Analysis of Design Ice Thickness Value in Erlang Mountain

Wu Guoqiang
Southwest Electric Power Design Institute
Email:gbz88@163.com

1 Preface

Wires icing in winter is a general phenomenon in cold region, and it has major impact to the investment in the construction of transmission lines and reliable operation of the lines. So the problem of wire icing gets universal concern and is studying to be solved. This article will discuss the way to take design ice thickness value reasonably of the electric power transmit lines in the area by analyzing and calculating the wires icing data of icing observe station in Erlang Mountain area.

Erlang Mountain Icing Observation Station (points) was established in November 2001. Up to now there are 5 years icing observational data of these station and points.

2 Calculation of standard ice thickness

According to “Technical code of meteorological Surveying for electrical power projects” (DL / T 5158-2002), the measured wire icing data should be calculated as the standard ice thickness with density equaling 0.9 g/cm^3 in accordance with the wire icing diameter or icing weight formula. So the calculation of standard ice thickness should be used the following formula.

$$B_0 = \sqrt{\frac{G}{0.9\pi L} + r^2} - r$$

Icing on wire is very serious at Erlang Mountain Icing Observation Station. Great icing process appears in each icing observational year. Measured ice density is between 0.14 ~ 0.45 g/cm^3. Accordance with the above formula, the maximum value of standard ice thickness is 70mm, appeared in the winter of 2002 ~ 2003.

3 Calculation of design ice thickness

3.1 Method of technical code

The value of design return period of 220kV is 15 years. So it is as the following table to select the return period conversion coefficient.

Design frequency	Return period (Year)							
	100	50	30	20	15	10	5	2
6.67%	0.76	0.83	0.88	0.96	1.00	1.10	1.30	1.80

The wire’s type of Erlang Mountain Icing Observation Station used is LGJ-400. If there is not wire diameter correction coefficient but height correction coefficient and return period conversion coefficient to calculate, the calculated result is 104mm with selecting the value of return period conversion coefficient as 1.3 according to above method. Considering the observational experience and actual icing investigated situation of Erlang Mountain Pass region, this calculation is larger.

3.2 Method of Jenkinson theory

According to the actual situation, it should use more universal form of extreme value distribution to ascertain icing extreme value for a return in many years with less annual extreme value data of Erlang Mountain. Icing Observation Station and inaccurately return period’s definition of a single extreme data.Therefore, we select extreme value distribution model of AF Jenkinson theory:

If m1 and σ_1 representatives the average and standard deviation of annual maximum, then:

$$m_1 = a(1-k!)$$

$$a = \sigma_1 \left\{(2k)! - (k!)^2\right\}^{-\frac{1}{2}}$$

$$\frac{x-m_1}{\sigma_1}=\frac{k!-\{\ln[T/(T-1)]\}^k}{\pm\{(2k)!-(k!)^2\}^{1/2}}$$

According to the above formula, the annual maximum value x can be expected to appear once in T years ,it means x is the standards ice thickness of which return period is T years. Finally, revised the value of height and diameter, the corresponding design ice thickness can be obtained.

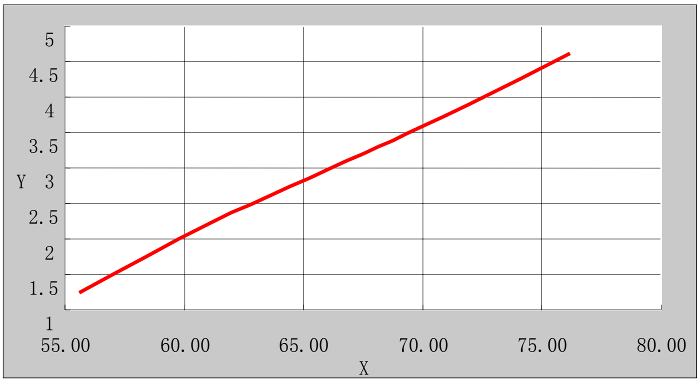
In accordance with the above formula, the basic calculating data select the maximum icing value of each year from 2001 to 2006, shown as below table.

Date	2002.01.20	2003.03.08	2003.11.12	2005.01.21	2005.12.02
standard ice thickness	61	70	55	53	56

It will get the following table and chart about return period calculating according to method of Jenkinson theory.

T	5	10	25	50	100
Y	1.25	2.25	3.2	3.9	4.61
(x-m1)/σ1	0.72	1.31	2.04	2.59	3.14
X	61.20	64.64	68.90	72.10	75.31

It can draw the calculated curve as following chart according to above table.



Accordance with the above formula the once in 15 years value of y equal 2.67, the corresponding value of x is 66.4. It means that the standard ice thickness value of once in 15 years on LGJ-400 in the Erlang Mountain Pass zone is 66mm. The design of the ice thickness by height revised can be 76mm.

Compare the results of these two methods, we can see the two groups results are quite different. Considering the observational experience and actual icing investigated situation of Erlang Mountain Pass region, the results using method of Jenkinson theory is close to the actual situation. The results using other method is too larger. The reason is still the observation period may be shorter. The calculations of return period have greater calculation error.

Analyzing the above calculating results of two methods , the design ice thickness in the Erlang Mountain Pass region should be 60 ~ 80mm, and in the local section of the local micro-topography, the design ice thickness can reach 80 ~ 100mm.

4 Peroration

From the above calculation results, while the observational period is shorter and the value observed in ice area is particularly great, we can try using method of Jenkinson theory to calculate the extreme desire distribution for short-term observation sequence, and the results can be referenced.

The method used by “Technical code of meteorological Surveying for electrical power projects” (DL / T 5158-2002) is a mature methods and have been widely used in electric power project. The calculated result of Jenkinson theory’s method can be a reference with shorter observation period or less actual surveying data.