Variable Resistance Conductors for Deicing Aerial Transmission Power Lines

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Normal operation of a power transmission or distribution line entails Joule heating of the conductor as current flows through it. Lines are normally designed to have a constant, low resistance, so as to avoid excessive power losses and avoid excessive operating temperatures. Because the normal heating is low (by design), it is of limited value in preventing or recovering from an icing event. A recently-invented a variable resistance conductor (VRC) power line [1,2] can switch its electrical resistance from a very low value, to transmit electric energy, to a much higher value, for de-icing. The switching between two conductor resistances does not disturb the main conductor function, which is to provide a customer with uninterrupted electric power.

A variable-resistance conductor (VRC) is built of N strands (or groups of strands) insulated from each other, where N is any odd integer greater than one. For instance, N = 3, 5 or 7, etc. In normal energy-transmission operations all the conductor strands (or strand groups) are connected in parallel, whereas in de-icing mode they all are connected in series. Switching from parallel to series connection increases the line resistance by a large factor of N2, making the resistance sufficiently high for heating the line above the ice melting point. One important advantage of the method is that it uses low-voltage and, thus, low-cost switches.

While the above references have introduced the VRC method and briefly described its components, the presented paper focuses on in-depth analysis of elements needed to design a practical cost- and energy-efficient VRC line 窠pecifically, detailed heat-transfer analysis; changes in the line inductance, capacitance and ampacity caused by the switching to the deicing mode; and changes in the conductor weight and wind load that occur when conventional conductors are replaced with VRC conductors. Operational algorithms for deicing and anti-icing modes are also discussed.

1. Victor F. Petrenko and Charles R. Sullivan, System and Method for Deicing of Power Line Cables, US Patent application, Publication No. 12/193,650, Priority date 04/02/2008.

2. Victor F. Petrenko, Charles R. Sullivan , Valeri Kozlyuk, Variable-resistance conductors (VRC) for power-line de-icing, J. of Cold Region Science and Technology, In Press, Corrected Proof, Available online 25 June 2010, ISSN 0165-232X, DOI: 10.1016/j.coldregions.2010.06.003.