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Determination and Collection of Technical Data Iceling of High Voltage Electric Transmission Lines

(On the example of the air line Bessopan-Gornyy (LBG)-220 kV)

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ABSTRACT: The problem of de-icing wire power lines is quite acute around the world, especially in regions with high humidity and low temperatures, as high humidity, winds, sudden changes in air temperature contribute to intensive ice formation on the wires of overhead lines with the corresponding undesirable consequences in the form of cliffs wires, cables, destruction of reinforcement, insulators and even supports of overhead lines.

KEYWORDS: overhead power lines; icing and frost deposits; anti-icing wires; stationary system of melting ice.

I. INTRODUCTION

Currently, for transmission of energy over long distances, due to the relatively low cost, overhead electro energy transmission lines (ETL) are widely used. One of the main elements of power lines are wires. When operating overhead power lines there is a problem of icing wires. A significant number of overhead power lines in the Zarafshan region are exposed in the winter season and in the autumn-winter and spring-winter seasons sticking of wet snow to the wires and the formation of icy frost deposits. Sudden changes in air temperature contribute to the formation of ice on the wires of overhead lines [1]. The high-voltage line Bessopan-Gornyy is located north-east from the city of Zarafshan. The total length of the line is 43,5 km. 10.5 kilometers of this air 220 kilovolt line passes through the mountain ranges of Muruntau. Therefore, this line is subject to sticking of wet snow to the wires and to the formation of icy frost deposits in the winter season and in the autumn-winter and spring-winter seasons. Sudden changes in air temperature contribute to the formation of ice on the wires. Ice deposits on wires and cables of high-voltage lines occur when the air temperature is about -5 ° C and wind speed is 5 ... 10 m / s. The presence of ice causes additional mechanical loads on all elements of overhead lines.

As a result of a significant increase in mass (7-9 t/km) of wires and the dynamic and static loads acting on them, dangerous and undesirable phenomena occur, especially in strong winds. These include the breakage of conductive wires and ground wire under the weight of snow and ice, the close proximity of the wires and their strong swinging (the so-called “dance”), the deterioration of the protective properties of insulators, the destruction of supports.

Such accidents bring significant economic damage, it takes several days to eliminate them, and huge amounts of money are spent. As a result, grid companies and consumers incur large losses, and the restoration of dangling wires is a costly and laborious process.

II.MAIN PART

The total length of the high-voltage line is 43,5 km. The ice line is 10.5 km. The line LBG 220 kV uses wire brand AC 300/39 is an uninsulated steel-aluminum wire, the core of which is made of steel wires, and the remainder is made of aluminum wires (A-conductor is aluminum, C-core is steel, 300 is transverse section of the aluminum part of the wire, mm^2, 39-section steel core, mm^2). In the manufacture of used stainless steel and aluminum. The main and only purpose of the wire AC 300/39 is a suspension on high voltage lines.

The main technical characteristics and design features of the AC 300/39 wire are given in Table 1.1., And the wire structure is shown in Figure 1.1.

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Table 1.1.
Main technical characteristics and design features of the wire AC 300/39

№	The name of characteristics	Unit.	Value
1.	Operating temperature range	^{0}C	from -60 to +90
2.	Estimated Wire Weight	kg/km	1132
3.	Weight of one meter of wire	kg/m	0,952
4.	Outside diameter	mm	24
5.	Allowable current	A	610
6.	The sectional area of the aluminum part	mm^2	261
7.	Sectional area of the steel part	mm^2	39
8.	Electric resistance of 1 km DC wire	Om	0,0283
9.	Service life, not less	year	45
10.	Single steel wire diameter	mm	2,65
11.	The number of steel wires in the wire	Pieces	7
12.	The number of povivov steel wires	Pieces	1
13.	Diameter of one aluminum wire	mm	4
14.	The amount of aluminum wires in the wire	Pieces	26
15.	The number of povivov aluminum wires	Pieces	2

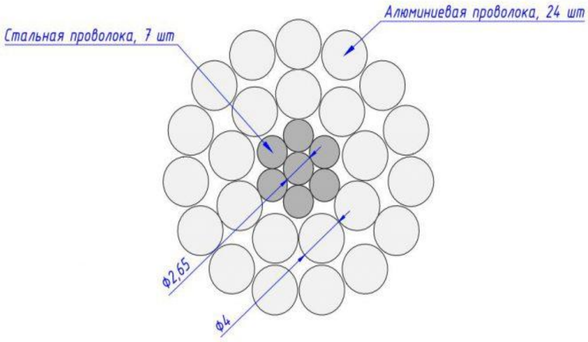

Figure 1.1 - Wire Structure 300/39.

Let us consider the periods of the most probable occurrence of ice on wires of power transmission lines on the example of the 220 kV Bessopan-Gornyy line. This site is characterized by a moderately windy climate, and changeable cool winters. The winter is moderately frosty, with frequent thaws, accompanied by rains (especially in December) and quite often with low temperatures lasting a week or more. In the process of studying the line LBG 220 kV, the following parameters were identified: current in lines 690 A; 220 kV voltage (single linear diagram of 220 kV LBG line is shown in Fig. 1.2); active power 43 MW; reactive power of 9 MVAR; installed line capacity of 40 MW; line frequency 50 Hz; number of supports 36 pcs; the distances between the supports of 270-325 meters, as well as the temperature, wind speed and air humidity of section №1 were measured. In table 1.2. The data of these parameters are given.

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III.RESULTS AND DISCUSSIONS

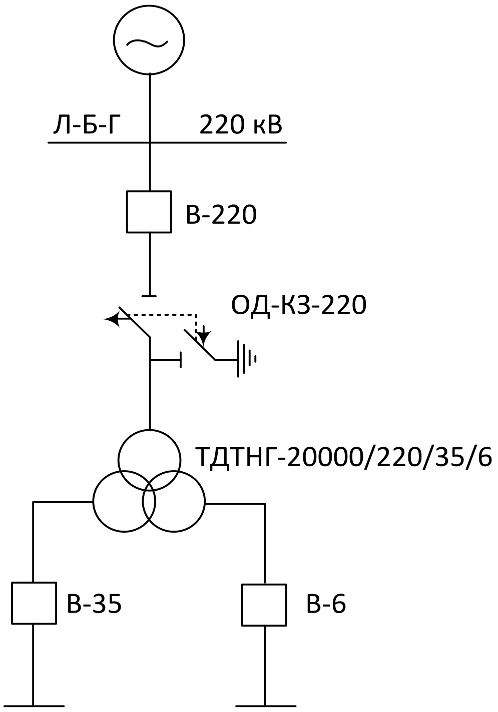

Fig. 1.2-single-line power supply LBG 220 kV.

Parameters of plot number 1 (LZB 220 kV)

Table 1.2

№	Time hour	Temperature °C	Wind speed м/с	*Air humidity %*
		31.12.2018		
1	01-00	-3	10,8	76
2	04-00	-4	11,9	75
3	07-00	-5	12,3	77
4	10-00	-4	11,6	76
5	13-00	-4	11,4	75
6	16-00	-3	12,1	76
7	19-00	-5	13,1	78
8	22-00	-6	11,3	77
		01.01.2019		
1	01-00	-3	12,2	78
2	04-00	-5	11,6	75
3	07-00	-4	12,2	76
4	10-00	-5	12	75
5	13-00	-5	11,5	75
6	16-00	-4	12	76
7	19-00	-3	12,2	75
8	22-00	-4	11,6	78

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02.01.2019				
1	01-00	-5	12,3	79
2	04-00	-4	13	77
3	07-00	-5	11,4	78
4	10-00	-6	11,6	79
5	13-00	-7	11,6	79
6	16-00	-3	12,7	80
7	19-00	-4	13	75
8	22-00	-5	12,4	81
03.01.2019				
1	01-00	-6	11,4	77
2	04-00	-7	12,3	74
3	07-00	-7	11,5	79
4	10-00	-2	11,6	76
5	13-00	-3	12,6	79
6	16-00	-5	13,1	76
7	19-00	-4	11,9	76
8	22-00	-5	12,8	79

Using table 1.2. let us build graphs of temperature, wind speed and air humidity over time for plot No. 1. (Fig. 1.3, 1.4 and 1.5)

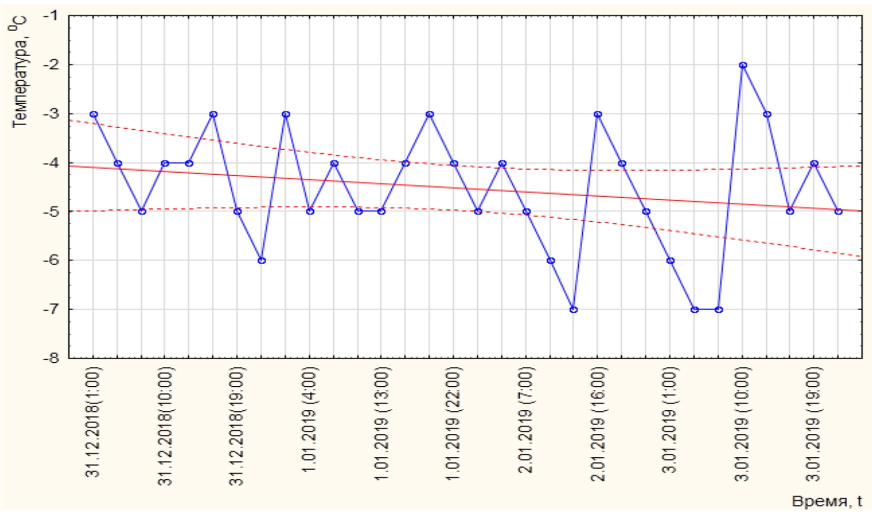

Fig. 1.3 - Temperature versus time.

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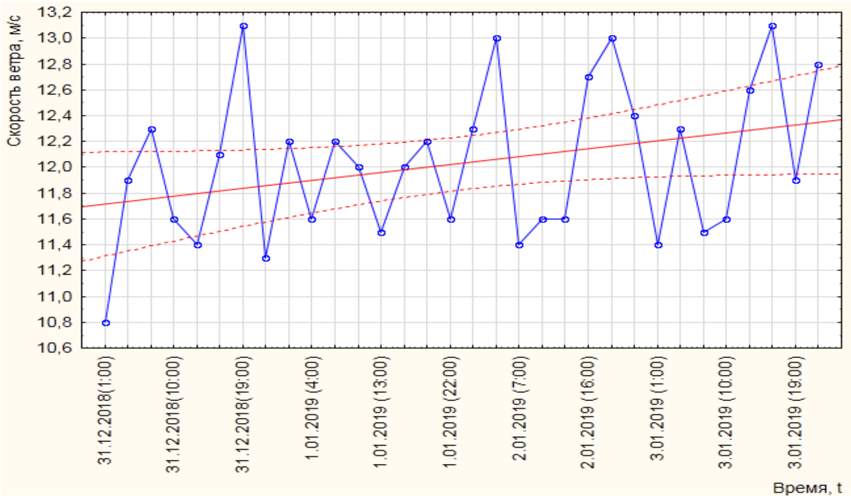

Fig. 1.4 - Dependence of wind speed on time

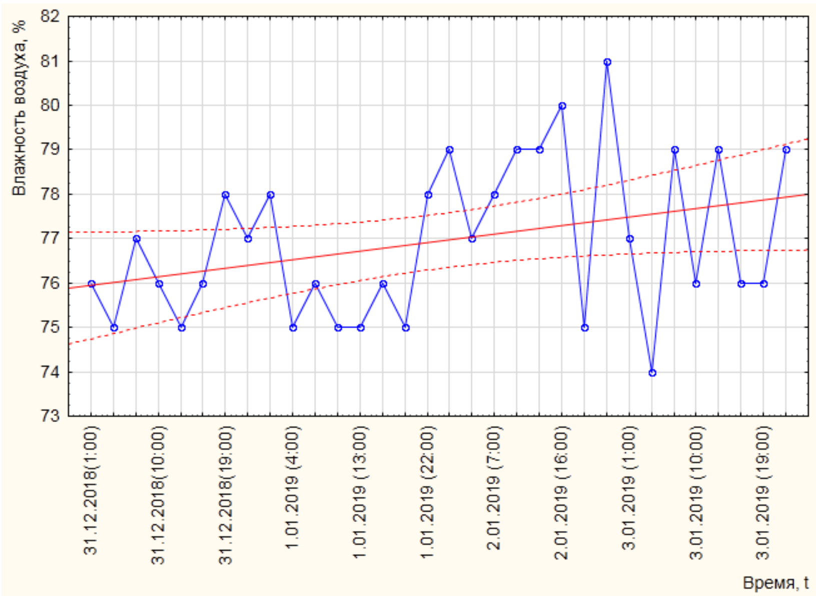

Fig. 1.5 - Dependence of air humidity on time

Wind is the flow of air mass due to changes in pressure and intensity of sunlight. Typically, wind energy is determined by the influence of a specific area perpendicular to the wind.

$$N_{wind}=0,0049*g*V*F; \quad (1.1)$$

where g is the air density (relative to temperature and atmospheric pressure), (kg/m^2); V- air velocity (m/s); F is the surface area.

From December 31, 2018 to January 4, 2019, technological violations in the work of the **LBG** 220 kV occurred due to the impact of ice and wind. Ice sleeves with a diameter of up to 180 mm grew on the wires, which was 20-30 times higher than the normal weight of the wire. The icing of the wires occurred at -4 ° C, the average wind speed was 10.9 m /s, and the humidity 73,9 %.

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IV CONCLUSION

Violations in the operation of overhead lines caused by intense ice and ice-wind loads are the most severe in their consequences. When this occurs, the destruction of supports, wires, cables, chains of insulators, fittings, in severe cases, many damaged lines over a large area. To recover requires considerable time, capital investment, material resources and labor costs, often there is great damage from an emergency undersupply of electricity in the sectors of the national economy and the household sector. Manifestations of ice phenomena and the conditions for their occurrence are very diverse, therefore, to prevent ice accidents, it is necessary to use all possible means. There is no universal method of dealing with icing.

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