The Research of Icing Magnitude of Transmission Lines in Mountainous Region

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***Abstract*—This article, which used the combination of weather, climate theory and geomorphology, research the icing characteristics of current transmission lines of the mountain micro-terrain and micro-climate in mid-latitude of our country. With the difference of micro-relief，the route of heat source and humidity is different, the weather and terrain is interdependent, but differ from microclimate. Microclimate is reflective of the integrated status of divergence, heat, moisture and wind etc on atmospheric surface layer. The mainly factor of influence microclimate are terrain, landforms, vegetation, soil and around environment. Then, the different character of underlying surface contributes to different microclimate, and this discrepancy is reflective of the differentiation of small scale. The different criteria of icing size of transmission lines was analyzed through utilizing the actual measurement data of icing observation stations (spots) in the micro-terrain and micro-climate area, then explained the application how to confirm the icing area division of current transmission lines in micro-terrain and micro-climate area.**

Key words: mountains region; transmission line; icing magnitude

1THE IMPACT OF MOUNTAINS TO THE ICE MAGNITUDE

The icing size of transmission lines depends on the geography location, mountain direction, mountain height, mountain structure, slope and watershed, tableland, YaKou, rivers and lakes and so on, the icing size is mostly restricted by the terrain in the mountain area. Since 1982, SWEPDI has started to measure the ice size of transmission lines on different terrain condition in Sichuan, Chongqing, Guizhou, Yunnna, Hunan and Hubei, and has obtained some actual measurement data, and have some knowledge on mountain area ice.

1.1 Ice magnitude of transmission line of YaKou and wind-gap

1) Ice magnitude of transmission line of Erlang Mountain YaKou

Erlang Mountain belongs to Qionglai~Jiajin mountains, cloud and fog filled its eastern slope full year, the carrying water vapor almost lost while the monsoon cross the western ridge. The ratio of ice coating thickness of transmission lines of Erlang Mountain pass to other terrains was showed as table1-1:

TABLE 1-1 THE RATIO OF COATING THICKNESS

Place name	Altitude（m）	Standard ice thickness ratio
Erlang mountain pass	2987	1.0
Other terrains	2700－2850	0.3－0.56

2) Ice magnitude of transmission line of Liang Mountain Tianxiliangzi wind-gap

Liang Mountain is the dividing line of eastern wet and western dry subtropical climate in china. The mountain ranges are mostly south-north, the Tianxiliangzi wind-gap located in the main vein of Huangmaoba, it is the important dividing line of liang mountain geography climate. The ratio of ice thickness of transmission lines of Tianxiliangzi wind-gap and other terrains was showed as table1-2:

TABLE 1-2 THE RATIO OF COATING THICKNESS

Place name	Altitude（m）	Standard ice thickness ratio
Tianxiliangzi wind-gap	3000	1.0
Other terrains	2900－3000	0.43－0.78

1.2 Ice magnitude of transmission line of the hilltop and mountain ridge

Xuefeng Mountain located in the west of Hunan, it is the southern transition zone of the second ladder in China, it is the natural dividing mountain of eastern hills, plain and western mountain. The ratio of ice thickness of transmission lines of Xuefeng Mountain hilltop, mountain ridge and other terrains was showed as table1-3:

TABLE 1-3 THE RATIO OF COATING THICKNESS

Place name	Altitude m）	Standard ice thickness ratio
Xuefeng Mountain hilltop	1500	1.5
Xuefeng Mountain ridge	1350	1.0
Other terrains	1000～1350	0.6～0.75

1.3 Ice magnitude of transmission line of windward and leeward

The ice of transmission line of windward and leeward at the same altitude was statistical analyzed respectively in Niba mountain, Dalou mountain, Daliang mountain and Xuefeng mountain, it’s standard ice thickness ration of windward and leeward is 1:0.4~0.9.

1.4 Ice magnitude of transmission line of the downwind area of lake and reservoir

The ice of transmission line have close relationship with water body, Liangwang mountain located in the

south-east of Kunming, its altitude is 2700m, and two facing lake, have enough water vapor, the water vapor rise and form cloud on the hilltop in winter every year, then the ice formed. Observation data of 3 years show that the ice is little when the distance is about 2500-2700m, the ice magnitude is less than 5mm. But the standard ice thickness of transmission line of Liang Mountain Zhuyuan ice measurement station reach to 12mm.

2 THE APPLICATION OF ICE AREA DIVIDING

Ertan-Zigong I back 500kV transmission line is the first line which has large capacity, high altitude, and across the heavy ice area, it across Daliang Mountain about 200km, the line section in Daliang Mountain have not encountered any accident which coursed by ice.

SWEPDI have built large glaze rack, surface meteorological observation field, and 500kV 3-basic 2-gear uncharged analog circuit in Huangmaogeng which is the climate dividing mountain of main vein of Daliang Mountain, the second line corridor program is supposed to be built on this place, SWEPDI also collected the high altitude data of ice, then built micro-terrain and micro-climate observation station for ice and glaze in the different climate area of 200km around Dalinag Mountain area, filled the gaps of mountain ice and meteorological data, the result fully reflect the influence which micro-terrain and micro-climate have on the ice of transmission line. From the running condition and the feedback information, the line ice area dividing is correct. The engineering ice area dividing is shown as figure 2-1:

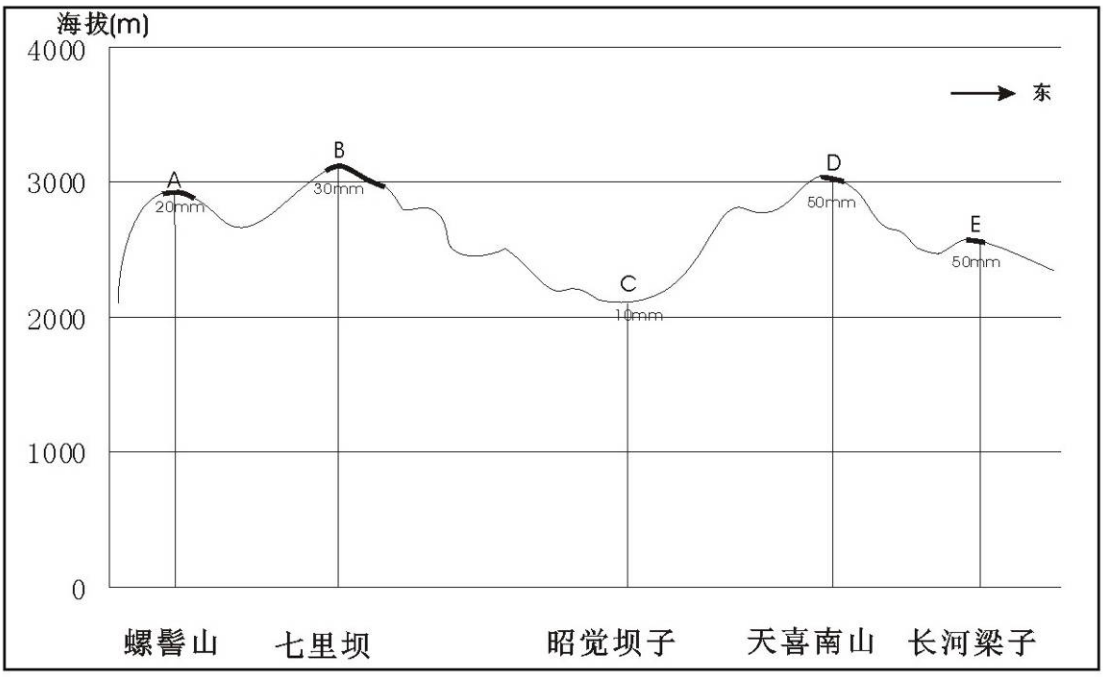

Figure 2-1 The engineering ice area dividing

A, B, D is the top point of Liang Mountain's three south-north mountains which from west to east. Its eastern is windward, and its western is leeward. E(Changheliangzi) is the first prominent ridge in first ladder, the altitude is lower relatively, it belongs to YaKou terrain, the transmission line ice is very heavy, the designed ice coating thickness is 50mm; D (Tianxinan Mountain) is the dividing mountain of Liang Mountain climate, it belongs to wind-gap terrain, it is the first barrier which block the leading wind direction of ice in winter, the transmission line ice is very heavy, the designed ice coating thickness is 50mm; B is peak of the middle mountains ,but the water vapor is not abundant, the transmission line ice is heavy, the designed ice coating thickness is 30mm; A is the peak of western mountains, it is blocked by B and D in the east, the

transmission line ice is smaller relatively, the designed ice coating thickness is 20mm; E is Zhaojuebazi, it belongs to mountain basin, blocked by the terrain, the wind speed is slow in icing period, the designed ice coating thickness is 10mm.

3 CONCLUSION

3.1 Transmission line ice have a significant impact on the construction investment of transmission line and running reliably. The micro-climate characteristic was discussed, and the micro-terrain and micro-climate area influence on transmission line was proposed in this paper according to the SWEPDI observing data of ice observing station and site survey data. The difference of transmission line ice on different terrain condition was also analyzed in this paper.

3.2 The transmission line ice distribution is influenced by the meteorological factors heavily, especially by the micro-terrain and micro-climate, the changes of ice in the space is very difficult. To realize and hold the transmission line ice distribution in mountain areas, detailed field reconnaissance and survey on the terrain and climate structure was needed. Be watchful to distinguish micro-terrain heavy and light ice area, and design the ice coating thickness reasonably and reliably.

3.3 The transmission line which go across micro-terrain and micro-climate condition, such as YaKou, wind-gap, mountain ridge and col, the ice magnitude should be considered larger; when the transmission line go across windward and leeward, the ice magnitude should be increased or decreased which according to the leading wind of this area; when the transmission line go across large region of water, the ice magnitude should be considered larger properly.