TRANSMISSION LINES MALFUNCTION IMBALANCE TENSION TREND MONIT -ORING AND TILT MONITORING DEVICE OF RESEARCH

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***Abstract**: T*ransmission line ice-cladding creates an imbalance tension on transmission line towers. The imbalance tension will damage the tower. Real-time monitoring of transmission line the tilt of tower and the imbalance tension's intensity and direction on ice covered conditions. Using GPRS wireless public network transmission the data to the long-distance PC server and database. Using expert system analysis data and issue warning, it is important to operate and issue transmission lines.

Introduction: A bad freeze disaster threat power grid security in 2008. Tower ice covered, and the ice would pull the bad tower, the main re as on is Tower on either side of the wires covered non-uniform ice, and the ice covered produce portrait imbalance tension in 2008, the reason about 90% of pour towers collapse is line ice covered and uneven of ice produce longitudinal imbalance tension. Therefore strengthen research transmission lines malfunction imbalance tension monitoring device and tower tilt device; it is useful to take precautions against natural calamities and real-time monitoring.

1. RESULTS AND DISCUSSION

Monitoring system is mainly included field collection points part and monitoring server parts. Field collection parts consist of kinds of build in the transmission lines and tower sensors device, including imbalance tension sensor, Angle sensor and central processing unit. Monitor server consists of monitor server, the server is a high-powered PC . PC installed a set of tower tilt and un balanced tension monitoring software, software's main function is to show the sensor data collecting, and the other function is judgment the data , given warning value, give a transmission line operation attendants who alarm values.

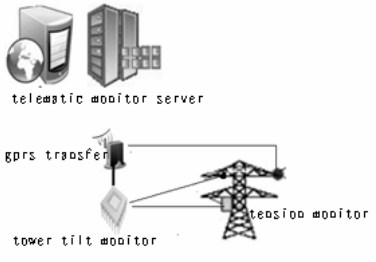

Figure 1: Monitoring system structure

In the overhead lines resistance segment have many difference, such as different height, different distance between towers, when weather conditions change, overhead lines is not equal stress changes produce the imbalance tension. Angle sensor's installation is attachment style, respectively in the tower waist and malfunction rundle installation 2 multi-axial pour Angle sensors.

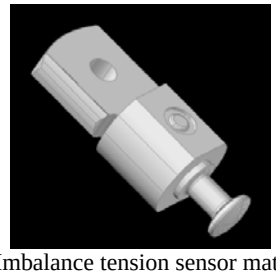

Figure 2: Imbalance tension sensor material graphs

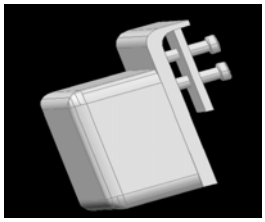

Figure 3: Tower tilt sensor

Table 1: Zhe Quan line 233# tower imbalance tension change data

Data collection time	tension（T）	temperature (℃)	Data analyses
2009-2-27 7:56	1.4	-1.3	Insulator tension began to increase , appear ice covered.
2009-2-27 20:58	1.6	-0.5	Insulator, wire tension keep ice covered thickness to maintain
2009-3-1 7:56	1.2	1	wire ice covered thickness significantly reduced, about 0.3 mm

2. CONCLUSION

The daily operation collected a lot of tower force and insulator Angle data and observation the line actual ice covered thickness and unbalanced tension changed. It is useful to promote the transmission lines of disaster prevention technology development.

3. REFERENCES

[1] Yan Yaocheng,Gong Shouyuan and Qiu Xiuyun "Anaiysis on the Influence and Harm of Transmission Line Icing to Tranmission Network" Water Power, vol. A34, pp. 52–54, November 2008.

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***Abstract*—Transmission line ice-cladding creates an imbalance tension on transmission line towers. The imbalance tension will damage the tower. Real-time monitoring of transmission line the tilt of tower and the imbalance tension's intensity and direction on ice covered conditions. Using GPRS wireless public network transmission the data to the long-distance PC server and database. Using expert system analysis data and issue warning, it is important to operate and issue transmission lines.**

Keywords- transmission;line Tower tilt;GPRS;Unbalanced tension

I. INTRODUCTION

A bad freeze disaster threat power grid security in 2008.Tower ice covered, and the ice would pull the bad tower, the main re as on is Tower on either side of the wires covered non-uniform ice, and the ice covered produce portrait imbalance tension. Such damage in wire haven't occurs when ice covered overload and appear rupture, fallen etc. The normal working conditions of tower and its sides of wire tension basic balance. But when the tower on both sides of the wires cladding uneven ice, this force equilibrium state is destroyed, tower sides create poor tension, tower will happen to tilt on the big tension side, bending. When the tension is over a certain value, tower rods will be going to pull, pressure, and resulting in the tower broken and collapse. From the investigation and statistics, in 2008, the reason about 90% of pour towers collapse is line nonuniform ice covered and uneven of ice produce longitudinal imbalance tension. At present, the domestic and foreign research unit for fight back transmission line ice disaster, In Hunan, the researcher has successfully developed a series of ice melt device. At the same time, the new problems arise in the process of melting ice, because the length of the lines is longer wire, somewhere ice melt condition is different, so will cause the wire off ice uneven and produce the line dance, then the tower tension will be obvious changes, imbalance phenomenon intensified. Therefore strengthen research transmission lines malfunction imbalance tension monitoring device and tower tilt device; it is useful to take precautions against natural calamities and real-time monitoring.

II. MONITORING PRINCIPLE AND SYSTEM STRUCTURE

A. System structure

Monitoring system is mainly included field collection points part and monitoring server parts.

Field collection parts consist of kinds of build in the transmission lines and tower sensors device, including imbalance tension sensor, Angle sensor and central processing unit. Unbalanced tension sensor installed in insulators and tower shape ring between, replaced the original ball head ring, imbalance tension sensor by a combination of six direction angle sensor and tension sensor composition, which is used to measure the size of the Tower force and force's direction, Tower tilt sensor installed in the main tower's waist and rungs, tower's waist installed two multi-axial Angle sensor, used to measure the tower waist of writhing and gradient, In the rungs of the tower also installed two multi-axial angle sensor .Because the tower was under unbalanced tension , so the sensor could measure the waist and twist degrees. The composition of collection equipment mainly by low power consumption of embedded system structure, through the solar panels to power supply system, signal transfer way through wireless public network GPRS to collect Angle value and sent to the telnet monitor server .

Monitor server consists of monitor server, the server is a high-powered PC . PC installed a set of tower tilt and un balanced tension monitoring software, software's main function is to show the sensor data collecting, and the other function is judgment the data , given warning value, give a transmission line operation attendants who alarm values.

Identify applicable sponsor/s here. *(sponsors)*

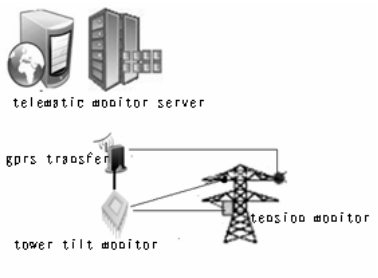

Figure 1. Monitoring system structure

B. UUNBALANCED TENSION MONITORING HARDWARE DESIGN

In the overhead lines resistance segment have many difference, such as different height, different distance between towers, when weather conditions change, overhead lines is not equal stress changes produce the imbalance tension [1], this is a widespread phenomenon, not only campagna but also mountains have the same problem. If the phenomenon happens in these area will produce imbalance tension, especially wind meteorological conditions change caused by the unbalance tension, transmission lines appear uneven ice covered will cause imbalance tension on tower. Unbalanced tension measurement based on the strain gauge sensor, and the stress in stress sensor installed a Angle sensor, the unite sensor can be in measuring force and measure the direction of the force. The strain gauge variety, but its basic structure broadly similar, is to wire around type strain gauge structure as examples, its structure schematic drawing as figure 2 shows. Metal resistance wire embedded in the substrate, and on the top of the metal is a layer of film, make them into an integer, this basic structure is the resistance strain gauge wire.

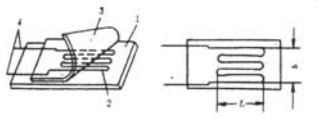

Figure 2. Resistance strain gauge wire of structure schematic

Sensor installed in the joint of insulator droppings, replace a ball head ring, sensor material graph fig.3 shows.

Figure 3. Imbalance tension sensor material graphs

C. Tower tilt monitoring hardware design

Through statistic and analyses the previous tower tilt malfunction data to help developed monitor device. The device main function is measure tower tilt angle. On the tower suffer stress two typical section, installation 4 multi-axial Angle sensors. Different position from the tilt changes specific description tower's offset angle and offset value. Actually the angle sensor's main component is application widely, acceleration sensor SCA100T - D02. SCA100T-D02 cooperates with various protection circuits, the power supply unit to get to Angle measurement purposes.

Angle sensor's installation is attachment style, respectively in the tower waist and malfunction rundle installation 2 multi-axial pour Angle sensors, as shown in figure 4 sensor material diagram shown

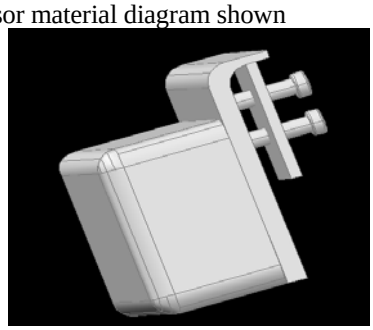

Figure 4. Tower tilt sensor

III. COMMUNICATIONS SYSTEM AND EXPERT SYSTEM DESIGN

Communications system use GPRS technical to gather sensor data. And control long-range devise.

The function mode of data process analysis can collect and integrally analyses the data of all kinds of parameter.

1) Tower tilt Angle measurement and analysis: by monitoring the insulator Angle and wind direction、wind speed. Using Application background software to built calculation model to analysis transmission line in different natural conditions, Identify the tower tilt and line electric distance and sag overhead corresponding relation.

2) Automatic analysis function: using the computational model, the calculated data to issue warning. Based on B/S information browse mode: the whole system utilize the B/S model building,this mode can issue convenient the whole system message. Apply this model in the whole system, such as department heads, the court, provincial company and all users in power system.All of user can inquire and analyze the choiced mornitoring data and photos from each terminal.At the same time, through use the client system software could connectionl each base long-distance station to provide effective platform system information released. Using the B/S model browsing system, easy-to-use, users can convenient utilize IE browser obtain filed conditions and obtain real-time monitoring date、analysis results, User also could set various user view permissions.

IV. FIELD USE

The device built in the Zhe Quan line 233 # tower , and in early February 2009 the lines of ice covered process shows the routes of unbalanced change of tension. Data see table 1 below.

TABLE I. ZHE QUAN LINE 233 # TOWER IMBALANCE TENSION CHANGE DATA

Data collection time	**tension（T）**	**temperature (℃)**	**Data analyses**
2009-2-27 7:56	1.4	-1.3	Insulator tension began to increase , appear ice covered.
2009-2-27 15:22	1.6	-0.9	Insulator tension significantly increased, based on observation simulation wire ice covered thickness reaches 2mm
2009-2-27 20:58	1.6	-0.5	Insulator, wire tension keep ice covered thickness to maintain
2009-2-28 7:56	1.8	0.6	Observation simulation wires, ice covered thickness reaches 4mm, insulator offset Angle increases, tension increase
2009-2-28 19:56	1.7	1.2	Insulator by unbalanced tension small amplitude decreases, and insulator offset Angle increased significantly, the ice covered started to melt.
2009-3-1 7:56	1.2	1	Insulator suffered greatly reduce tension imbalance, insulator offset Angle recedes, according to simulated wire ice covered thickness significantly reduced, about 0.3 mm
2009-3-1 19:56	1.1	1.2	Insulator by unbalanced tension small amplitude decreases, and insulator offset Angle was decreased.
2009-3-2 7:29	1.2	0.4	Insulator by unbalanced tension small range increased, observation simulation wire ice covered thickness of about 0.2 mm
2009-2-27 7:56	1.4	-1.3	Insulator by tension began to increase , appear ice covered.

According to the data display, imbalance intension of general situation in 1.0 to 1.2 T. The minimum value is 0.9 T, the maximum value is 1.8 T (severe ice cover). And insulator offset Angle (X) is in commonly 5.5 to 6.5 degrees changes, the biggest 7.65 degree, the minimum is3.45 degree; Insulator deviation Angle (Y) in commonly 2 ~ 3.5 degrees between change, the maximum is 9.15 degree, the minimum 1.95 degrees. By installing monitoring equipment complete reflects ice covered process, and got the raw data, for the future research.

V. CONCLUSION

Project team finished the “tower imbalance tension and tower tilt on-line monitoring system” project. And in the daily operation collected a lot of tower force and insulator Angle data and observation the line actual ice covered thickness and unbalanced tension changed. It is useful to promote the transmission lines of disaster prevention technology development. This system base on past many online monitoring devise introduces technological innovation, such as the system architecture, the power system, transmission mode, system test etc. Transmission line of disaster prevention and mitigation of monitoring provides powerful reference.

References

[1] Yan Yaocheng,Gong Shouyuan and Qiu Xiuyun “Anaiysis on the Influence and Harm of Transmission Line Icing to Tranmission Network” Water Power, vol. A34, pp. 52–54, November 2008.

[2] LI Xing, ZHAO Hua-zhong, LI Wei-xing “Quick Restoration of a Seriously Inclined Pylon in 500 kV Transmission Line” SOUTHERN POWER SYSTEM TECHNOLOGY , vol. A2 No.5, pp. 71–78, October 2008.