Development of a reinforcement method for BC Hydro 230 kV portal towers through numerical analysis and a full scale laboratory test

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After the severely damaging Eastern Canadian ice storm of 1998, BC Hydro embarked on a plan, the Transmission System Ice Hazard Reduction Program, to identify the transmission line components that may be deficient under the 1-in-100 and 1-in-200 year return period equal and unequal ice loads. Under this program, a non linear dynamic and static ice load analysis of sample sections of 230 and 500 kV transmission lines concluded that under an extreme ice loading, a broken insulator or conductor on a 230 kV tangent tower would increase the design vertical and longitudinal loads on the adjacent towers by 230% and 250% respectively. About 72% of the towers on this circuit are type A portal tangent towers. To design for upgrade of a transmission tower, knowledge of its actual load carrying capacity is very important. This paper reviews and discusses the results of full scale laboratory test of a 230 kV type A portal tower, both un-reinforced and reinforced, under vertical and a combination of vertical and longitudinal loads. Failure modes of tower components were reported and a cost effective method of upgrading the tower is proposed.