wang Z F. Design and research on power network dispatching integration of smart grid. Power System Protection & Control, 2010.
[9] Zhang D L. Development and Application on Integration of Power Dispatching and Distribution Automation in County-Level Power Network. Electrical Equipment, 2008.