

**B2 OVERHEAD LINES
PS 3: ENVIRONMENTAL AND SAFETY ASPECTS OHL
(JOINT PS WITH C3)**

Experience use of bird protection devices on power lines and environmental impacts

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SUMMARY

Around the world, the availability of electricity has become part of the standard of living. The transport of electricity from power plants to end users is mainly through overhead transmission lines. Worldwide population growth is resulting in the spread of habitation even in some of the most remote areas. The majority of overhead transmission lines constructed to date can pose increased risks for birds, significantly affecting their habitats, namely, in their breeding, staging and wintering areas.

The idea have to be equipped equipment with special devices to provide bird protection known for a long time, but the lines of Federal Grid Company of Unified Energy System (PJSC FGC UES) have used a point wise today.

According to statistics, disconnections of power lines for reasons related to the bird streamers are the fourth most important factor of outages in electric networks. This problem is two-sided: on the one hand, the electric power industry suffers, and on the other – there are irreversible changes in the environment and harm to the environment as a whole.

The article proposes is to solve this problem by equipping the power transmission line with bird protection devices in order to increase the reliability of power supply to consumers and reduce the percentage of bird deaths from electric shock and nesting on the traverses of supports, forcing them to look for familiar nesting sites, such as clearings and forest belts.

KEYWORDS

Bird protection, bird protection device, oriental white storks, electric network, environmental safety

1. INTRODUCTION

The idea of equipping the equipment of power transmission lines with bird protection devices has been known for a long time, but until now it has been used pointwise on the power lines of PJSC FGC UES (PJSC FGC UES). According to statistics, disconnections of power lines for reasons related to the bird streamers are the fourth most important factor outages in electrical networks. This problem is of a two-sided nature: on the one hand, the electric power industry is suffering, and on the other, irreversible changes in the environment are taking place and harming the environment as a whole.

The novelty of this project is to solve problem by power transmission line equipping with bird protection devices in order to increase the reliability of power supply to consumers and reduce the percentage of bird deaths from electric shock and nesting on the traverse of supports, forcing them to look for familiar nesting sites, such as clearings and forest belts.

2. CONCEPT OF “BIRD PROTECTION”

The concept of "bird protection device" is legislatively fixed in the Decree of the Government of the Russian Federation No. 997 dated 13.08.1996 "On approval of requirements for preventing the death of wildlife objects during production processes, as well as during the operation of highways, pipelines, communication lines and power transmission". This concept allows you to avoid mistakes when choosing the right products among a variety of protective devices that have different, often mutually exclusive, target and functional characteristics.

Bird protection devices (hereinafter referred to as bird protection devices) are designs for operation at ambient temperatures from minus 60 ° C to +50 ° C, at an altitude of up to 1000 meters above sea level, in areas with I-IV degree of pollution according to GOST 9920 (IEC 815-86, 694-80), in areas with wind and ice from the first to the special inclusive. Climatic design and placement category UHL according to GOST 15150 (IEC 721-2-1:1982, 68-1:1988).

Despite the fact that the first domestic bird protection devices appeared only in 2007, today they were already installed in almost every subject of the Russian Federation. Outages have increasingly begun to occur on overhead power lines, caused by birds and their waste products. This problem is two-sided: on the one hand, the electric power industry is suffering, and on the other, irreversible changes are taking place in the avifauna and the ecosystem as a whole.

In the course of their life, birds use power lines for various purposes: for example, birds of prey use supports as additives for tracking prey; high metal poles of power lines even become a nesting place for some bird species. The death of birds on a power line can occur from electric shock during direct simultaneous contact with the grounded part of the support and the live wire, from a collision of a bird with a high voltage power line, or from a bird falling due to an electric shock.

The most dangerous overhead lines for birds are traverses overhead line supports 35-220 kV including at the attachment points the supporting garlands insulators. Their design is such that the metal traverse on which the insulators are fixed welded to the armature inside the support and grounded. A bird sitting on the traverse flaps its wings and, hitting an uninsulated live wire with them, dies. The worst option would be the

fall of a dead bird between the wire and the traverse: in this case, the dead animal will create a stable short circuit.

Of course, power lines are most dangerous for large birds: falcons, monitor lizards, hawks, etc., but smaller birds can also die on the lines, for example in rainy weather, and they sit on the wire in a dense group.

Power lines with a voltage of 35 kV and higher are less dangerous for birds, and they often arrange nesting there. Such a neighborhood is unfavorable for the lines: waste from the vital activity of birds, accumulating on insulators, can lead to insulation overlap even at operating voltage.

Due to the fact that non-compliance with environmental legislation regarding the arrangement of power lines of the bird protection devices creates a risk of harm to the environment in the future, which by virtue of Article 1065 of the Civil Code of the Russian Federation and Article 80 of the Federal Law "On Environmental Protection" is the basis for suspending the relevant activities in court.

3. RULE ANALYSIS OF THE OUTAGES

According to the statistical analysis, the transmission lines outages caused by birds have the following characteristics:

3.1. Environment around the towers

The poles and towers where the outages occurs are mostly located in areas with wider vision, nearby water sources or rivers, abundant vegetation and food, relatively few human and high elevation. Such areas are conducive to birds' foraging, habitation and reproduction activities.

3.2. Type of towers and insulators

The probability that outage occur in straight towers is higher, the probability that outages occur in type I or II strings is higher, and that of V strings and tension strings is less. However, there have been several bird droppings flashover at jumpers recently, which is related to the lack of bird protection devices on jumpers. The outages has little to do with insulator material, and the probability of outages on porcelain, glass and composite insulators is basically the same; it has little to do with the type of sheds of insulator, and the probability of bird damage on large and small shed, double sheds and triple sheds insulators is basically the same.

3.3. Flashover and burns characteristics of the outages

The outages caused by birds generally belong to instantaneous outages with high probability of successfully reclosing. After the outages happen, there are usually obvious burn points on the grading rings and the wires. And there may be burns on the insulator strings, but they will not be distributed on each piece evenly. The flashover obviously whitens the composite insulator; and the down conductor with loose contact has obvious damage points in the contact area between grounding bolt and tower.

4. WHAT WAS DONE IN FEDERAL GRID COMPANY

In the Russian Federation, bird protection devices were used to protect power lines, which are distinguished by the following types of Bird protection devices:

- anti-landing type - devices that prevent birds from landing on overhead line elements and substation equipment;
- roost type - devices that create conditions for the safe landing of birds;

- nest-forming type - devices that create alternative safe sites for the construction of nests;
- barrier type - devices that protect the garlands of insulators, as well as other elements of overhead lines and PS equipment from contamination by bird waste products and prevent birds from being electrocuted through a stream of droppings, as well as preventing the penetration of birds and other objects of the animal world into electrical installations;
- combined - devices that combine various types of bird protection devices protection functions.

The calculation of the economic efficiency of the bird protection devices is carried out. In general, there are the following techniques:

- The methodology for calculating the amount of damage caused to objects of the animal world listed in the Red Book of the Russian Federation, as well as other objects of the animal world that are not related to hunting and fishing objects and their habitat, approved by Order of the Russia;
- The methodology for calculating the amount of damage caused to hunting resources was approved by the Order of the Ministry of Natural Resources of the Russian Federation No. 948 dated 08.12.2011;
- The methodology for calculating the effectiveness of bird protection devices is contained in the "Methodological recommendations for the organization and conduct of measures to prevent the death of birds of prey on 6-35 kV power lines" developed by the Research Institute for Nature Conservation and Conservation (was used in the calculations of the effectiveness of the use of bird protection devices).

Pic 1. Contact type of bird protection device



There are standards for ordinary cost species from the order Passeriformes - Ordo Passeriformes range from 1.0 to 10.0 thousand rubles, for each destroyed individual, then with respect to species listed in the Red Book of the Russian Federation, the standards are much higher and amount:

Table 2 - Cost species

Birds	Amount, rubles
Barrow	25 000
Burial eagle	100 000
Golden eagle	300 000
Saker falcon and peregrine falcon	600 000
Gyr Falcon	1 100 000

According to the above methodology, when choosing working sections of power lines for testing, preference should be given to those located in areas with comparable numbers and density of live birds in similar seasons of the year. For such a choice, preliminary research work on the accounting of live birds in different seasons is necessary. The length of each of the compared sections of the transmission line should be at least 5 km, and if they consist of several segments, then the length of each should be at least 2-3 km. The minimum test period of the bird protection devices should be recognized as an annual cycle covering the spring and autumn periods of bird migrations and the entire nesting period.

Evidently, indicators of the degree of reduction in the frequency of bird deaths and the magnitude of the prevented damage caused to wildlife as result of the operation of a bird-hazardous power line can be used as the basis for the ecological and economic assessment of the effectiveness of environmental protection measures using bird protection device. For the convenience of the assessment, it were recommended to distribute the species of power lines-vulnerable birds by tax groups.

The calculation of the amount of damage caused to the animal world of one tax group and the state, as its owner, is carried out according to the formula:

$V = N \times HC$, where:

V – the amount of damage caused to objects of the animal world, rub.;

N – the number of individuals (specimens) of one tax group destroyed during the operation of power lines;

HC - the standard value of the animal world object of this tax group of power lines-vulnerable birds, rubles/copy.

The presence of individuals of rare "red book" species in the risk groups automatically gives these territories (zones of high and increased bird deaths on power lines) the legal status of "emergency" response territories, and bird protection measures with the use of bird protection devices rank the highest ecological and economic efficiency ("profitability").

The Federal Grid Company in 2017, in cooperation with the WWF Russia, a joint pilot project «Monitoring the effectiveness of measures implemented by the MES East

branch to prevent death of Oriental white storks on power transmission lines» was launched. According to the results of the above monitoring, the effectiveness was noted of the efforts of the MES East branch aimed at protecting Oriental white storks, and the necessity to implement the following measures with the involvement of the Russian Birds Conservation Union was determined:

- to assess the effectiveness of bird protection measures to prevent outages of transmission lines caused by birds;
- to erect nesting platforms taking into account the bird population growth;
- to equip power transmission lines with bird protection devices taking into account the recommendations of specialists on their types and installation methods.

Measures that are implemented annually by Federal Grid Company to prevent bird death and bird-caused outages at electric grids include the following:

- erecting nesting platforms and equipping transmission lines with bird protection devices of various types and designs in mass nesting places;
- installation of electronic bird repellent devices in the territories of substations;
- OHL inspections at the beginning of bird nesting with fixation of their habitats.

The Federal Grid Company, WWF Russia and NGO AmurSEU organized a photo expedition to the electric grid objects of Amurskaya province where the Oriental storks used to build nests (pic.2).

WWF and the Amur Coalition of environmental NGOs was declared 2018 - the Year of the Oriental stork. According to the expert estimates the world population of this bird species comes at about 4 000 individuals. WWF Russia considers that since the beginning of 2000 the numbers of the Oriental stork in Amurskaya province have doubled, among other things thanks to the protection measures on the objects of electric grid infrastructure.

Large bird species such as Oriental stork are in a high risk group. The only possible solution for their protection is the mounting of anti-landing devices and safe platforms for nests. This equipment is mounted on 52 out of 59 main transmission lines within the Oriental stork home range. Members of the expedition visited the nesting sites on 220 kV transmission lines “Blagoveschenskaya-Varvarovka”. The storks build nests and bring out chicks on specially mounted safe platforms.

The activity of the Federal Grid Company can be considered as best practices to prevent the outages on the electric lines, and at the same time ensuring the extension of the Oriental stork range. These practices can be replicated for protection of other large bird species.

Cooperation experience between Rosseti FGC UES and WWF Russia on the conservation of the Far Eastern stork on power lines is a successful example of cooperation between business and public organizations in the conservation of biodiversity.

The professional activity of power engineers is directly related to the vital activity of birds, including the red-book Far Eastern stork. For the construction of nests, birds often choose power line supports. This phenomenon has become widespread in the last decade, when the population of the species began to grow. The lack of trees in the

main areas of their habitat, suitable for massive stork nests, forced the birds to build their "houses" on the poles of power lines.

Pic.2. Nest-forming type of bird protection device (Oriental storks)



Pic 3. Anti-landing devices on the electric power towers



According to statistics (the reasons for disconnections 35 kV and 110 kV overhead lines for the period 2019-2021 in Siberia and the Far East are analyzed), every fifth violation of the operating mode on Russian power transmission lines is associated with birds. The reasons that have the greatest impact on the number of overhead line failures have identified and the main ways to improve the reliability of overhead lines have proposed.

Table 2 – Analysis of 35 kV and 110 kV outages

Year	35 kV		110 kV	
	Total	Shutdowns due	Total	Shutdowns due to bird

	number of shutdowns	to bird exposure		number of shutdowns	exposure	
2019	2	1	50 %	41	17	41,5 %
2020	4	3	75 %	23	2	8,7 %
2021	3	2	66,6 %	3	3	100 %

Spring and autumn are the seasons with high incidence of bird related fault in Russia. The failure rate presents a "double hump" curve, of which the main peak is in March and April and the secondary peak is in September and October.

In 2020, 500, 220, 110 kV OHLs at the Federal Grid branches – MES East, MES Siberia, MES South, MES Centre and MES North-West were equipped with 10,739 bird protection and bird repellent devices designed to prevent and eliminate cases of bird destruction by electric shock and to reduce bird-caused outages at electric grid facilities. Costs amounted to RUB 13.26 million. The result: Over the past three years, only isolated cases have recorded of bird death on the Company transmission lines.

PJSC "FGC UES" pays special attention to ensuring the environmental safety of production activities, takes measures aimed at preserving wildlife, as well as preventing technological disruptions caused by exposure to animals. In 2021, in order to ensure environmental safety, a tender procedure was conducted for the supply of bird protection devices for the needs of branches of PJSC FGC UES-MES for the period 2021-2024.

In 2020, 7 771 bird protection devices were installed in company, which are designed to ensure the protection of birds during the operation of power transmission lines and the conservation of biodiversity. The bird protection devices prevent landing on poles, while they are safe and do not harm the life and health of birds.

The safety of the animal world near power facilities is provided using self-supporting insulated wires during construction, reconstruction of high-voltage lines, as well as connecting new customers.

The policy pursued by the Federal Grid Company has shown that the use of bird protection devices has a positive effect on the environmental component and increases the reliability of power supply to consumers and reduces the percentage of bird deaths from electric shock and nesting on the traverse of supports, forcing them to look for familiar nesting sites, such as clearings and forest belts.

5. CONCLUSION

Research shows that the probability of bird droppings flashover on transmission lines in the insulator-centered circle is significantly different. In the design of the size of the insulator bird protection shield, the opening angle of the bird thorn and the installation position of the spacer, it is necessary to ensure the full coverage of the high-incidence area and strive for the best bird repelling effect of bird protection devices.

Strengthen the basis of line operation and maintenance, improve the supervision and assessment mechanism, and train the basic skills of line safe operation. Eliminate some

employees' misconception that bird related outage is a natural disaster and bird damage can not be prevented.

Proposed methods of emergency response.

First, this is use of the anti-landing type bird-protection devices, which prevent birds from landing on overhead line supports and their contact with overhead line elements.

These devices on the overhead line traverse above the insulators attachment point and prevent the bird from landing on the traverse in their protection zone were installed. In addition, they have a deterrent effect due to fluctuations in the elements of the devices caused by the influence of wind. Insulators and wires have protected from bird contamination.

Secondly, use contact type bird protection devices (pic. 1) protect birds from direct contact with overhead line wires, and the surface of insulators and the adjacent part of the wire from contamination by birds.

At present, bird protection measures are changing with each passing day relevant units of operations and maintenance should timely track bird protection measures with good effect, simple operation and maintenance, and long service life.

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