A New Construction of Command System under the Active-rush Repair Mode of Distribution Network

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Abstract. With the improvement of socio-economic level and people's material living standard, the distribution network changes from the traditional passive repair to the active-rush repair mode in order to improve the efficiency of emergency repair. This paper proposes to construct a new command system under the active-rush repair mode of distribution network in order to improve the efficiency of emergency repair. First of all, through information sharing and data fusion between different departments, we can effectively clear the obstacles and strengthen the efficiency of multi-department cooperative office. Then, with the help of highly covered distribution automation system, the monitoring and automatic evaluation of distribution equipment are realized and the original construction of the command system has been constructed.

1. Introduction
The distribution network is at the end of the electric system’s structure and is the link between the electric system and the power user. If the distribution network fails, it will likely cause serious impact on factory production, people's life as well as distribution network safe operation [1]. The operation failure of distribution network depends on many factors, such as natural damage, man-made damage, line aging, unsafe electricity consumption by customers, etc. With the improvement of social and economic level and people's material living standard, the requirement of power supply reliability is higher and higher. In order to improve the repair efficiency, the distribution network should change from the traditional passive repair mode to the active-rush repair mode [2]. Doing a good job of distribution network regulation is an important guarantee for improving power supply reliability and improving power supply service level. Therefore, a new command system is proposed under the active-rush repair mode, so that the new command system can better adapt to the active-rush repair mode, which is helpful to improve the operation and management ability of distribution network, as well as improve the efficiency of repair [3,4].

2. The change from passive repair to active repair
For a long time, China’s distribution network continues to use the mode of “fault - user repair - on site investigation - eliminate fault” as the main process of passive repair mode. Passive repair based on 95598 customer repair failure is not timely, which is easy to affect people’s production and life. At the same time, due to the inaccurate fixed point of customer repair, it is also difficult to carry out repair.
In recent years, the construction of smart grid is in full swing, and departments of power grid companies are fully realizing informatization. The distribution automation system that tends to be
highly covered can provide the processing basis for power production management [5]. The main goal of active emergency repair is to establish an integrated command and control system in order to repair distribution network emergency on the basis of existing power grid data, to achieve the unification of operation platform, data resources and management, to actively monitor and judge distribution network faults, to shorten the reaction time, to improve the efficiency of emergency repair, to change fault outage to planned outage, and to improve supply quality and service level.

3. Defects of command system under passive repair mode
In the organization system of conventional repair mode, the marketing department directly docks with the customer, receives the customer’s demands by 95598 telephone repair and roughly classifies the demands. Among them, the marketing appeals are directly sent to the marketing team, while the fault appeals are handled by the maintenance department. In addition to the 95598 telephone repair fault, the power grid fault or other abnormal conditions generated in the operation of the distribution network are registered by control center and processed by the maintenance department [6]. The early system organization system is shown in Figure 1.

![Figure 1. Early-phase organization system](image)

In the early organization system, it can be seen that the marketing department and distribution network control center are responsible for receiving customer demands, the marketing team are responsible for processing demands and solving faults and the emergency repair class subordinate to the maintenance department belong to three different departments. There is a certain information difference in the process of information flow between departments, so the fault repair information and emergency repair information are not fully shared, resulting in low efficiency of emergency repair fault handling. In general, the command system under the conventional distribution repair mode has the following defects [7]:
(1) Difficult coordination of interdepartmental distribution network rush repairs Distribution network repair work, mainly involves the maintenance and marketing two departments. In the process of collaborative work, the two departments are difficult to coordinate the emergency repair work of distribution network among departments due to the inconsistency of data management standards and the difference of working concepts.
(2) Difficulty in construction of integrated emergency repair system for distribution network. The long-term independent operation of the current information system leads to difficulties in the construction of a standardized distribution network emergency repair integrated system with coordinated operation of various functional modules.
(3) Lack of expertise in personnel In the distribution network repair work. Some marketing personnel and maintenance personnel are not aware of the information system and business of another
department, so there are difficulties in communication and cooperation. The early business processes can be seen in Figure 2.

![Figure 2. Early-phase business processes](image)

4. Construction of Command System in active-rush repair mode

4.1. System-building objectives

In order to fundamentally improve the reliability of distribution network power supply, distribution network fault repair management mode needs to explore new directions, and the construction goal of command system is to be able to successfully deal with all kinds of power system emergencies. The main construction goals of emergency repair command and scheduling platform are as follows [8].

1. Realization of remote real-time monitoring of distribution network. The remote real-time monitoring of distribution network based on power automation technology can monitor the working conditions of distribution network in real time by monitoring the temperature and load status of distribution network equipment, so that the fault of distribution network can be timely feedback and the efficiency of emergency repair can be improved.

2. Integration of Distribution Network Repair Data. By integrating the existing monitoring information of distribution network fault system and customer repair, active repair and other emergency repair information, the maximum utilization of information can be realized, and the fault information can be quickly transmitted, which is conducive to accurate judgment and timely summary of lessons learned.

3. Centralized monitoring of distribution network emergency repair indicators. The centralized monitoring and statistical analysis of a series of related indexes, such as the timely rate of dispatch orders and the time of fault repair, can realize the centralized monitoring of distribution network operation, which is conducive to the overall planning and consideration of distribution network companies to develop repair schemes. Targets of command platform is shown in Figure 3.
4. Implementation of remote real-time monitoring of distribution network

4.2. New Architecture of Command System in active-rush repair mode

(1) Building an integrated business system for intensive resource management. Building an integrated business system should be based on the principles of unified receipt, unified command, vertical penetration and horizontal coordination [9]. In the study and judgment of emergencies and power grid faults, the information collected by the remote real-time panoramic monitoring terminal of the distribution network and the centralized monitoring terminal of the emergency repair index are summarized to the power supply service command center at the first time. When it is necessary to mobilize resources, the distribution network operation command center should view the overall situation and allocate tasks to various departments. In the emergency management module, with the help of highly covered distribution automation system, command center staff can directly carry out remote emergency operation. The formation of a cross-disciplinary command system integrating command, coordination and information dissemination can effectively simplify business processes, improve coordination efficiency, and achieve rapid response and unified command.

(2) Optimizing departmental structure and strengthening multi-sectoral collaborative office. The two departments of distribution network repair command and distribution network dispatching should be combined to make them become the subordinate departments of the service center. When the distribution network fault is reported for repair, it is uniformly accepted by the State Grid customer service 95598. The State Grid 95598 customer service dispatches the emergency repair fault list through the marketing (SG186) system, and the emergency repair command personnel assigns the emergency repair personnel to deal with it. The emergency repair command is responsible for receiving the report repair work list, fault analysis and judgment, service command, supervision and coordination, process supervision and evaluation. The emergency repair team arrives at the emergency repair site on time for fault point investigation according to the instructions issued by the command center. The fault point is isolated according to the nature of the fault, and the field situation is fed back in time, which is responsible for the fault recovery within the business scope.

(3) Clearing up barriers in various sectors and establishing information sharing platform. Relying on the integrated distribution command system, led by the company’s relevant leadership, the department can set up a distribution network repair work WeChat group [10]. Distribution network operation, fault, repair process and other important information are released in real time by fault repair monitoring personnel. Ensure the whole process of distribution network repair disposal, ensure real-time information sharing, timely response, instant communication. The new architecture of command system under active-rush repair mode of distribution network, which shows more details of command system, is shown in Figure 4.

**Figure 3.** Target of Command Platform Construction
4.3. Comparative analysis

(1) Interdepartmental distribution network repair work coordinated development.
Under the passive repair mode of distribution network, there are great differences in responsibilities and working concepts between departments. When carrying out the operation and distribution integration at the same time, it is often not properly coordinated, the division of labor is not clear enough, and even repeated implementation is inefficient. In the active-rush repair mode, by optimizing the department structure and simplifying the business process, the inter-departmental distribution network repair work is coordinated.

(2) Establishment of integrated emergency repair system for distribution network.
The information system used in the passive repair mode lacks overall awareness in construction, and does not achieve coordinated operation and standardization. Therefore, the data of each application system is difficult to be unified, and the functional modules of each application system are likely to have repeated problems. Under the active-rush repair mode, the establishment of an integrated system for the coordinated operation of each functional module can effectively realize information sharing and improve efficiency.

(3) Application of distribution automation system.
Under the passive rush repair mode, customer repair, fault analysis and other aspects rely on manual, there is insufficient experience of staff, lack of professional knowledge, etc., which hinders the smooth and efficient development of distribution network rush repair. On the basis of high coverage of distribution automation system, active-rush repair mode realizes real-time monitoring and automatic judgment of distribution network faults, which greatly reduces the influence of human factors.

5. Conclusion
In today’s demand for power supply reliability of electric power enterprises is getting higher and higher, and the transformation of distribution network from passive rush repair to active rush repair mode has become the trend of the times. This paper proposes to build a new command system under the active rush repair mode of distribution network. The original passive rush repair command system is adjusted and optimized based on the principle of operation and distribution integration, guided by improving service and quality, and driven by innovation. It is beneficial for power supply companies to enhance the management and control ability of service process, improve the utilization level of rush repair resources and the operation ability of distribution network equipment. In this paper, the development of distribution network rush repair under passive and active rush repair mode is...
compared and analyzed, and the necessity and feasibility of new construction of command system under active rush repair mode of distribution network are further explained. At the same time, efficient active repair is also conducive to improving customer satisfaction and helping to establish a good image of the power supply company.

6. References

[1] Zhou Xiaoxin; Chen Shuyong; Lu Zongxiang. 2013 Review and prospect for power system development and related technologies: a concept of three-generation power systems. *Proceedings of the CSEE* **33** pp 1-11.

[2] Zhang Yuanlai; Yi Wentao; Fan Qijun; et al. 2015 Distribution network fault analysis scheme based on dispatching operation management system: *Automation of Electric Power Systems (in Chinese)* **39** pp 220-225.

[3] Zhou Weifeng; Zhuang Xiaodan. 2015 The distribution network production repairing command platform based on CIS and PMS: *Power System and Clean Energy (in Chinese)* **31** pp 79-83.

[4] Asatilla Abdukhakimov; Sanjay Bhardwaj; Gaspard Gashema; Dong-Seong Kim. 2019 Reliability Analysis in Smart Grid Networks Considering Distributed Energy Resources and Storage Devices: *International Journal of Electrical and Electronic Engineering & Telecommunications* **8** pp 233-237.

[5] McDaniel P; Mdaughlin S. 2012 Security and Privacy Challenges in the Smart Grid: *Security Privacy* **7** pp 75-77.

[6] Zhang Dongxia; Miao Xin; Liu Liping; et al. 2015 Research on development strategy for smart grid big data: *Proceedings of the CSEE* **35** pp 2-12.

[7] Yang Cheng-yue, Lin Yang-yu. 2012 Research on GIS-based distribution network production repairing command platform and its applications: *Electric Power Information Technology* **10** pp 92–95.

[8] Ranaweera DK. 1994 Comparison of neural network models for fault diagnosis of power systems: *Electric Power Systems Research* **29** pp 99-104.

[9] Dow M Grawford; Stewart B Holt. 2013 A Mathematical Optimization Technique for Location and Sizing Distribution Substations, and Deriving their Optimal Service Areas: *IEEE Trans* **2** pp 176-224.

[10] Thomas, Matthew G. 2010 GIS 2.0: 2010 Much More Than Technology: *Transmission& Distribution World* **62** pp 20.