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## Exploitation and Application of Galloping Database Based on PMS System

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### Abstract

Our country is rich of line galloping, there are many important galloping data failed to collect systematically and completely because there is no unified management platform. After the galloping occurrence in 2009-2010's winter the department of productive of the State Grid Corporation organized a lot of human to carry out the research of galloping information, this work is time-consuming and inefficient. The State Grid Corporation has used the production management system (PMS) which is a powerful and easy to use. With the help of the system we can create a galloping database which can save resources and storage the galloping data. To build and put it into application of database can provide technical support for line galloping prevention and galloping research work.

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### 1. Foreword

In recent year, galloping disasters in domestic power transmission line are frequently increased, State Grid Corporation has collected a large quantity of observation data at the galloping site, these data aren't effectively collected and managed, its utilization efficiency is obviously too low, which brings great inconvenience for galloping protection works in power transmission line of the corporation. In particular to winter of 2009~2010, large area icing galloping phenomenon successively occurred in seven power transmission lines in Henan, Shanxi, Hunan, Jiangxi, Zhejiang, Liaoning, Hebei and Shandong etc provinces, which caused mechanical and electrical faults in several lines with different voltage classes and seriously affected safe and stable operation of the grid. After fault occurred, the production and technology department of State Grid

Corporation organized a large quantity of man power and materials to carry out fault investigation on galloping of the power transmission lines, this investigation work lasted for one month, it is time consuming and inefficient. Repeated works were frequently carried out, efficiency was very low, therefore it is urgent to develop a set of galloping data management system for the power transmission line to specially store and manage galloping data.

The production department of State Grid Corporation owns special production and management system (PMS) which can manage count information of the power transmission lines and equipments in the scope of the whole grid, and provincial company of each grid has established special network with the headquarter to carry out data transmission, each city-region team realizes mutual connection and mutual accessing with PMS of the provincial company. The headquarter can conveniently realize data transmission with each provincial company, and realizes information exchange and share. Whereas PMS system has strong count information management function of the power transmission lines and equipments, this paper develops the galloping database system in combination of the galloping condition of our domestic power transmission lines, the galloping database is completed by means of PI3000 platform on basis of the current production management system (PMS).

## **2. Building plan of galloping database for power transmission line**

### *2.1. Building target of system*

Design target of the galloping database for the power transmission line is to establish a unified collection, storage and analysis platform of the galloping data for the power transmission lines in scope of State Grid Corporation on basis of the production and management information system (PMS). Data share and communication of the galloping information are realized through PMS system.

### *2.2. Building principle of system*

Main building principles consist of:

- Intensive and standardized principle must be insisted on during building, system design is simplified and optimized from intension, uniform and economic etc angles, standardization design shall be outstanding.
- The building faces to future and long term development of the corporation, applies principles of “unified design and building in section” and realizes stable propulsion of system building.
- Boundaries and interface relationships with variable existing, on-building and on planning other types unified building systems of the corporation related to this system must be fully considered during building, data collection and storage plan and user application plan shall be comprehensively considered, play building efficiency of the information system at maximum degree.
- Technical lines shall be in accordance with relevant technical requirements of “SG186” engineering and “SG-ERP”.

### *2.3. Description of each function module in galloping database*

The galloping database consists of following modules: galloping historical data of domestic power transmission line, galloping treatment data of domestic power transmission line, galloping data inquiry and statistic function of domestic power transmission line etc.

According to requirements of PMS system, the galloping historical data of domestic power transmission line and galloping treatment data of domestic power transmission line these two function modules are placed

in operation working centre menus of PMS (figure 1), the galloping data inquiry and statistic analysis is placed in the power transmission module of the production and operation inquiry centre (figure 2).



Fig.1 address of collection module for galloping data in PMS



Fig.2 address of rogatory and statistical module for galloping data in PMS

#### 2.4. Frame design of galloping database

The galloping database of the power transmission line shall be completely deployed in headquarter of State Grid Corporation and provincial grid corporation in combination of the production and management system

(PMS). Various galloping data information shall be fixedly stored in the provincial grid corporation, users of the city-region (including team) and the provincial grid corporation shall use the galloping database through logging in PMS system of the provincial grid, the headquarter can call galloping data information of each provincial grid through PMS system.

Frame design is shown as following:

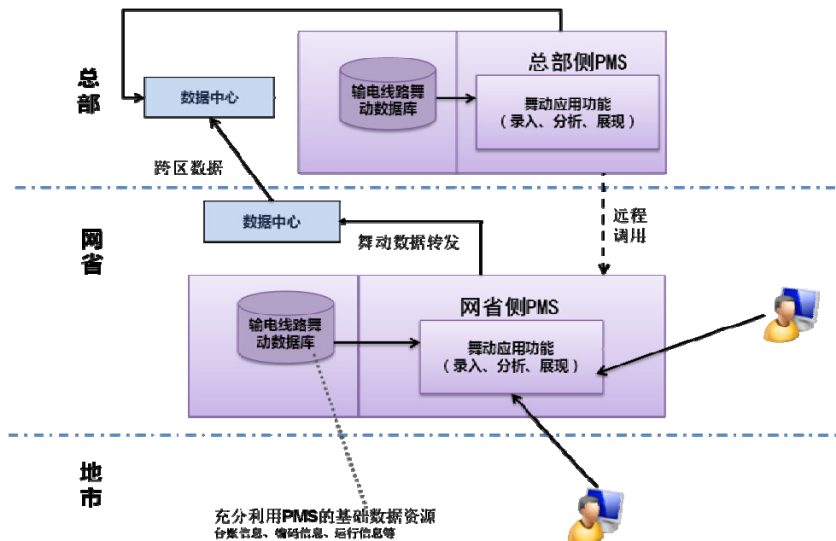


Fig.3 the framework of galloping database for transmission line

Shown as figure 3, the galloping database system jointly provides information service for production management with status inspection and standardization operations etc on basis of the production management system. The galloping database mainly provides input, analysis and showing function of galloping data, the headquarter of State Grid Corporation or other authorized users can remotely call galloping information of lines in each provincial grid through PMS of the headquarter if necessary, so as to meet special demand under fault or other abnormal conditions.

## 2.5. Data model of galloping database

Design of the data model is carried out by object-oriented method in the system. Gallop data of the line is unified abstracted to various objects and property of object, which are unified to existing database structure design of PMS. Key points on design of the line galloping database structure are shown as following:

- Abstract modelling of line galloping historical data and line galloping treatment data.
- Galloping database structure can be conveniently adjusted and expanded on basis of dynamic modelling technology of PI3000 platform.
- Line galloping database applies unified and norm equipment to carry out object designation and time designation.

Collectivity data planning of the power transmission line galloping database is shown as following in figure 4:



Fig.4 the collectivity data programming of galloping database

Line galloping database consists of the galloping historic data and the galloping treatment date in design. The line, tower, meteorological documents, terrain, fault information and video documents etc data are stored in the historical data sheet, the count data isn't stored, it is read out from PMS database if necessary; the line, tower, type and quantity of anti-galloping device, anti-galloping effect data are stored in the treatment data sheet, the count is also read out from PMS database.

## 2.6. Function design of galloping database

Functions of power transmission line galloping database mainly consists of four categories:

- Data collection, including galloping historical data, galloping treatment data etc various domestic data related to galloping aspects.
- Data analysis, carry out inquiry statistic on the galloping historical data and the galloping treatment data etc according to one-key type reporting inquiry function or customized relevant inquiry function, and form analytical documents.
- Date showing, provide viewing and calling for the user by various medium format including words, pictures, video and audio etc.
- System management, including system setting, user management, and right management etc system functions.

## 3. Design and application of galloping database interface

### 3.1. Design interface of galloping historical data

Apply primary collective input for the collected galloping historic data; the newly generated galloping data shall be input by PMS operation and maintenance person according to the galloping data standards.

Parameters in the galloping historic data consist of filled in parameters and optional parameter. For the filled in parameters, the operation and maintenance person can save and exist only after corrected data are filled in, the optional parameters shall be filled in according to actual conditions. If data is easy to be collected, it is filled in. If data isn't easy to be collected, it isn't be filled in. Following figure 5 is design figures of galloping historic data interface.

Fig.5 the collection interface of galloping historical data (have not collected data)

### 3.2. Design interface of galloping treatment data

Use the starting tower number and the termination tower number to fix one section according to format of the historic data. If there is several sections, input number of the section. Confirm whether differential treatment is necessary for each section, and then determine whether anti-galloping device shall be used, select type of the anti-galloping device in the down pull menu, and mark number. If several anti-galloping devices are used, they will be displayed in parallel in the treatment section after operation is complete. Evaluation of anti-galloping effect is carried out in every section. Refer to figure 6.





Fig.6 two of the collection interface of galloping treated data

### 3.3. Reporting of galloping data

After newly built galloping data is complete, and it is correct after inspection of PMS system operation and maintenance person at side of the provincial corporation, this galloping data is transmitted to PMS system at headquarter site for inquiry of the headquarter. Following figure 7 is reporting schematic figure of the galloping data. The galloping data is firstly enveloped by the data exchange centre of the state grid, and then transmit to ODS system at headquarter side, PMS system at headquarter side is transmitted to the front desk of the system and shows through galloping data in ODS system.



Fig.7 the sketch chart for galloping data uploading to the State Grid Corporation's headquarters

### 3.4. Statistical analysis of galloping data

The galloping data inquiry statistics provides one key type reporting inquiry statistics function and combination customized inquiry statistics function, select most convenient and fast inquiry statistics way according to actual demand, the statistic results are shown as pie chart and column chart etc, and statistics data are output. Following figure 8 show inquiry statistics process of single parameters.

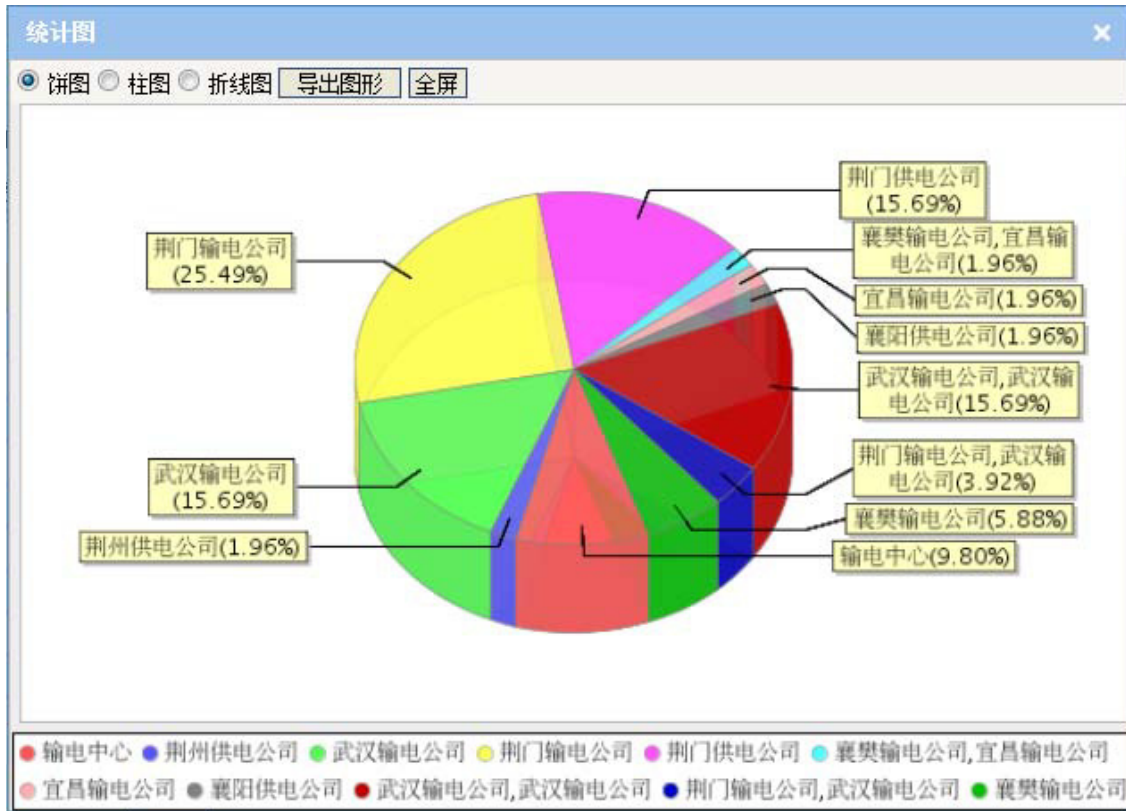


Fig.8 statistical outcome chart

Besides single parameter inquiry and statistics, multiple parameters inquiry and statistic are carried out (shown as figure 9), they are similar, which are not described in this paper.

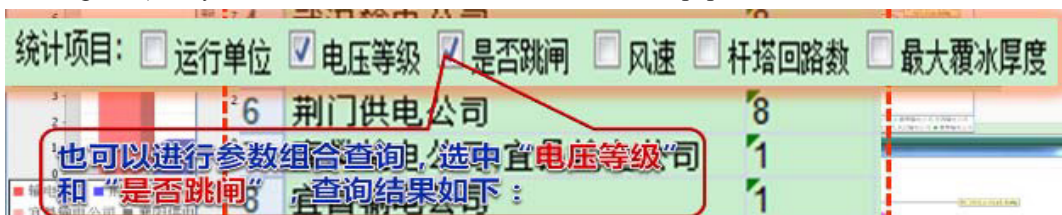


Fig.9 multi-parameters inquire and statistic



#### 4. Conclusions

This paper develops power transmission line galloping database on a large quantity galloping data which are collected in China in recent year, main conclusions are listed as following:

- Determine building principle for the galloping database on basis of extensive investigation, the galloping database shall be in accordance relevant technical requirements of “SG186” engineering and “SG-ERP”.
- Establish the galloping database of State Grid Corporation system, human-machine interface of database is friend, operation is convenient.
- Building of the galloping database can provide data supporting function to research and treatment of galloping. The galloping database is served as collection and analysis platform of the galloping data, which can provide data support function for galloping study, it can also provide reference and guiding assistance for anti-galloping works, the galloping database will provide great convenience on routine operation and maintenance works of the power transmission lines for the production department of State Grid Corporation.

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