Technological developments to prevent damages on powerline transmission network

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Keywords: De-icing techniques, ice storm, network solution, tactical solution

This paper summarises Hydro-Quebec's power line grid de-icing and icing prevention technologies. It also details the technological choices made to implement its network protection strategies. Ice storms have been known to cause major damage to electrical installations in many countries. Surprisingly, very few utilities have made this issue a priority so investments have been low in technology development for grid protection. Moreover, China, United-States and Europe have recently endured important ice storms in areas previously never affected by such events.

The well publicised 1998 ice storm in Quebec caused major damages. Following this event Hydro-Quebec made substantial investments and efforts in R&D to develop mitigation techniques and to support R&D experimental testing in its laboratories. Hydro-Quebec has built a strong expertise from experimenting with ice condition on transmission equipments. In this paper, seven (7) technologies are presented; some have been implemented, while others are still either in development or in research stages.

This technology portfolio can be divided in two categories: network enhancement and tactical intervention solutions. The first are aimed at preventing damages and improving network resilience and the latter to be deployed during major ice storms events to restore equipment functions.

The network enhancement solutions have many functions. They primarily strengthen the grid, limit ice damage and improve control over global grid performance. Storm monitoring and reactive systems relay information with switching modules ("the Smart Power Line", on-going research), prevent ice accumulation on substation electrical equipments (HV and UHV with the Photonic deicer, in R&D phase); or on overhead ground wire (OGW) with Joule effect and improves decision making for optimal strategic planning of transmission lines de-icing interventions during ice storms (the stradeg software). All systems are designed to ease decision making for optimal strategic planning of the network during ice storms.

To address and limit damages from ice accumulation on aerial conductors and equipments, Hydro-Quebec has developed various tactical intervention solutions. One of these solutions is to deice and inspect live transmission network conductors and OGW (The LineROVer, a de-icing remotely operated vehicle). For ground based de-icing and cleaning needs on various HV equipments a remotely operated de-icing all-weather vehicle has been developed and tested (RODAV). Hydro Quebec has evaluated and tested several de-icing techniques. In one particular device, a mechanical impulse is used to de-ice OGW (Shwodi, a shock wave de-icer).

To summarise, over the past 12 years, Hydro-Quebec has developed and evaluated several devices and techniques to mitigate against ice storms events. This paper highlights the potential of each technology, its strengths and applications and its grid deployment strategies, it will also presents the expertise and capability of the laboratory. Discussions are also presented on whether these solutions can be used strictly for Hydro-Quebec's grid or if they represent an interest to other electric utilities.