

Fault statistics on overhead transmission lines in Russia caused by icing

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Introduction

Icing events make a significant impact on normal operation of overhead transmission lines. During OHL operation, technical failures can occur. In the article, an attempt has been done to assess failure rate caused by icing. The analysis of the failure rate of overhead line components (towers, conductors, ground wires, insulators and line hardware) at 110-750 kV was done for the period from 1997 up to 2007.

The main goal of fault statistics analysis was to mark out elements of OHL and substations most suffering from icing events.

Accidents and incidents.

Depending on the character and heaviness of failure, it is possible to distinguish *accident* and *incident*. Accident it is an event when there is equipment damage or power outage for a long time. Incident it is an event when there is no or small equipment damage or power outage for a short time. According to Russian standards after every accident or incident happened, a special investigation commission is organized.

Investigation results are formalized with the “Technical failure investigation act”. This act contains the following main sections:

- Address section – with main info on failure: day and time of failure beginning, location, damage, etc.
- Description section – with network operating conditions before failure, failure beginning and development, failure causes, damages description;
- Damaged equipment description section – with information on damaged equipment type, brand and technical parameters.

Fault statistics for substation equipment

During the period 1997-2007 at 110-750 kV substations were recorded nearly 6.500 events of substations' equipment failures. Main portion of failures happened with switchers (46,2%) and disconnectors (30,4%), less with transformers (12,9%). Icing events do not have a noticeable effect on damage statistics to main substation's equipment. So out of all the examined cases, no more than 2-3% ones occurred due to icing events.

Fault statistics for OHL and it's elements

During the period 1997-2007 at 110-750 kV OHL 9948 events of overhead line's components failures happened, including:

- 110 kV – 7953 (84,2%) events;
- 220 kV – 1185 (12,5%) events;
- 330 kV – 110 (1,2%) events;
- 500 kV – 164 (2,0%) events;
- 750 kV – 7 (0,1%) events.

Main failure causes as follow:

- outside interference (influence) (trees falling, running-down accidents, vandalism, etc.) – 26,2%;
- ice loads and combined ice-wind loads – 17,6%;
- lightning overvoltages – 15,2%;
- failures caused by technical condition of overhead line components – 13,8%.

During the period 1997-2007 occurred 324 events of tower damages.

Main causes for metal towers are:

- tower elements, conductors and ground wires stealing – 26,2%;
- climatic loads – 25,7%;
- corrosion and aging – 19,2%;
- building and mounting defects – 14,7%;
- outside interference (influence) – 13,9%.

Main causes for concrete towers are:

- climatic loads – 38,7%;
- building and mounting defects – 24,0%;
- outside interference (influence) – 15,4%.
- natural disasters – 13,8%.

During the period 1997-2007 happened 4755 event of conductor damages.

Main causes are:

- Mounting defects – 10,7%;
- Icing – 10,2%;
- Trees and young growth – 11%;
- Corrosion, aging and strength loss – 10,4%;
- Outside interference – 13,1%.

During the period 1997-2007 occurred 1305 events of ground wires damages. Main causes are:

- Corrosion, aging and strength loss – 32,9%;
- lightning overvoltages – 21,1%;
- Icing – 17,9%.

Conclusion

Icing events have a significant impact on the reliability of power supply. The most damaged and vulnerable elements include conductors and ground wires. For these elements icing events are one of the major causes of damage.