Research on Electric Micro-Meteorological Disaster Monitoring and Early Warning Technology

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Abstract: Because in our country complex topography, power transmission line is often affected by abnormal climate and environment, so relevant research of the micro-meteorological disaster monitoring, early warning become increasingly important. This paper introduces the impact on the power system of the micro-meteorological, the formation of warning principles and methods of electric micro-meteorological disaster, at the same time, focusing on the disaster monitoring and forecasting model, transmission conductor galloping monitoring model, frozen disaster forecasting model and evaluation model, studies the electric micro-meteorological disaster warning model and data processing methods, proposed construction of an integrated micro-meteorological warning system, which achieved the real-time weather monitoring and warning on the grid, as well as monitoring of general and special weather analysis and forecasting and warning.

Key words: Micro-Meteorology, disaster monitoring, early warning technology, integrated micro-meteorological warning system.

1. Introduction

Micrometeorological refers to the atmosphere near the ground because of some structural features of the upper and lower cushion, arising out of the soil and the upper small-scale climate features. The general performance of the individual values and changes in the weather and abnormal weather phenomena on the individual, which is characterized by vertical changes, changes in the level of large, rapid changes in time.

Micro-meteorological disasters grid system can give a serious impact. It can cause power transmission and distribution lines tripping, phase flashover, conductor galloping, break down the tower, damaged interrupt communication transmission network, power supply unit downtime.

Currently in China, affecting the normal operation of all types of disasters is icing, filthy, heavy rains, affecting the widest range of three kinds of disaster, accounting for 80%, respectively, 70% and 80%. Followed by the fire, distribution typhoons, lightning, and account for 60% [1].

2. Problems

Because of complex and varied terrain, so the prevalence of micro-topography, micro-meteorological characteristics, resulting in power transmission lines in these areas are often subject to abnormal climatic conditions (icing, filthy, heavy rain, fires, typhoons, lightning, floods, earthquakes, storms, high winds and blizzards, etc.) effects.

Related Statistics based knowledge service platform Wanfang Data showed that the study of

micro-meteorological disasters from around 2000 began to study the "hot words" from the initial focus on ecology, atmospheric research field, in recent years more and more to the grid grid icing disaster prevention and reduction, transmission line monitoring, micro-meteorological disaster monitoring, early warning studies become increasingly important to the work of disaster prevention and reduction on the grid also has positive significance [2].

Although aspects of domestic and foreign companies in the electricity power industry and disaster prediction, warning and so a lot of manpower and material resources, as well as research and development of a series of disasters, disaster prevention and reduction of electricity technical methods and applications, and in practice has also achieved some results. But in the past the development of early warning systems, often for a single hazard, not a comprehensive early warning system, we need a variety of disaster and its impact on a comprehensive analysis, the establishment of an integrated micro-meteorological warning system.

3. Micro-Meteorological Disasters Forming Principle and Early Warning

Wind, ice and dirt (fog) and other weather disasters are in varying degrees, interfere with the normal operation of the power system, affecting people's lives and led to the corresponding economic losses.

The meteorological disasters on power system is an integrated, single tool is difficult to fully quantify the physical processes and internal drivers of disaster, it is difficult to meet the needs of disaster warning accuracy and application of research [3].

3.1. The Monitoring and Forecasting of Windstorm Disaster

The causes of the windstorm disaster are complex; there are systemic winds, strong convective winds, typhoons and terrain winds. With the development of science and technology, the latest and most modern atmospheric detection technology has been applied to the detection of early warning of strong winds, such as satellites, Doppler weather radar, automatic rainfall stations and other technical means.

3.2. Monitoring of Transmission Line Galloping

Transmission line galloping, mainly due to the low frequency iced conductors by non-circular cross-sectional structure and vertical alignments formed by the action of wind, leads a large amplitude vibration, dancing frequency range of approximately 0.1-3Hz, the amplitude of up to ten meters.

General galloping form factors are mainly icing. Structural parameters of the wire, independent of galloping and operating voltage level, under weather conditions and mechanical parameters are appropriate, any level of line galloping are likely to occur. In rivers and lakes, plains and other open areas or valleys outlet, the wind continued to blow leads to a greater angle, prone to galloping [4], [5].

3.3. Forecasting and Assessment of Ice Disaster

The theoretical model to predict loads sleet icing research work has been carried out over 50 years. So far, more than 20 kinds of icing forecast model, representative of the Imai model, Lenhard model, Goodwin model, Chaine model, Makkonen model, until now there are various models under study [6].

Table 1. The Formation of Different Types of Icing Conditions

Icing Type	Temperature（℃）	Wind velocity（m/s）	Droplet size	Liquid water content	Duration
Rain frost	-10<t<0	Any wind speed	Larger	Moderate	Several days
Wet snow	0<t<3	Any wind speed	Snowflake	High	Several days
hard rime	-10<t<1	>10	Moderate	Medium to high	Several days
Rime	-20<t<1	<10	Smaller	Lower	Several days

Icing transmission lines has obvious regional characteristics; icing type formed under different climatic conditions is different. Defined in IEC60826-2003 the icing into four types are rain frost, hard rime, rime and wet snow. IEC standard also gives a different type of form icing conditions, as shown in Table 1.

According to temperature, wind speed and humidity conditions will be able to conduct a preliminary estimate icing type, but due to differences in the various types of icing, you must understand the different types of icing of the growth process can be given as to whether the possibility of icing and Disastrous forecast [7].

4. Model and Data Processing Research on Micro-Meteorological Disaster Warning

Meteorological services on the grid and data sharing channel approach, as well as methods to protect data transmission security and application conversion timeliness of research is essential for the establishment of micro-meteorological disaster warning models. The model of the micro-meteorological disaster warning and data processing as shown Fig. 1.

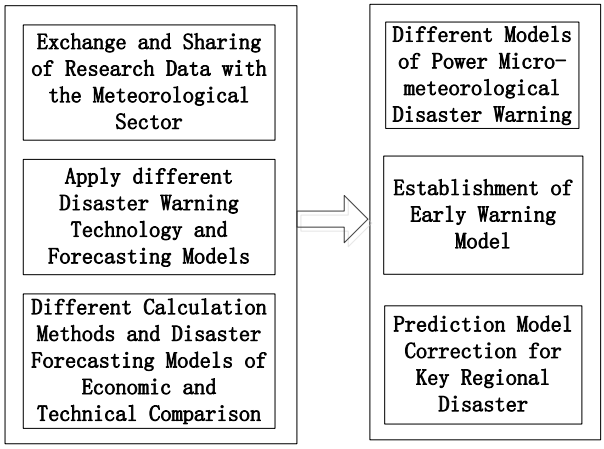

Fig. 1. The model of the micro-meteorological disaster warning and data processing.

4.1. Transfer Programs on Data Sharing and Security

Data sharing channel approach, and guarantee the security of data transmission conversion, and application of timeliness method, as shown below:

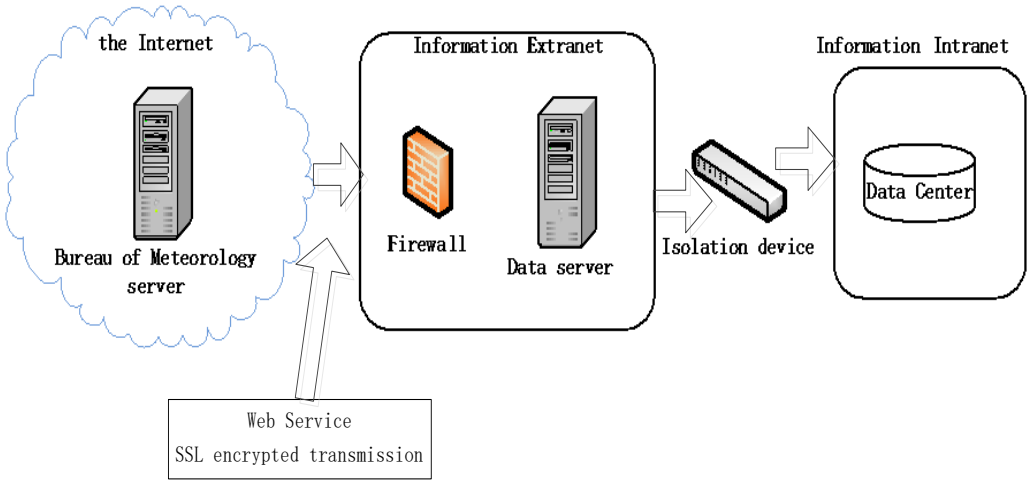

Fig. 2. The diagram of the data sharing and the secure transmission.

Meteorological data should be transmitted through the corporate firewall to external network data server and then write to the internal network of weather database through an isolation device.

- XML-based standard data format

Standardization is the basis of information integration which mainly includes communications protocols, standardized product data, as well as the standardization of electronic documents, interactive graphics.

- The data sharing based on the protocol of Web service

Web Service is the interface; mainly to make the original information between the various isolated sites can communicate with each other and sharing. Under this protocol, the software components or applications are able to communicate via standard HTTP protocol.

- Data encryption transmission

By default, HTTP protocol to transmit data in clear text, WebService use the HTTP protocol for data transmission which data transmission is clear text XML format. It did not take any encryption, so the user's important data can easily be stolen; we must use SSL encryption to transfer XML files.

- Real-time data transmission

To ensure timely data, using push Server Push technology is the active query information from the browser to the server. This way to ensure that the data required obtaining a long connection to the server and the server to the meteorological department data update, the information network of internal data centers to obtain real-time micro-meteorological information.

4.2. The Study of Early Warning Model

Warning model should be integrated power micro-meteorological monitoring data and meteorological data services, based on past historical data analysis, in-depth analysis, and the results of the field survey to assess the disaster, the focus of the disaster warning model parameters can be corrected.

5. Construction of an Integrated Micro-Meteorological Warning System

We use the object-oriented approach on the grid full description, considering the grid properties for all device types, behavior, power characteristics, constraints, rules, relationships and so on, to construct the corresponding object model after abstraction. Systems in a unified grid object model, based on a component-based, dynamic, service-oriented design thinking, according to the data layer, component layer, application layer, the business layer and other multilayer structure system design. System functions as follows:

5.1. Grid Monitoring of Real-Time Weather Warnings

- Power real-time weather monitoring and warning. With the deepening of GIS platform grid applications, platforms and substations, lines, towers and other vector data superimposed combination, we can grasp the substation and power lines in real-time temperature, wind (with gust wind), wind speed (including gusts), relative humidity, precipitation strength, surface pressure, visibility and other weather monitoring information, that information provides an intuitive real-time weather data.

Click on the system corresponding grid infrastructure, not only to display real-time data, also provides the evolution of the curve in the past 24 hours, which can be studied to understand the evolution of the influence of the weather on the grid operation. [8].

- Real-time weather monitoring alarm threshold. System uses real-time weather monitoring information, combined with power distribution and operation of the actual needs, pre-heat, cold, wind, rain, humidity, fog and other weather alarm threshold. When the threshold is reached meteorological conditions, marquee, etc. automatic alarm notification is conducive to grasp the trend of the meteorological effects on the grid and judgments.

- Professional weather forecasting and early warning monitoring and analysis. The system provides 12 hours 7 days by wind speed, wind direction, maximum temperature, minimum temperature, and weather phenomena forecast information and typhoons, heavy rain, snow and other weather disaster warning information. Forecasts updated once every three hours, the maximum time resolution of one hour, the highest spatial resolution of 4 km, enrich forecast content; update frequency and accuracy are much higher than the public network of meteorological information.
- Real-time monitoring of meteorological data. With the deepening of GIS platform application grid, over 1600 real-time weather data of meteorological stations in the province to township grid GIS platform, we can grasp the real-time transmission corridor near the substation and the temperature, wind (with gust wind), wind speed (including gusts), relative humidity, precipitation intensity, surface pressure, visibility and other meteorological monitoring information [9].

5.2. Monitoring and Analysis of General and Specialized Meteorological for Forecasting and Early Warning

The system can provide 7 days 12 hours wind speed, wind direction, maximum temperature, minimum temperature, weather phenomena forecast meteorological disaster warning information and typhoons, heavy rain, snow and other information, updated forecasts, the maximum time resolution of one hour every three hours, the highest spatial resolution of 4 km. It provides support for the development of early warning data grid maintenance, infrastructure and other work plans, power load forecasting.

5.3. Special Weather Forecasting and Early Warning for Monitoring and Analysis

Systems for important substations, specialized meteorological monitoring and forecasting studies and technical support transmission lines can generate lightning, heavy rain, high winds, fog, typhoons and other weather thematic maps, satellite imagery and radar map. These grid operation, maintenance, load forecasting, disaster prevention and mitigation, emergency response, to provide real-time, professional and targeted monitoring and analysis of meteorological forecasting and early warning information.

- Thunder and lightning map. Use lightning location, current intensity information, displayed in a grid GIS platform location, in order to achieve lightning activity occurring within any area of the province of effective monitoring and analysis, and the formation of thunder and lightning thematic maps.
- Typhoon thematic map. Monitoring of each typhoon may affect the occurrence and development of the movement route, and typhoons are identified. When China's meteorological department on typhoon numbered, it provides the current typhoon position (latitude and longitude), strength, speed, direction of movement, the future path prediction.
- Icing monitoring and early warning. According to the meteorological department ， which provide real-time and historical monitoring of meteorological data, system can combin with operational experience, icing monitoring and early warning related departments to carry out research and meteorological departments to improve the early-warning monitoring capabilities.

6. Conclusion

A meteorological disaster on power system is an integrated, single tool is difficult to fully quantify the physical processes and internal drivers of disaster; it is difficult to meet the needs of disaster warning accuracy of research and application. The current means of micro-meteorological meteorological disaster monitoring area is more scarce, warning high difficulty, limited only by ground monitoring technology and methods can not be fundamentally resolved, we must establish an integrated prevention and control system, in order to better forecast and early warning forecast, reduce losses .

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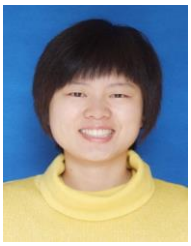

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