**ЛОКАЛЬНЫЕ И ИНТЕГРАЛЬНЫЕ МЕТОДЫ КОНТРОЛЯ ГОЛОЛЁДА НА ЛИНИЯХ ЭЛЕКТРОПЕРЕДАЧ**

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**Аннотация.** Рассмотрены два наиболее эффективных метода контроля гололедных отложений на воздушных линиях электропередачи. Первый - локационный метод, суть которого заключается в подаче импульса в линию и определения времени, затраченного на его распространение в прямом и обратном направлении и амплитуды. Второй метод основан на контроле отдельных участков линий электропередачи, которые наиболее подвержены гололѐдообразованию.

**Ключевые слова:** гололедные отложения, локационный метод, автоматизированная система контроля гололедной нагрузки.

**LOCAL AND INTEGRAL CONTROL METHODS ICE ON POWER LINES**

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**Abstract.** The two most effective methods for controlling ice deposits on overhead power lines are considered. The first is the location method, the essence of which is to apply an impulse to the line and determine the time spent on its propagation in the forward and reverse directions and amplitude. The second method is based on monitoring individual sections of power lines that are most susceptible to ice formation.

**Keywords:** ice deposits, location method, automated ice load control system.

Ice deposits on power lines are a serious problem affecting the reliability of the electrical power industry. The ice formed on the wires exerts additional

mechanical stress and can cause severe accidents associated with short circuits, breaks in wires and cables, and even breakage of traverses and supports, which also poses a danger to human life [1]. Timely detection of ice and monitoring its changes allows to take the necessary measures to eliminate these deposits.

There are various methods for detecting ice on overhead power lines; we will consider the two most effective methods that currently exist.

The first method is a location method for detecting ice deposits on overhead power line wires [1,2], the operating principle of which is to supply a pulse signal to the power lines path of an overhead power line, and determine the total time spent on its propagation along the wire in the forward and reverse directions. after reflection from the end of the line. The location method allows you to determine the presence of ice on wires and their quantity by comparing the signal propagation time and the amplitude of the reflected signals in the presence or absence of ice. The attenuation of the location signal is caused by dielectric losses of the energy of the electromagnetic wave, which goes to heat the layer of ice on the wires.

The advantages include the ease of implementation of this method, all equipment can be located at the substation, there is no need to make any changes to the design of overhead lines on which power lines paths are equipped for process communication, relay protection and automation, and there is no need to extend communication lines and install additional devices for overhead lines. One location complex can probe up to 16 power lines extending from the substation. In addition, the location system allows you to determine the location of damage on the line.

The disadvantage of this method is the integral determination of ice deposition along the entire sounded line, and ice may form differently in different sections of the line. This disadvantage can be overcome by dividing the line into location sections using the existing wave inhomogeneities of the line [1,3].

The second method is based on local control of ice load - automated ice

load control systems [4]. The operating principle of such a system is to constantly monitor the ice load of one span of overhead power lines using various types of sensors. Control points (PC) are installed on power transmission line supports and include ice load sensors on overhead line wires (strain gauges), temperature sensors for overhead line wires, PC cabinet opening sensors, weather stations that include temperature and humidity sensors, wind direction and speed sensors, etc. The PC is powered using solar panels installed on overhead power lines. The reception point is located on the premises of the system operator. Communication between two points is carried out via

communication channels: radio channels, a cellular communication channel (GSM), a fiber-optic communication channel, telemechanics channels.

The advantage of such systems is the accurate determination of dangerous ice mass on a specific span of overhead lines.

The disadvantage of such systems is their locality, because the condition of the wire is determined only in the spans adjacent to the support on which the device is installed. To increase the reliability of control, it is necessary to increase the number of such devices, which increases costs.

Based on the above, we can conclude that it is necessary to simultaneously use local and integral methods for detecting ice deposits, which will allow timely and accurate assessment of the condition of power lines, and take measures to remove ice when the load on the wires approaches critical, thereby increasing the reliability of overhead power lines. At the same time, the location method informs about the early appearance of ice, shows the thickness of ice along the entire length of the power line or its section, thereby allowing one to estimate the mechanical load on the wires, and the automated system controls several spans and provides information about the local ice load, wind load, wire temperature. In particular, the wind load at certain wind speeds and directions can be greater than the ice load [5], then even thin ice deposits can create critical loads on power transmission line wires.

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