Study of on-line Icing Monitoring System and Typical Case Analysis of Guangdong power Grid

Wu Ya

Electric Power Research Inst. Of Guangdong Power Grid Corp.，Guangzhou 510080

Abstract

To prevent large-area damage of power transmission facilities by icing disaster and enable real-time operation monitoring on power lines，the on-line icing monitoring system for Guangdong power grid was constructed. The principle and operation of this system is briefly introduced. Detailed description and analysis are made on the icing condition of Guantong Line No.68 monitoring point in north Guangdong power grid in mid-February 2010. It is proved that the on-line icing monitoring system can reflect icing condition on-site and judge icing accidents of lines timely，accurately and reliably，thereby providing dependable information for deicing and ice melting of transmission lines.

Key words：microclimate; icing; on-line icing monitoring system

0 Introduction

Because of the special geographical position and the unique climate condition，It is easily happen disaster icing accident. Especially the icing disaster on 2008 caused unprecedented serious damage to Guangdong north power grid. Studies suggest that if design 500kV lines in accordance with 20mm ~ 30mm ice, the cost will be 1.8 times to2.6 times. Clearly，It can not rely solely on improving the design standards to prevent the icing disaster. while the technical level must be enhanced to response to extreme disasters (including weather, geology, terrorism). So the on-line icing monitoring system for Guangdong power grid was constructed.

1. on-line icing monitoring system theory and composition

the three aspects of icing include ice and snow、freezing rain、power network incident. the elements of ice disaster is not only cold, but the combined effects of three pretects ： continuous freezing rain、the characteristics of lines and terrain factors.

1.1 the principle of the system

Micro-meteorological parameters should be collected such as wind speed，wind direction， temperature，humidity，atmospheric pressure，rainfall . These datas should be analysed in the system and compared with the icing condition. During icing period，the system can predict the short-term and long-term trends of icing condition by artificial intelligence techniques and mathematical models. At the same time，the system can achieve intelligent alarm by monitoring more parameters ， icing， sag， discharge distance to ground，dancing curvature and damping of line， icing of the insulator, level tension of the line，etc.

1.2 System structure

According to above analysis, we need to monitor the microclimate datas(wind speed, wind direction, temperature and humidity, atmospheric pressure, rainfall), and those fator which affect lines (level tension，vertical tension，line temperature sag，etc.). We can judge the icing state of lines、poles and handware fittings through image monitor. The on-line icing monitoring system was constructed based on these data. It include two parts：The first part is information gathering system, including the combination of online and offline monitoring system, including the integration of production and operation management system, the second part is analysis and alarm system. This system comprehensive analysis the state of the line based on the information collected by the

first part，including power dispatching EMS information integration.

The sensors installed on lines and poles periodically (real time) collect information and package for the global system for mobile communications（GSM）, short message service（SMS）, and then send to the monitoring center through the general packet radio service network（GPRS）.Finally，the system software will determine the line icing situation. Users can browse monitoring information on Local area network（LAN）. The system access to the Guangdong Power Equipment Remote Monitoring and Diagnosis Center. Through this center, users can directly inquiry the parameters of the pole and insulator in MIS system such as test report、design value and power dispatching EMS data. According to various modified theoretical models, test results and the running results，expert software determine transmission line icing conditions, then send out warning information timely to prevent icing disaster.

2 On line icing monitoring system application results in Guangdong Power Grid

At 1:00 on February 14, 2010, the ambient temperature of 220kV Guantong Line No.68 monitoring point ripadly dropped to -1℃, at night temperature dropped to -2℃, line began to glazed, line stress increased from 512kg (normal state) up to 700 kg, temperature maintained -2℃.At 11：00 on the 16th，the temperature rose to -1 ℃, and maintained to at 0:00 on the 18th. the cold and humid weather continued, ice thickness of the line increased rapidly，line stress has risen to 1200kg at 17th afternoon. There was no more cold air, the temperature rose to 0 ℃, low temperature and humidity conditions continued, line icing was stable, at 22:33 on February 18, on line icing monitoring system showed that line integrated stress was 1382 kg increasing 870kg than normal, which is the maximum duing this icing priod, according to the density of 0.85 g/cm3, ice thickness is about 14 mm. At 10:00 on February 19, with the gradual improvement in weather conditions，temperature rose, humidity rapid declined from 100% to 80% or less，the lowest about 35%. At 0:00 on the 19th, ice began to melt, At 8:30, the speed of melting increased obviously . this period were rapidly de-ice from 10 am to 14:30pm，85% of ice have melt, to 15：30, all ice off , the icing process of Guantong line over. The icing process has gone through 130 hours of continuous low temperature，several rainfall，humidity of 99% and Wind speed of 0~ 6 m / s.

Figure 1.2010 Gantong line No.68 monitoring point temperature curve

Figure 2. 2010 Gantong line No.68 monitoring point humidity curve

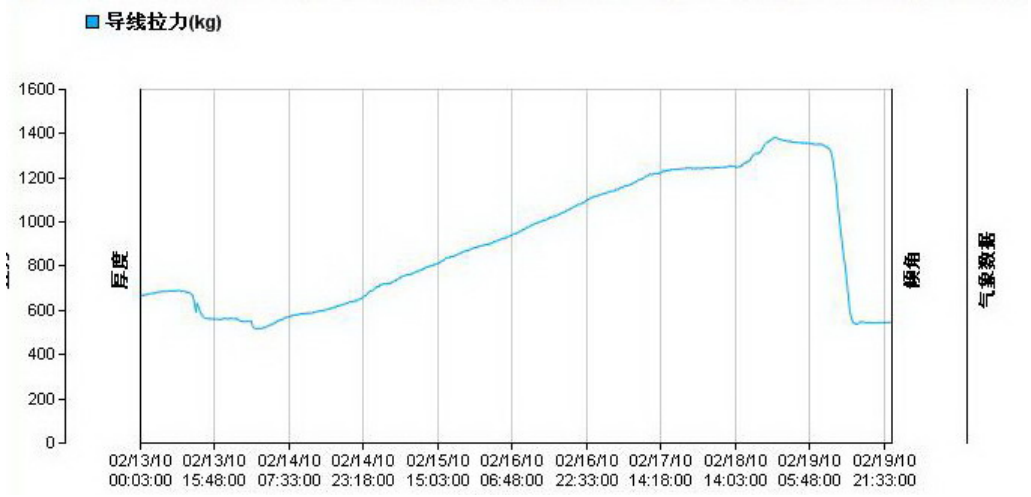

Figure 3. 2010 Gantong line No.68 monitoring point stress curve

3 Weather condition analysis of two icing periods

Through analysis the data collected by Icing monitoring system in 2010 and 2009 ， we can found different microclimate characteristics between 2009 and 2010. The temperature fluctuated between 0 ~ -1 ℃ ，but different humidity lead to different icing situation. In 2009 icing age, only on 7th and 9th January two days´s humidity were more than 80%. and then weather conditions improved, the humidity dropped to 50% quickly, the line icing condition eased. In 2010 icing age， the humidity has more than 90 % always，and continued cold air lead to low temperature, wind speed was 3 ~ 5 m / s which had accelerated the condensation of cooling water.

Interaction effect of these conditions, ice developed continued during the Spring Festival. Dr. Makkonen of Finland research the relationship between humidity and icing to prove that the humidity is more than 100% in Icing conditions. Therefore，the key factor is long-term high humidity which resulted in rapid and severe icing in February 2010 . At the same temperature and wind speed, the higher humidity, maintaining more time , icing up more quickly.

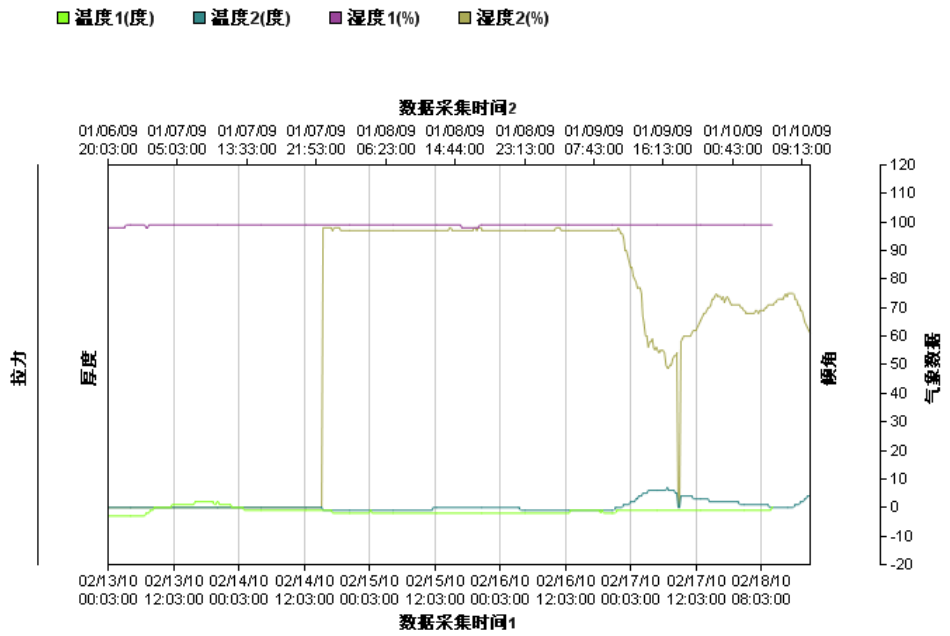

Figure 4. micro-meteorological comparison chart of icing in 2010 and 2009

4 Conclusion

The on line icing monitoring system of Guangdong Power Grid can reflect icing conditions of lines. Comprehensive analysis of the mechanical data, microclimate datas and images of lines，the actual icing information can be measured more accurately. It play a good role for icing monitoring.

The monitoring terminals often install in areas with harsh weather conditions. Because of cold and fog，the camera may be covered by ice during icing period. It is difficult to get comprehensive icing information through pictures. Further technical measures research should also be developed to prevent the camera frozen.

Further analysis of the monitoring datas such as microclimate，the line temperature, mechanical datas；Intelligent segment of the historical datas；identify change patterns and the correlation between different mode.The results can be used in the distribution of ice map and real-time climograph of Guangdong power grid. Broading the application of icing system，it can play more important role.