Connector Integrity Restoration

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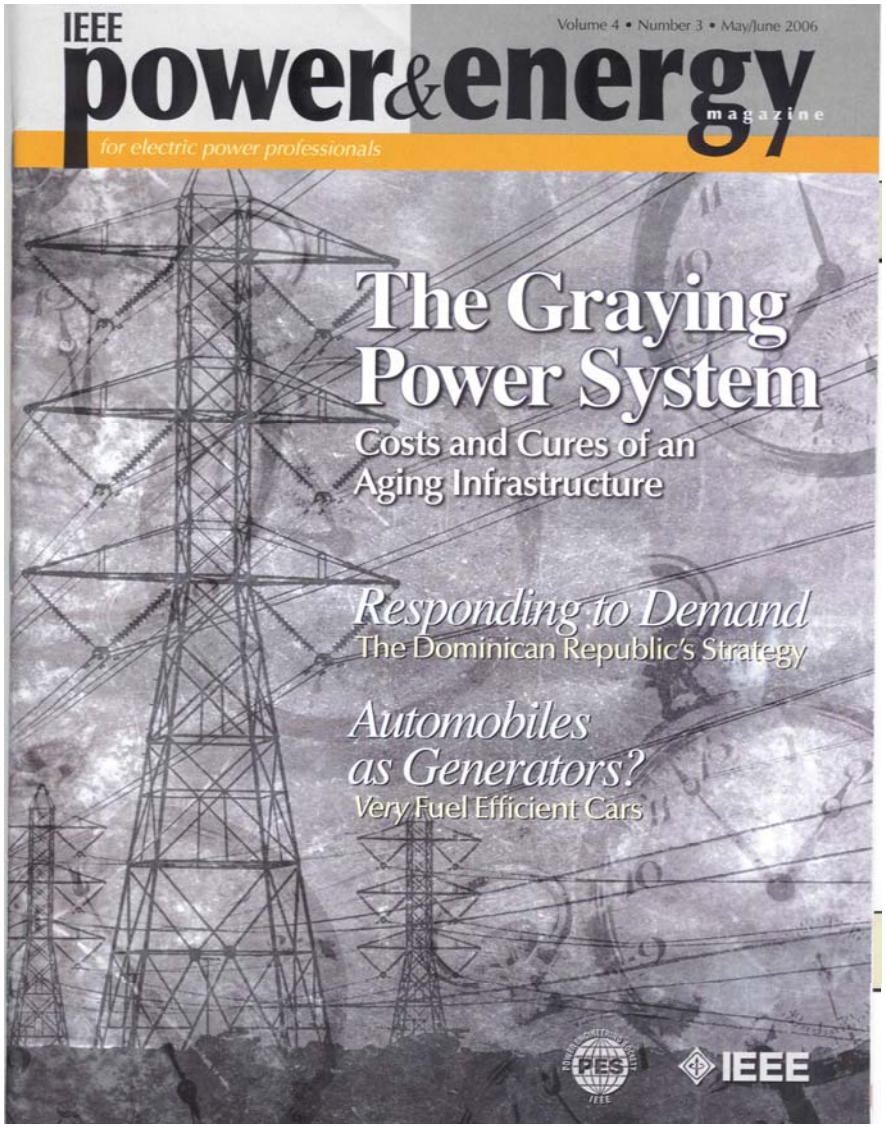
IEEE

An Aging Grid Built of Aging Connectors



The first aluminum conductor used commercially in a transmission application was by the Hartford Electric Light Company in 1899. By 1929, 300,000 miles of aluminum conductor spanned the United States, much of which has already been replaced once.

Since that time, there have been built, approximately 300,000 miles of transmission line, and over two million miles of distribution circuit in North America.

Most of this was built following WWII, up through the mid 1970's, and it follows that the vast majority of aluminum conductor in North America is 40 to 70 years old.

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Connectors Have a Finite Life!

- The design parameters for most utility grade connectors up through the 1970's, when 90% of the existing infrastructure was built, was 30 years at a max conductor operating temp of 70°C.

Aluminum Connectors Average 40-70 Years.

Connector Failures Are Increasing at an Alarming Rate!

- Increased Operating Temperatures
- Corrosion and Weathering Factors
- Natural Aging Factors

Conductor Fatigue is a Major Concern

- Broken Strands in Suspension Clamps, Splices, Spacers, Etc.

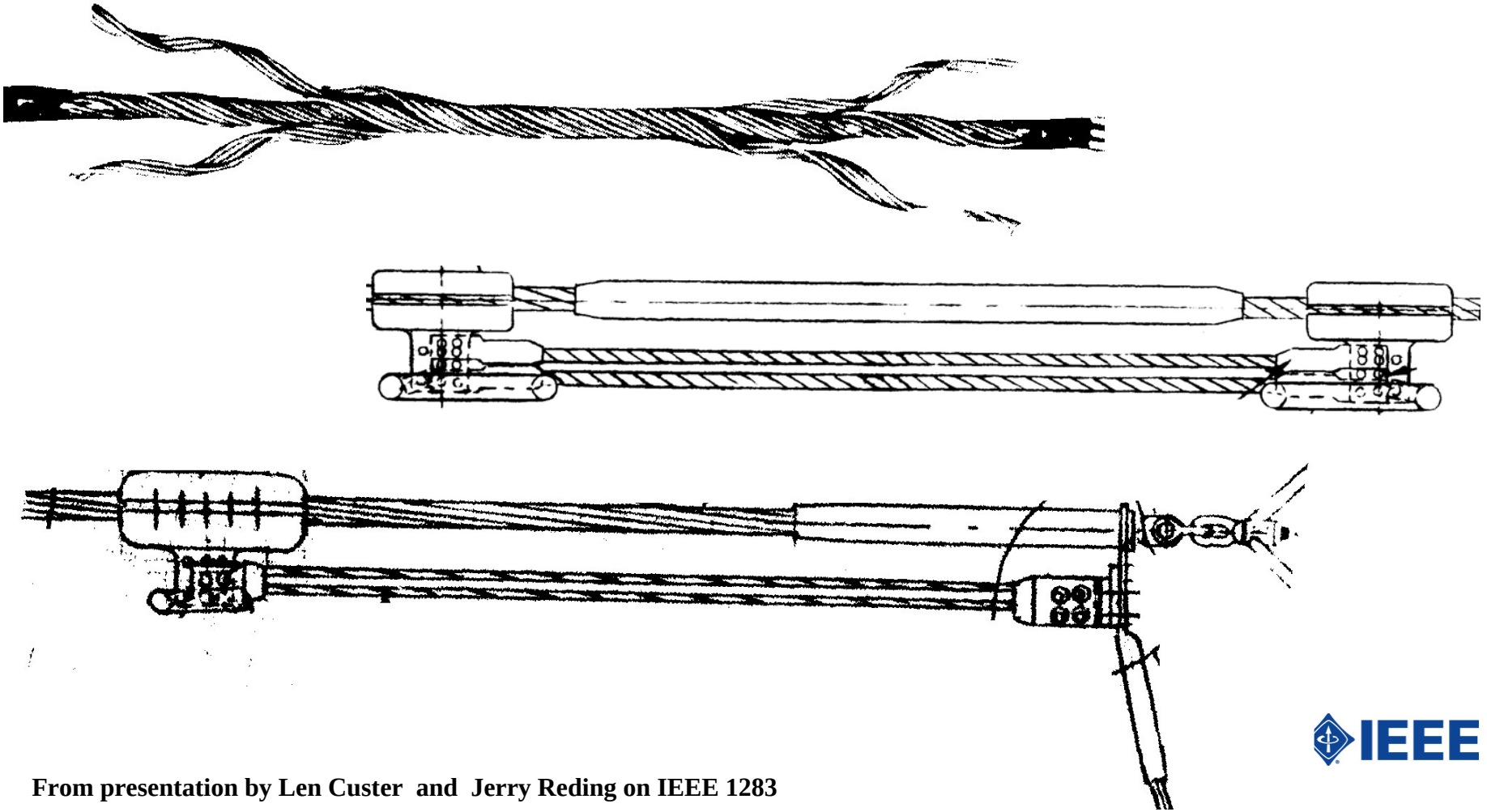
Standard/Guide in Process

IEEE P1283™/D1
Draft Trial-Use Guide for Determining the Effects of High Temperature Operation on Conductors, Connectors, and Accessories

- Tremendous Effort has been put forth by members of IEEE TP&C Committee, led by Jerry Reding and Len Custer of BPA, to identify and quantify pending failure conditions of conductors, connectors and associated hardware.

Demand Exceeds Construction

- Mitigation for Increased Operating Temperatures



From presentation by Len Custer and Jerry Reding on IEEE 1283

Solution Needed to Restore Both Electrical and Mechanical Integrity

Upon finding a “hot” splice or connector, simply shunting for electrical purpose is not sufficient. Many aged connectors, particularly Automatics and Single Die Compression, are at risk mechanically due to unknown condition of annealing.

ClampStar™ is a shunt type device, designed to be installed on a live conductor, over an existing connector, and restores both the electrical and mechanical integrity.

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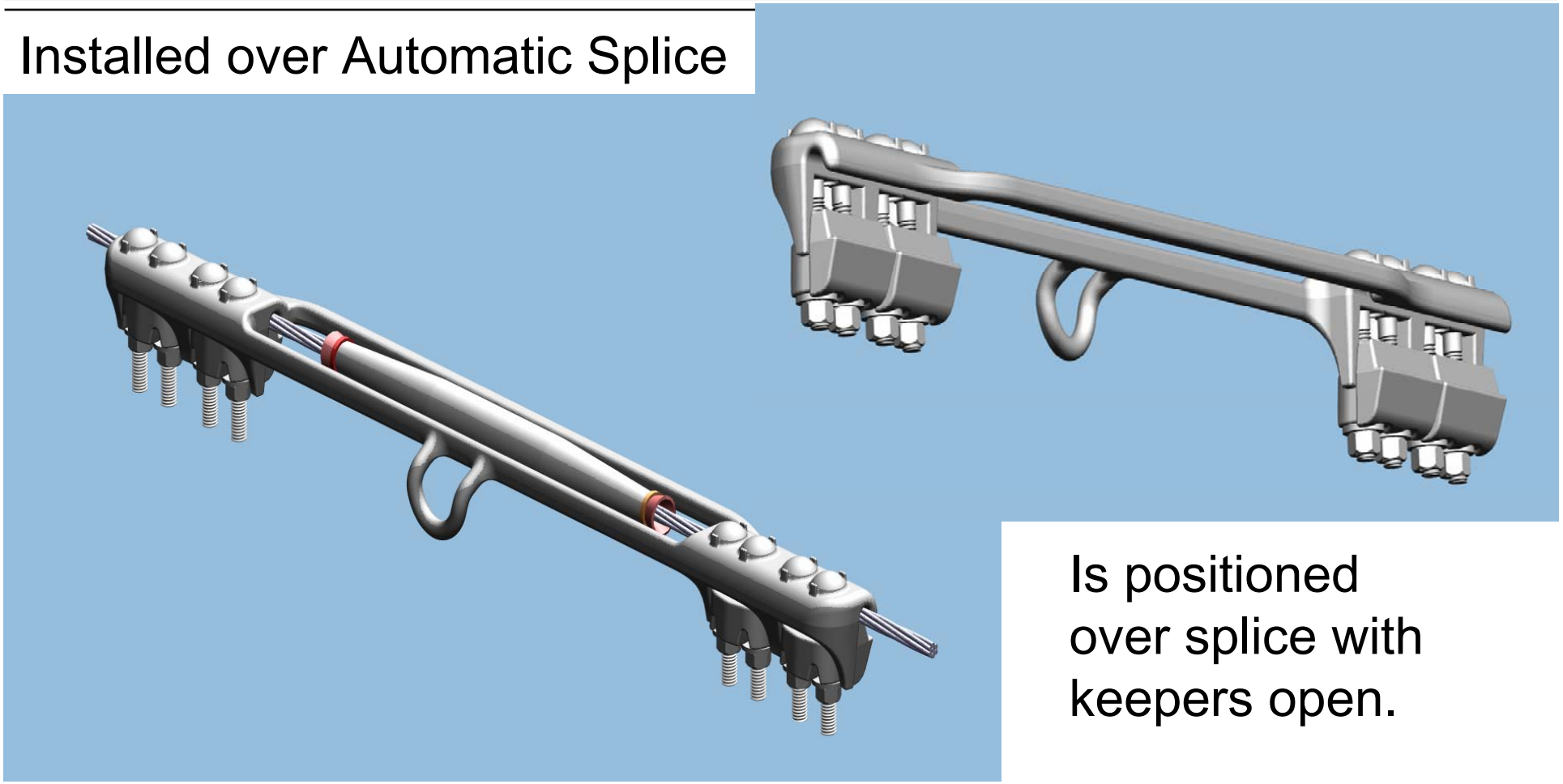
ClampStar™ for Smaller Conductors Distribution Sizes #4 to 266kcmil

Installed over Automatic Splice



Is positioned over splice with keepers open.

Distribution size, having fixed legs and readily installed with a Clamp Stick in three sizes.

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ClampStar™ for Larger Conductors Transmission Sizes 3/0 to 2156 kcmil

Assembled on Deadend, includes steel tether cable for mechanical safety.

Larger units have “Flexible Frame” comprised of conductor to flex to various degrees of bend, and to accommodate vibration issues.

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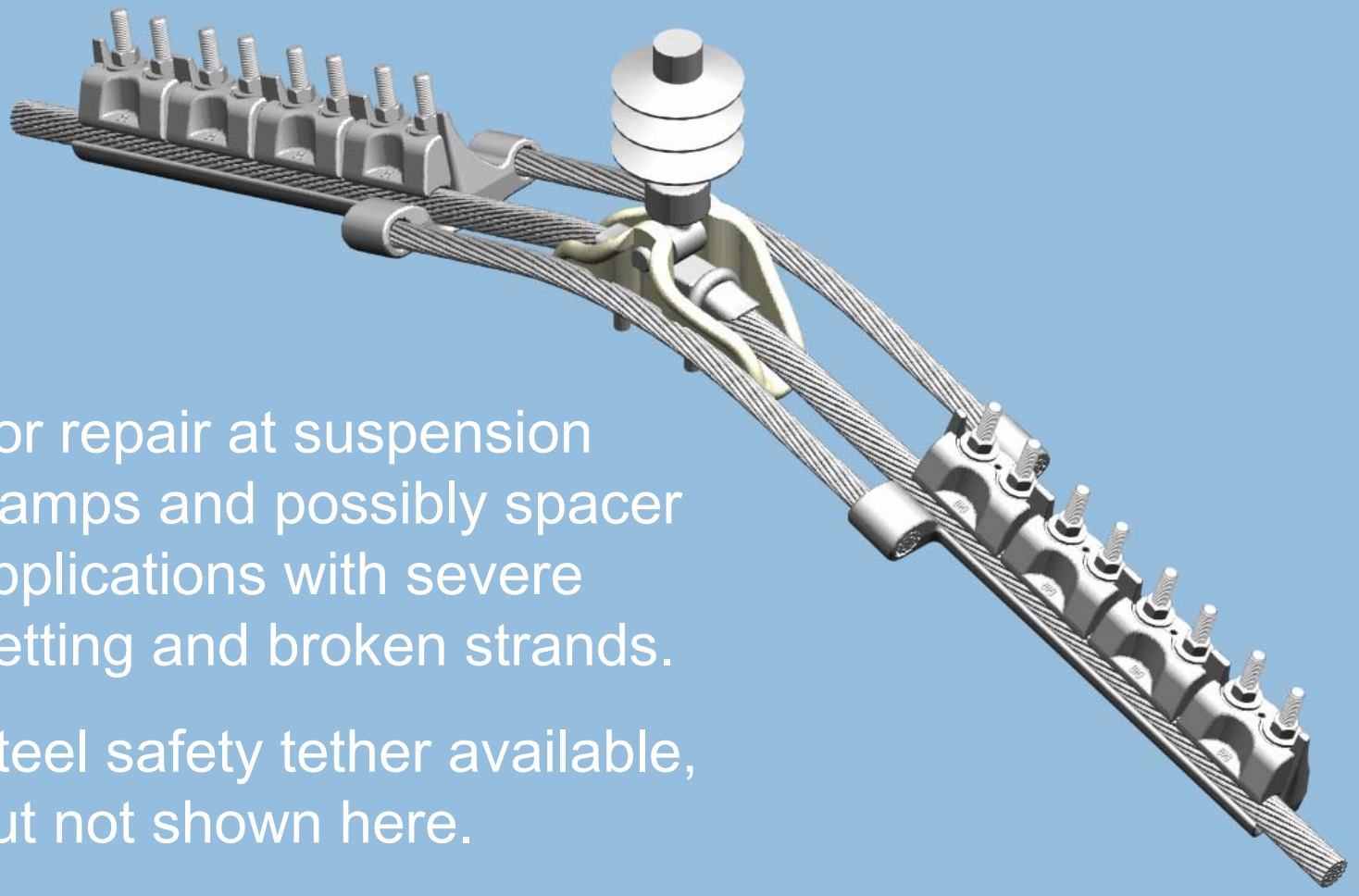
ClampStar™ for Larger Conductors Transmission Sizes 3/0 to 3500 kcmil

ClampStar™ for Splices Suspension Clamps and Spacers

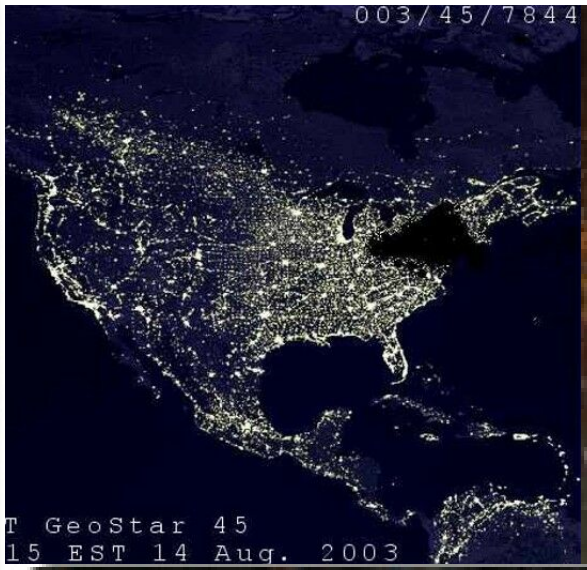


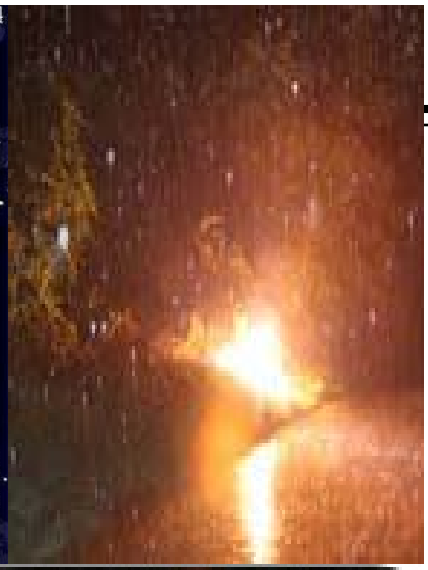
For repair at suspension clamps and possibly spacer applications with severe fretting and broken strands.

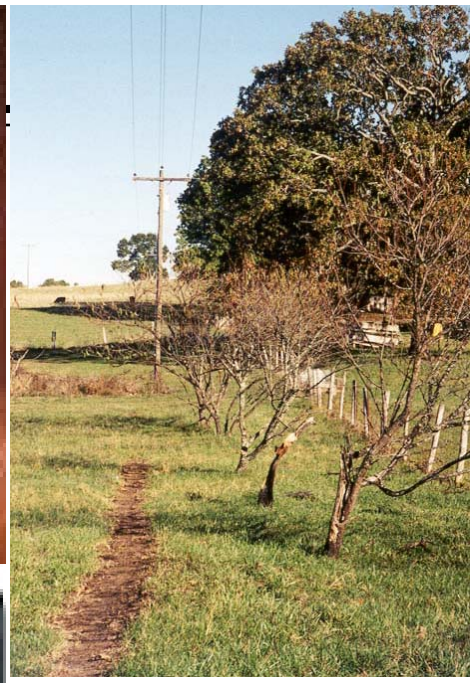
Steel safety tether available, but not shown here.

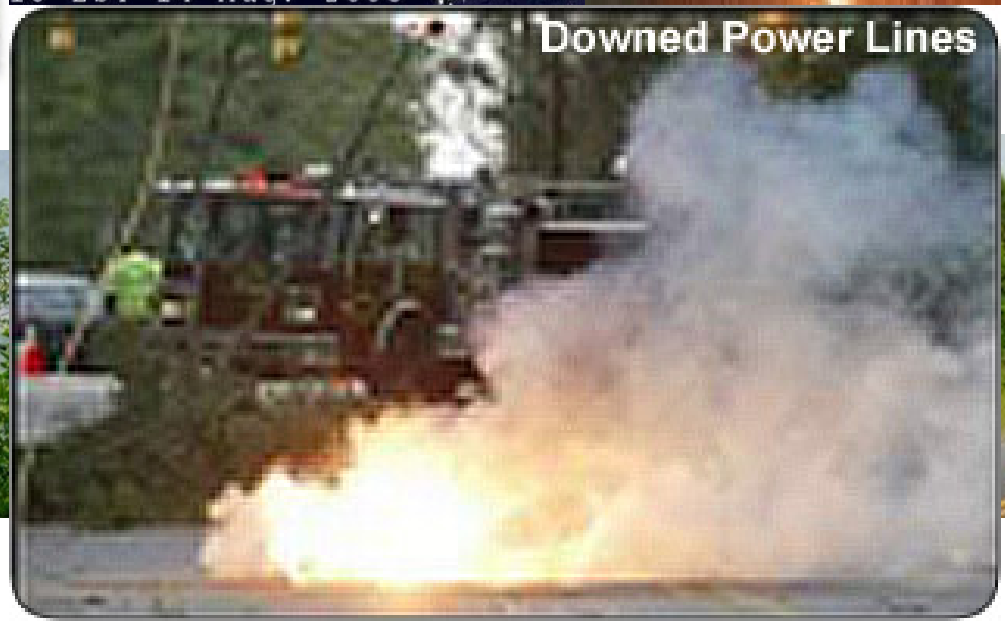
When Lines Come Down!

Firefighters work on a burning snag on the Curve Fire









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Questions????

- Rejuvenate aged / failing / hot connectors?
- Belt and Suspenders for Suspension Clamp?
- Restore integrity to damaged conductor?
- Possibly allow increased line ampacity?
- Quick fix for automatics – 3.5 minutes to install vs. 30 minutes to an hour?
- Extend line life to end of conductor life, perhaps another 30 years?

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