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Book of Abstracts

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19. Thermal compensation of wire sag for power lines up to 110 kV.

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Introduction. Compensation of wire sag on overhead power line wires allows to optimize construction of power lines.

Materialsandmethods. Graphtheory,principlesoftheoryofautomaticregulation, physical and mathematical process modeling.

Resultsofdiscussion. Increasing the length of the power lines or reducing the height of the towers while maintaining the existing estimated spans can significantly reduce the cost of building materials, linear fittings, isolation during the construction of power lines. Such devices by the authors were called thermal compensators of power line arcs of sagging. The active thermal compensation of the sag can be achieved with the help of force elements, which are fastened to the wire and act on it. Making devices with negative temperature extensions for a certain temperature range became possible after the discovery of the unique property of some alloys "to memorize the shape".Most vividly this property is manifested in the alloy of nickel with titanium - nitinol. The alloy is heated to change its structure to a high-temperature modification and in this state it is given a certain shape. Then the alloy smoothed out below the critical temperature and passed to another, low temperature phase. This process resembles thermoelastic transformation.

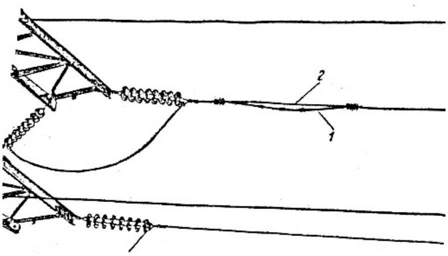

Fig.1. Thermal compensator installed on power line with voltage class 110 kV. Here 1 – thermal compensator, 2 – power line wire.

With increase of air temperature, the length of a wire increases. When the ambient temperature reaches the temperature of the start of the reverse martensitic transformation of the thermal compensator, it begins to change its length and pull the wire. Lowering the temperature to the point of direct martensitic transformation causes deformation of the thermal compensator. The tension along the wire in the temperature range from the beginning of the direct martensitic transformation to its end is changing. With a further decrease in temperature, the thermal compensator does not participate in the work of the wire, and the tension varies according to the natural characteristic. The main requirement for the work of the thermal compensator with the shape memory effect (SME): the length of the section of the wire, parallel to which the thermal compensator attaches, shall be equal to the length of the thermal compensator in the unloaded state, increased by the magnitude of the maximum permissible deformation of the compensator in the plane parallel to the wire, and the magnitude of the maximum possible deformation of the thermal compensator must be equal to the absolute elongation of the wire in the given temperature range.

Conclusion.The results of these studies can be applied for power lines up to 110 kV. It can be implemented on power lines with any type of towers.