

Icing Monitoring Technology of Transmission Lines

He Qing, Wang Tao, Jin Tao, Ruan Lin, Deng Wanting

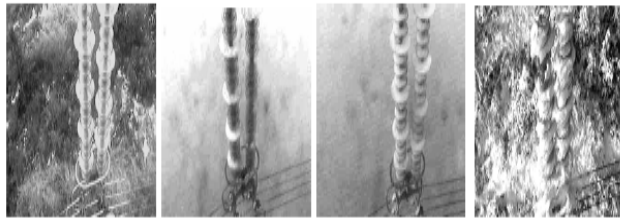
High Voltage Department of Testing & Research Institute of Hubei Electric Power Company

*Email: junesnow2005@163.com

Abstract: The latest research and application achievement of the icing monitoring technology to transmission lines is introduced. Take into account of the geographical peculiarity of icing area in Hubei province, the principle and applied ranges of this technology are proposed. By analyzing the icing causes and its hazards of the transmission lines, the applied characteristics are summarized and improvement measures are proposed of the icing monitoring technology.

1. INTRODUCTION

When the overcooled water droplets or wet snow in the sky close to the transmission lines of which temperature is lower than 0°C , the condensation around lines causes the icing process. In northern area, the dry climate of the winter leads to cover snow in the lines, while the verglas in southern area brings the greater dangerous.



(a) 正常条件下的图像 (b) 2007年1月17日 17:42 的图像 (c) 2007年1月17日 18:42 的图像 (d) 2007年1月18日 10:42 的图像

Figure 1: Process of icing on line insulator

Now the icing monitoring warning system has used in Hunan and Hubei Electric Power Company. When the expected weather condition is occurred, the system generates the alarm signal as the *electronic dog* installed the cars.

The system usually includes on-site measurement unit, communication networks and expert system.



Figure 2: Icing on 109# Tower of Shenyuan I lines

By analyzing the icing monitoring technology/device of transmission line, proposing improvement and integrated design on transmission line monitoring.

2. RESULTS AND DISCUSSION

The application of transmission Line Monitoring System make it isn't necessary to establish high cost icing observing station in serious icing mountain, which can save a lot of manpower and financial resources. In addition, the Transmission Line Monitoring System has been gradually developed towards the information, intelligence. It not only can measure the parameters of conductor temperature, tilt angle, sag, weather conditions, line corridors and other information, and also can detect early risk of ice damage by the intelligent control, which is benefit to eliminate the icing accidents at beginning and improve the reliability of transmission lines in ice coverage area.

On the other hand, the comprehensive collection and long-term accumulation of lines operating state can provide the fundamental data for the design, operation, maintenance and economic scheduling of power. The video monitoring to the line corridor is also used to prevent external damage of power facilities.

It is an effective measure of reducing disaster to establish and improve the transmission line monitoring system, which is more consistent with the realistic than traditional data provided by the meteorological department.

Development of Transmission Line warning and monitoring system, establishing an accurate icing map, and defining the operating rules and standards in ice conditions have very important significance to ensure the safe operation of transmission lines.

3. CONCLUSION

Considering the disaster areas of Hubei and the effectiveness of icing monitoring, the icing online monitoring system should installed at Jing-Yi-Jing-Jing grid and Xianning heavy icing area which is the border between the eastern part of Hubei and Jiangxi. The principle of applications is:

(1) In the mountain, the icing online monitoring system should be installed at the place according to different altitude.

(2) In the plain areas, the icing online monitoring system should be installed at the isolating place or hillside.

[1] (3) The icing online monitoring system should be installed at the 220kV towers where the tower collapses and line broken down have happened.

Icing Monitoring Technology of Transmission Lines

He Qing, Wang Tao, Jin Tao, Ruan Lin, Deng Wanting

High Voltage Department of Testing & Research Institute of Hubei Electric Power Company

*Email: junesnow2005@163.com

Abstract: The latest research and application achievement of the icing monitoring technology to transmission lines is introduced. Take into account of the geographical peculiarity of icing area in Hubei province, the principle and applied ranges of this technology are proposed. By analyzing the icing causes and its hazards of the transmission lines, the applied characteristics are summarized and improvement measures are proposed of the icing monitoring technology.

4. INTRODUCTION

When the overcooled water droplets or wet snow in the sky close to the transmission lines of which temperature is lower than 0°C , the condensation around lines causes the icing process. In northern area, the dry climate of the winter leads to cover snow in the lines, while the verglas in southern area brings the greater dangerous.

According the statistical analysis, the fundamental meteorological conditions which transmission lines are icing in the rain and snow are:

- (1) The temperature of ambient and device surface is less than 0°C ;
- (2) The air relative humidity is more than 85%;
- (3) The wind velocity is great than 1.0m/s, which the water droplet can move.

1. ICING MONITORING TECHNOLOGY OF TRANSMISSION LINES

Now the icing monitoring warning system has used in Hunan and Hubei Electric Power Company. When the expected weather condition is occurred, the system generates the alarm signal as the *electronic dog* installed the cars.

The system usually includes on-site measurement unit, communication networks and expert system.

2.1 Shanxi Icing Online Monitoring System

The icing online monitoring system which is Based on Global System for Mobile Communications/ Short Message Service (GSM / SMS) was developed in October 2005. In February 2006, the Xinzhou power company installed the system at Shenyuan I lines which located in serious icing area. As of March 1, 2007, the system successfully monitored 3 times icing, including a severe icing process that appeared in 2007, February 28 to March 1.



(a) 杆塔覆冰



(b) 导线覆冰

Figure 1: Icing on 109# Tower of Shenyuan I lines

2.2 Hunan Icing Online Monitoring System

Hunan Electric Power Company has installed 68 icing monitoring points, which locates the 15 500kV lines (22 towers) and 34 220kV lines (46 towers) in 14 districts.

The disaster monitoring network of Hunan transmission lines is initially built.

The data acquisition is fulfilled by the embedded sensors installed in the towers. Then, through GPRS (CDMA) network the system connects to the Internet. Finally, these data bring together by the special central server in the scheduling department.

During the 2008 icing disaster, especially earlier stage of icing form, the monitoring system provided the ice thickness, temperature, humidity, wind direction, wind speed, rainfall and other information in time.

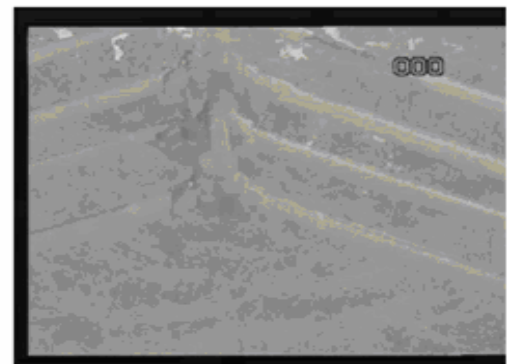


Figure 2: Icing on 65# Tower of Hunan Heyuan lines

2.3 Hubei Icing Video Monitoring System

High-performance cameras, low power pan tilt and special sensors are used to capture live video images, which transmitted by GPRS / CDMA.

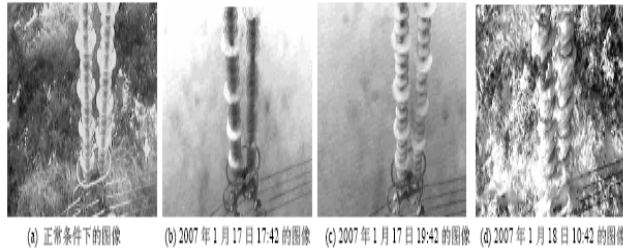


Figure 3: Process of icing on line insulator

Central China Electric Power Company has completed the development of "Icing Online Monitoring System of Transmission Line" in the December 17, 2006, which has appraised by the Science and Technology Department of Hubei Province. At present the system has applied in Hubei Extra-high Voltage Company and Hubei Power Transmission Engineering Company.

2.4 Icing Monitoring and Warning System in China Southern Power Grid

The anti-icing and warning system of China Southern Power Grid Corporation comes into implementation in April 2008. There are installed 30 monitoring points during the construction of Guizhou power grid, which is the first demonstration project.

2.5 Icing Research of Transmission Lines in Canada

In 1998, the Quebec Water and Power Bureau in Canada established a icing testing station, which is used to observe icing and test icing monitoring devices. The conventional climate models are used to simulate and predict icing. By the data of weather predicting system, combined with the icing model, the map of icing area is generated, which is used to predict the possible icing region and play the role of disaster prevention.

2. FEATURES AND IMPROVEMENTS OF TRANSMISSION LINE MONITORING SYSTEM

3.1 Features

- (1) Accurate, detailed records of on-site icing process.
- (2) To provide early warning function.
- (3) To provide guidance for deicing (melting ice) and decision support.
- (4) To draw power grid icing map and provide the foundation for the design.
- (5) To reduce the working time of icing observation station and staff labor intensity.

3.2 Problems

- (1) The stability to be improved.
- (2) The mechanical driving components easy to freeze.
- (3) The incomplete monitoring parameters.
- (4) The mountain poor communication.

3.3 Improvements

- (1) The ability against severe ice damage / bad weather conditions should further improve, which ensure the good working condition and the accuracy of transmitted information.

- (2) The plotting of monitoring system should be rational planning, and the monitoring to micro topography lines, crossing railways and highways lines should strengthen.

- (3) The monitoring parameters should be improved.

3. INTEGRATED DESIGN OF ICING MONITORING SYSTEM

4.1 Parameters Design

- (1) Conductors, which include electric lines, ground lines, OPGW and the main features are radial thickness of ice, amplitude and frequency of galloping, angle of wind deflection, the conductor temperature.

- (2) Insulator string, of which main features are leakage current, angle of wind deflection and so on.

- (3) towers, which include steel tube towers and angle-steer towers and the main features are tower tilted, tower stress and so on.

- (4) Meteorology and environment, which include meteorological conditions, channel conditions and the main features are wind speed, wind direction, air temperature, humidity, rainfall, air pressure, channel and other environmental conditions.

4.2 Icing Online Monitoring Device of Transmission Lines

The device should include line icing monitoring, conductor galloping monitoring, wind deflection monitoring, conductor temperature monitoring, leakage current monitoring, tower tilt monitoring, tower stress monitoring, weather monitoring and line video monitoring.

4. CONCLUSION

The application of transmission Line Monitoring System make it isn't necessary to establish high cost icing observing station in serious icing mountain, which can save a lot of manpower and financial resources. In addition, the Transmission Line Monitoring System has been gradually developed towards the information, intelligence. It not only can measure the parameters of conductor temperature, tilt angle, sag, weather conditions, line corridors and other information, and also can detect early risk of ice damage by the intelligent control, which is benefit to eliminate the icing accidents at beginning and improve the reliability of transmission lines in ice coverage area.

On the other hand, the comprehensive collection and long-term accumulation of lines operating state can provide the fundamental data for the design, operation, maintenance and economic scheduling of power. The video monitoring to the line corridor is also used to prevent external damage of power facilities.

It is an effective measure of reducing disaster to establish and improve the transmission line monitoring system, which is more consistent with the realistic than traditional data provided by the meteorological department.

Development of Transmission Line warning and monitoring system, establishing an accurate icing map, and defining the operating rules and standards in ice conditions have very important significance to ensure the safe operation of transmission lines.

Considering the disaster areas of Hubei and the effectiveness of icing monitoring, the icing online monitoring system should be installed at Jing-Yi-Jing-Jing grid and Xianning heavy icing area which is the border between the eastern part of Hubei and Jiangxi. The principle of applications is:

(1) In the mountain, the icing online monitoring system should be installed at the place according to different altitude.

(2) In the plain areas, the icing online monitoring system should be installed at the isolating place or hillside.

(3) The icing online monitoring system should be installed at the 220kV towers where the tower collapses and line broken down have happened.

5. REFERENCES

- [1] Huang Xinbo, Sun Qindong, Cheng Ronggui, et al. Mechanical analysis on transmission line conductor icing and application of on-line monitoring system[J]. Automation of Electric Power Systems, 2007, 31(14) : 98-101(in Chinese).
- [2] Huang Xinbo, Sun Qindong, Wang Xiaojing, et al. Image remotemonitoring system of transmission lines dangerous items[J]. High Voltage Engineering, 2007, 33(8) : 192-197(in Chinese).
- [3] Jiang Xinliang , Zhang Lihua , De-icing and Anti icing of Transmission Lines [J]. HIGH VOLTAGE ENGINEERING,1997,23:1-73
- [4] Jiang Xinliang, Yi Hui, Protection of icing transmission line [M]. : China Electric Power Press, 2002. Beijing
- [5] Liu Heyu. Theory and Application of icing on Overhead wires [M].China Railway Press, 2001. Beijing
- [6] Seminar on Coping Impacts of Natual Disaster on Electric Power Facilities 2008.5.30-31 Beijing