

ASCE SPRING CONVENTION, ATLANTA CITY, NEW JERSEY 4/27-28/87

A LOAD-LIMITING DEVICE FOR
TRANSMISSION TOWER DESIGN

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A transmission tower failure can result in a significant economic loss to an electric utility. Tower repair often extends past the tower at which a failure occurred due to the unbalanced loading on adjacent towers (cases have been reported in which miles of transmission line were damaged). Downtime equates to lost revenues. Losses can easily approach millions of dollars.

This paper describes a passive device that reduces and contains damage to electric power transmission lines and towers during severe dynamic events (storms, wind ice-load shedding, tornadoes, aircraft impact, insulator string failure, vandalism, stringing accidents, etc.). Attached between insulator string and tower, the load-limiting device, which weighs approximately 40 kg (88 lb) and is 15-cm (6-in.) long, acts as a passive rigid link under normal conditions. The device looks at first like two flat plates bolted together. These plates are flame cut in such a way as to allow them to extend, much like a double-coil spring, under tension. In the event of a dynamic shock, that could fail a tower or tower arm, the device extends up to 2 m (7 ft) to absorb the shock energy and limit the force applied to the tower or adjacent towers. In this way, tower damage is prevented or limited to the tower directly affected and thus mitigates against multiple tower or cascade failures. Since the device has spring properties, it can be pre-loaded so that it has the ability to carry the initial line dead weight, thereby eliminating the need of an elaborate trigger mechanism. The ability to lock the device is available to facilitate tower servicing without activating the device.

Experiments, in both the lab and at the Electric Power Research Institute's Transmission Line Mechanical Research Facility, have proven the device and its potential for limiting tower damage.