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Intellectual approach to the effects of geomagnetic waves generated in solar flares on pumping stations high voltage transmission lines

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ABSTRACT: Effects of climate change on high-voltage power lines of pumping stations and an intelligent approach to assessing these effects. Long-term high retention and environmental impact in the spring-summer-autumn seasons. The negative impact of these factors on power transmission systems has been studied.

I. INTRODUCTION

High voltage transmission lines are subject to such basic requirements as reliability of its operation throughout the year under any climatic conditions, maintaining minimum values of electrical energy losses and ensuring their environmental safety. [1]. Recently, the influence of space weather on technological objects and systems has attracted increasing interest. The term "space weather" refers to a set of phenomena and processes occurring on the Sun, in near-Earth outer space, the magnetosphere, ionosphere and upper atmosphere of the Earth, affecting the functioning of technical means and systems [2]. The main impact of GIC on electric power systems (EPS) is the saturation of the magnetic system of power transformers, which leads to an increase in non-sinusoidal magnetization currents. An increase in the magnetizing current causes overheating of the transformer, as well as an increase in its consumption of reactive power and the appearance of higher harmonics in the network. The above factors lead to both a deterioration in the quality of electricity supplied to consumers and a negative impact on the equipment of the power system [3]. The power transformers included in the generator - transformer unit of the power plant are a key element providing high-quality power supply. Geoinduced currents are practically not transformed, since the system perceives them as direct current, and therefore the power transformers are magnetized. This causes additional heating of insulation, oil and windings of power transformers [4].

If geomagnetic-induced currents have such an effect on transformers, it should be assumed that their impact will also affect the equipment associated with them. GIT have a direct impact on the operation of generators of power plants. The nonlinear distortion of the harmonic composition leads to a decrease in the power of the generator, and the loss of reactive power leads to a decrease in voltage, and also causes overheating of the stator winding. In addition, the appearance of higher harmonics in the rotor current can lead to increased vibrations of the turbine shaft line [5].

In this paper, the mechanism of the appearance of geoinduced currents is considered, the analysis of approaches to the problem of the influence of geomagnetic-induced currents on electric power systems, the main methods of monitoring GIT is carried out. The coefficient of harmonic components is calculated as one of the indicators of the GIT. Based on the results of the work carried out, the need to continuously measure, monitor and take into account the impact of the parameters of the GIT on the power system was revealed. For the first time, a control system was proposed geoinduced currents, taking into account the impact of their impact on the equipment. As well as test methods for measuring harmonic components in the network. [6].

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II. LITERATURE SURVEY

One of the manifestations of the growth of solar activity is coronal mass ejections. The magnetic clouds associated with them can propagate against the background of a calm (background) solar wind with speeds up to 2000 km /s and have features of the impact of geomagnetic storms on the operation of the power system, a strong and orderly magnetic field of tens. If the ejection velocity exceeds the velocity of the main stream by the local speed of sound, then a shock wave is formed in front of it, in the transition region behind which the magnetic field is enhanced by compression. It is such formations that cause the most powerful storms [7].

Varying conditions in the solar wind manifest themselves on the Earth's surface in the form of irregular geomagnetic variations. Extreme geomagnetic variations indicate magnetic storms. The magnetic variations observed more frequently in polar latitudes are called subburies. Magnetic storms have much higher energy and are caused by solar wind of abnormally high speed. One of the generally accepted criteria for the onset of a storm is the presence of a southern compo- the intensity of the interplanetary magnetic field is more than for at least 3 hours. The increased external influence leads to the intensification of magnetospheric currents and to the spread of their influence deep into the magnetosphere, which manifests itself in an increase in sub-storm activity. Therefore, during storms, the auroral zone, into which the outer zones of the magnetosphere are projected, shifts to the equator (up to 40-50 0 magnetic latitude during very strong events), which leads to the spread of the auroral zone and auroral geomagnetic variations to moderate latitudes [7].

The science of physical processes on the surface of the Sun, the magneto-ionosphere is young and dynamically developing. The development of this science is associated with the emergence of new technical means of observing the cosmos and processing the received data. Undoubtedly, an important role was played by the factor of shifting priorities to peaceful space exploration, which allowed expanding the range of research conducted. The simultaneous development of the theoretical base and the increase of public awareness expands the map of GMB zones. At the same time, the principles of development and operation modern nuclear power plants are also undergoing significant changes: the complexity of architecture, the use of new equipment, etc.The occurrence of an accident caused by GMB is caused by a combination of technical and natural factors. [8].

III. SYSTEM ANALYSIS

This, in turn, requires the operating organization to conduct more frequent and high-quality tests of equipment, the development and implementation of advanced methods for diagnosing the condition of equipment under operating voltage directly under operating conditions. Important factors that reduce the reliability of the main and other high-voltage power transmission are the severe climatic conditions of our region: prolonged dry hot weather with intense solar radiation; pollution of isolation from industrial and field sources, especially if we consider that in Central Asia, as in the whole of Central Asia, there are vast territories with saline and semi-saline soils, as well as the presence of the Aral Sea and its environs with an abundant salt dust content.

Overhead lines (overhead lines) play an important role in the operation of the electrical system (ES) and reliable power supply to consumers [4]. Thus, the solution of the problem of calculating the geoelectric field is based on the method of complex images. The method of complex images for solving geophysical problems was adapted in [10]. It was shown in that the method of complex images can be used for the analysis of GMB in both high and medium and low latitudes [11].

It should be noted that solar activity, including the intensity of solar flares, has a cyclical character, on average with an 11-year periodicity (Fig._2). As can be seen from this figure, the activity of cycles varies. Not all cycles are the same -- some are intense, with lots of sunspots and explosive solar flares. So, if the activity index of the 19th cycle (1954 – 1964_y.) averaged 180, and individual bursts exceeded 230 units, then the index of the cycle following it (1965 – 1976_y.) averaged only 105 units, and the indices of maximum outbreaks did not exceed 120 units.

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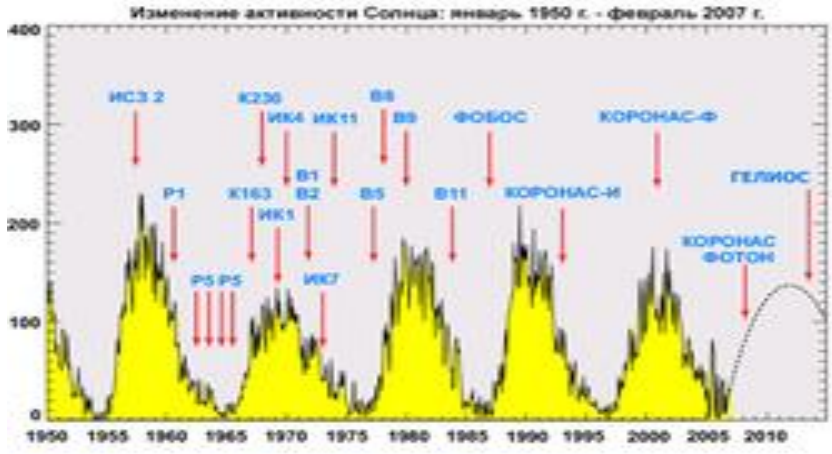

Fig. 1. Cyclical nature of solar flares since 1950

The previous (2009-2020_y.) 24th cycle was also passive. Firstly, he was double-humped, secondly, his average index did not exceed 117 units, and the maximum bursts did not reach 145 units [9].

As a result of the impact of these super-powerful solar flares and magnetic storms, as well as subsequent frequent impacts of magnetic storms with Cr = 5-6, especially the magnetic storms with Cr = 6-7 that became more frequent at the end of September 2017, as well as the beginning (up to 6-10) of October 2017 with frequent and prolonged Cr = 5 - 6, in the period from 27.09.2017 to 07.10.2017, 8 emergency shutdowns of 110 – 220 kV transformers occurred, including 3 of them with damage requiring repair. In one transformer (voltage 35 kV, power 4000 kV * A), a fire broke out and it completely burned down [9].

IV. CONCLUSION

New data on the occurrence of emergency outages of high-voltage power transmission in the event of solar flares and manit storms of varying intensity confirmed the previously revealed pattern of dependence of high-voltage power transmission exposure.

There are still many unexplained issues in the emergence and development of powerful and medium-sized solar flares, but bearing in mind the importance and high price of emergency high-voltage power lines and the damage to power transformers, it is necessary to pay special attention to this issue in the future.

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