Study Committee B2

Overhead Lines

10853_2022

Use of Anti Torsional Pendulums and Interphase Spacers for Reduction of Ice Accumulation and Prevention of Breakdowns Loads in 154 kV & 400 kV Lines

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Protection Methods Against Icing in Energy Transmission Lines

Operative and design systems for anti-icing and de-icing.

In general, anti-icing (AI) and de-icing (DI) techniques belongs to one of the following four categories:

- Passive methods based on natural forces or physical geometry
- Active coatings and devices
- Mechanical methods based on breaking down the ice
- Thermal methods based on ice melting.

Method/Approach

Applications in Turkey

In the case of single circuit towers, anti-torsional pendulums installation was performed for both phase conductors and earth-wires. However, in cases where heavy wind loads are detected on these lines, IPS were applied on the phase conductor too. Double-circuit lines were protected with anti-torsional pendulums and IPS.

The influence of the additional static weight on the conductor sagging was verified upfront. Re-adjustments of the conductor sag were necessary in long spans.

Objects of investigation

- There is no common application for IPS and pendulum devices
- It adds additional static loads to the towers
- It causes imbalances in sag and tension forces in lines
- It is an additional source of failure for conductors and towers

Conclusion

In Turkey around 4000 IPS and 20.000 anti torsional pendulums have been installed in the years 2018 till 2022 with following observations:

- the prevention of faults caused by the shortening of the phase-to-phase and phase-to-earth distances caused by ice load could be significantly reduced
- de-icing methods worked
- prevention of failures that occur as a result of heavy conductor swing due to heavy wind worked
- limitation of insulator angles worked
- limitation of distance between conductors worked (especially in long valley crossings where additional tower mounting cannot be done)
- loosening of bolted connections due to vibrations for a limited number could be solved successfully

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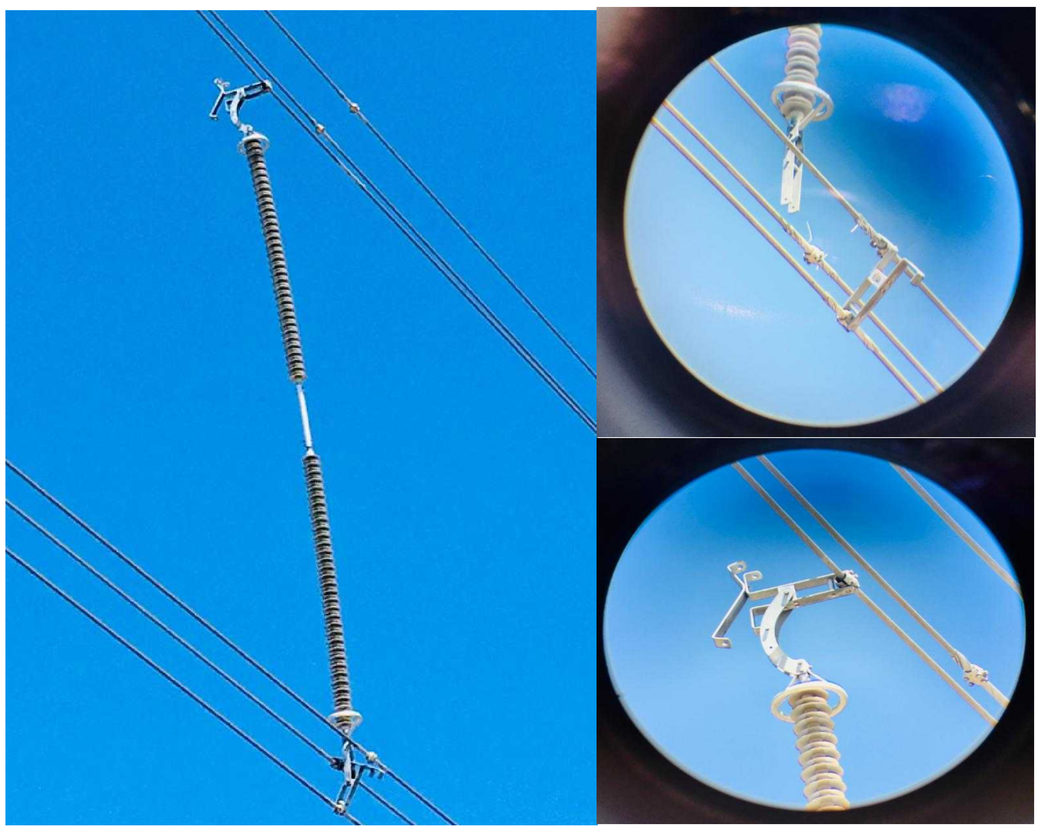
What is IPS used for?

- Using IPS is a passive de-icing method
- Mitigate conductor galloping
- Mitigate impact of ice shedding / ice loading
- Reduce conductor deflection under heavy wind
- Line compaction
- Flashover remedial from unknown cause
- Issues related to differential sagging give background of study, i.e. describe problem and previous findings
- Indicate aim of study

Problems with IPS assembly

- Installation took more time than anticipated when appropriate line cars were not used
- Impact on conductor sag more important than expected at long tower distances (600 m and above)
- Issues with IPS length adjustment (when longer or shorter length is requested to the real phase-to-phase distance)
- Actual phase-to-phase distance different than design value (due to deflection changes that occur during line installation phase or over time)
- Permanent failures have occurred as a result of bolt loosening due to vibration on the parts exposed to intense wind



Negatives after application

- Damage to metallic component of IPS (7 out of 4000 mountings)
- Damage to IPS clamp attachment to conductor (3 of 4000 mountings)

Issues to be considered in the application

- First, the exact phase-to-phase distance is determined
- Adjusting the IPS length in accordance with the existing phase-to-phase distance
- Completion of the ground assembly with a suitable torque wrench at the torque value specified by the manufacturer and that all bolt combinations are protected against loosening
- Availability of 2 line-cars for each phase
- Total weight control and correct IPS mounting direction in the basket for helicopter mounting
- Use of IPS and pendulum devices with armor rods to avoid damages of the conductors
- While determining the number of IPS, it should be ensured that the IPS is installed in sufficient numbers and with appropriate distances according to the intended use. (In lines with spans up to 600m or longer, the distance between IPS could be expanded. In heavy wind areas the distance should be reduced)

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Application efficiency

- There were no temporary malfunctions in the applied line sections
- This is a great success, especially when it is considered that the assembly is made in the parts of the line where permanent breakdowns such as tower collapse and conductor breakage are observed prior this pilot project
- There was no visible change in sag depending on the usage period

- As the icing on the conductors decreased, the ice loads on the poles decreased
- Failures caused by heavy oscillation are completely prevented in the parts that receive heavy winds (especially in the vertical direction)
- The assembly and material costs are very low when compared to the additional tower assembly and material costs