

THE OBSERVATION OF WIRE ICING AND ITS WEATHER CONDITION IN GUIZHOU

LUO Ning¹ Wen Ji-fen² Ran Jia³

1: Guizhou Meteorological Bureau, Guiyang,550002,China

2:Guizhou Weather Modification Office, Guiyang,550002,China

3: Key Laboratory of Atmospheric Physics &Atmospheric Environment(LAPE),
NUIST. Nanjing, 210044,China

1.INTRODUCTION

The emergence of the electric wire icing accumulated ice increased to build on stilts the perpendicular lotus of circuit to carry.Once over design standard, will take place ice to harm trouble, become disaster weather, bring national economy huge loss. Meteorological phenomena many years records the main body of a book according to Guizhou,the characteristic and oneself characteristic carry out analysis on electric wire icing meteorological phenomena , gets the parameter beneficial to harming an accident as well as electric wire icing occurrence temperature , wind speed , wind direction condition, ice happened. The temperature passed to once influence congelation process of cooling off the drop of water to influence the type of electric wire accumulated ice;The direction of wind, wind velocity passes the growth of the influence accumulated ice of the landings speed of changing the drop of water. May develop status according to accumulating the ice diameter and the thickness fluctuation , getting glaciation process's in glaciation process. As long as knowing ice density , glaciation diameter and glaciation weight hit the target, two parameters, are therefore likely to calculate out third parameters arbitrarily.

Atmospheric ice accretion on wires is one of the major problems in planning and constructing power transmission lines and communications networks in regions where

freezing temperatures occur frequently.Damage to structures by ice loads causes huge economic losses and operational difficulties in the power industry(GUIZHOU,2008).These estimates canbe obtained by collecting long time-series of observations on ice loads and quit extensive statistics have been obtained in this way for some location.

2. INVESTIGATED DATA

In order to reveal the law and mechanism of wire ice accretion in GUIZHOU plateau,micro-characteristics of fog and cloud were observed while investigating and collecting the macro-meteorological conditions in heavy ice accretion areas.

Accidents of wire ice accretion usually take place in heavy ice accretion areas . More fog is a typical climate characteristic of heavy ice accretion areas.Three heavy ice accretion areas of GUIZHOU Province were selected as field investigation areas in the project,they are MALUOQIN in the west LOUSHAN Mountain in north and YUNWU Mountain in the centre ,and their heights above sea level are 2128,1780 and 1659 meters respectively.The typical characteristic includes ice accretion data and routine meteorological data: temperature,wind ,ice increasing and so on.

3. WEATHER CONDITION DURING ICE ACCRETION

During ice accretion, ice increasing has a direct bearing on temperature,wind velocity and wind direction.

3.1 THE AFFECT OF TEMPERATURE ON WIRE ICE ACCRETION

According to the meteorological data of GUIZHOU Province over the past decades, the temperature distribution scope is mainly $0^{\circ}\text{C} \sim -8^{\circ}\text{C}$ during ice accretion, selecting the temperature distribution of some meteorological stations in east, north and centre of GUIZHOU Province during heavy ice accretion year (1976, 1984, 1985, 2008) and temperature distribution frequency of observation spots in heavy ice accretion

areas, table 1 obtained the height above sea level, the wider of the negative temperature areas. The temperature of MALUOQIN in 1976, 1984 was calculated through linear regression with the temperature of SHUICHENG meteorological station. The regression formula is $T_m = 1.03T_s - 2.17$. With 69 statistic samples. Coefficient of correlation $r = 0.89$. Where: T_m the temperature of MALUOQIN, T_s the temperature of SHUICHENG meteorological station.

Tab1 Frequency of temperature distribution (%)

areas	place	Height (m)	temperature scope(°C)											year	Degree of ice accretion
			≥0	0~-1	-1~-2	-2~-3	-3~-4	-4~-5	-5~-6	-6~-7	-7~-8	<-8			
cities	Kaili	720	3	45	31	21									heavy
	Weining	2237	6	12	12	12	16	10	14	11	2	5	1976,1984,1985,2008	heavy	
	Shuicheng	1811	5	26	19	15	14	17	4					heavy	
	Zunyi	844		48	29	24								heavy	
		Guiyang	1071		29	26	26	15	3					heavy	
Moun-tain areas	Maluoqin	2128	2	2	3	27	18	15	14	17	2		1976,1984	heavy	
		2128	11	9	10	40	21	6	3				1989	heavy	
		2128		6	62	26	6						1991	light	
	Loushan	1780		3	9	11	34	19	11	13			1990	heavy	

2008, 1984 and 1976 of GUIZHOU are especially heavy ice years. Some severe accidents such as poles collapsed and wires broken took place in many areas of GUIZHOU. Electric power accidents caused by ice took place in SHUICHENG, MALUOQIN in 1976, 1984 and 1989. The damage of All GUIZHOU by ice took place in 2008.

In the light of analyse, the lowest temperature of longest last ice accretion of MALUOQIN in heavy and especially heavy years is -8°C , and the frequency between $-2^{\circ}\text{C} \sim -5^{\circ}\text{C}$ is most often, up to 60%, so is in LOUSHAN (up to 64%). The minimal temperature of some cities whose heights

above sealevel are below one km is -3°C during heavy ice years. The heights above sea level of most mountain areas of GUIZHOU Province are between one km and two km. Their temperature is not below the temperature of SHUICHENG and MALUOQIN. One could infer: the temperature of most areas of GUIZHOU during ice accretion is between 0°C and -5°C . Shown in fig1 and fig 2.

Temperature has a relationship with icing density, when the temperature is below 0°C , the higher the temperature, the greater the icing density, and vice versa. The longer the ice accretion time, the more thickness the wires ice accretion. The thickness of ice

accretion of wires shown fig 3.

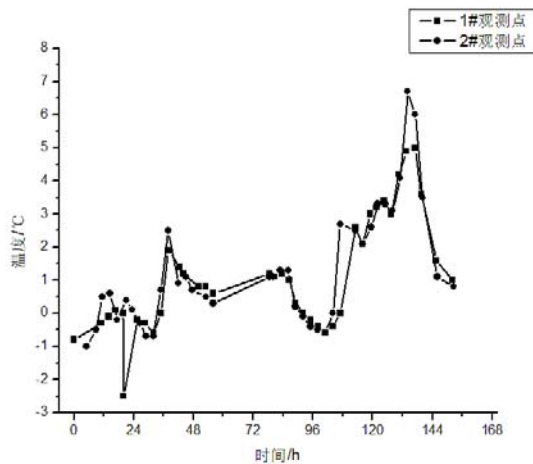


FIG.1. The Temperature change during ice accretion in 1990 in LOUSHAN

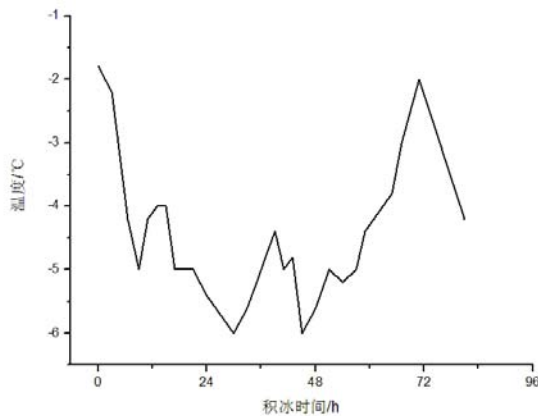


FIG.2. The Temperature change during ice accretion in 1994 in YUNWUSHAN

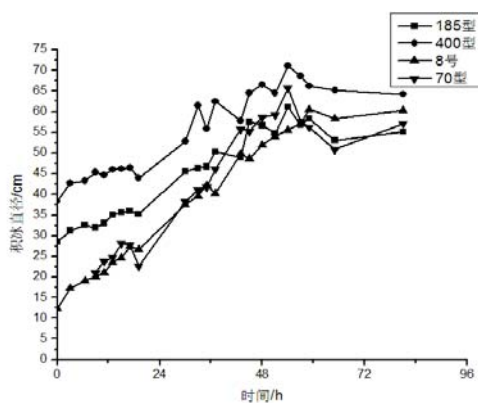


FIG.3. The change of thickness of wires ice accretion during ice accretion (sample93)

Three different kinds of temperature were given in Peksonne's wind tunnel experiment: $T = -16^{\circ}\text{C}$, -5.4°C , -1.5°C . Under the

same condition of equal LWC(liquid water content) and velocity, the icing density within 4 hours is $0.32, 0.54, 0.89\text{g/cm}^3$ respectively. Compared with Peksonne's wind tunnel experiment, the ice accretion of GUIZHOU Province is one under relatively high temperature. When temperature is high, icing density is great, adhesive force of ice to wires is great, and ice is not easily dropped. It is main reason that calamity was easily caused by ice accretion in GUIZHOU Province. Four kinds of icing density between 0.79 and 0.89g/cm^3 were observed in GUIZHOU Province in the study.

3.2 THE AFFECT OF WIND ON WIRE ICE ACCRETION

Collection of cloud droplet of cylinder is related with wind velocity and wind direction. When wind direction is perpendicular to the cylinder, cloud droplet collection amount is maximal, and the speed of ice accretion is most fast. Wind direction is parallel to the cylinder, there no cloud droplet collection in theory. To show the effect of wind direction on ice loading in this paper, North—South direction is defined as 0° and West—East direction as 90° . If the angle between wind direction and North—South wires is greater than 45°

, the wind is to the east or to the west, and to the south or to the north on the contrary ice accretion long diameters of the North—South direction and West—East direction were observed for the simulation wires and expressed with D_s and D_e respectively. If $K_d = D_s / D_e$, K_d could be obtained for different wind direction and velocity and shown in table 2. Frequency of wind distribution shown in fig 4.

Table 2 and Fig4 shows: wires ice accretion of North—South direction is more severe than that of West—East direction (except wind speed less than 2m/s).

Table 2 Average K_d of different wind				
Velocity(m/s)	$\odot > 45^\circ$	samples	$\odot < 45^\circ$	samples
$v < 2$	2.27	6	0.17	6
$2 < v < 4$	4.50	4	3.2	4
$4 < v < 5$	2.86	8	2.57	8

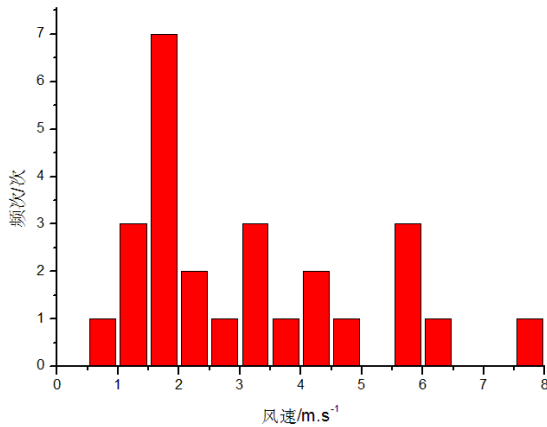


FIG.4. The Frequency of wind distribution during ice accretion

That is related with the macro-weather and climatic characteristic of GUIZHOU cloud and fog. When the surface wind direction is to the north, cloud and fog is relatively thin, and LWC of cloud on mountain is little, which is not favourable to the ice accretion of West—East wires. However, when the surface wind is to the east under the stationary front weather, cloud and fog is relatively thick, and there are more big droplets, which is

favourable to the ice accretion of North-South wires. The prevalent wind of GUIZHOU glaze and rime weather is all to the West—East.

4. CONCLUSIONS

The study of observation of wire icing and its weather condition indicates the following:

a. According to the investigation of historical data of GUIZHOU during heavy ice accretion years, the temperature distribution of GUIZHOU during ice accretion is between $0^\circ\text{C} \sim -8^\circ\text{C}$. The most concentrative temperature distribution is between $0^\circ\text{C} \sim -5^\circ\text{C}$ which contains the temperature distribution of cities and mountain areas.

b. The wire ice accretion of North—South direction is greater than that of West—East direction (except velocity less than 2m/s). The main reason is the existence of stationary front during ice accretion. When the surface wind direction is to the North—east, LWC is relatively great and sufficient liquid water is blow to the North—South wires.

c. Temperature has a relationship with icing density, when the temperature is blow 0°C , the higher the temperature, the greater the icing density, and vice versa. the longer the ice accretion time, the more thickness the wires ice accretion.