C14 Downed Power Lines & Electrocutions

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After attending this presentation, attendees will develop a better understanding of some causes of downed power lines which can lead to electrical injuries, electrocutions, property damage and business inter- ruption.

This presentation will impact the forensic community and/or humanity by assist the legal and insurance community in regards to determining the cause and origin of downed power lines and probable responsibilities of any electrical injury and/or electrocution that results therefrom.

Forensic scientists and engineers will develop a better understanding of some causes of downed power lines which can lead to electrical injuries, electrocutions, property damage and business interruption.

A downed power line is an electrical conductor which is laying on the "ground" or on a "grounded" object. The power line could be at any voltage usually between 120 V AC and 735,000 VAC. The lower the oper- ating voltage of the power line the less likely it can be detected by pro- tective devices such as fuses, circuit breakers, reclosures and/or relays. A downed power line that causes fault current is usually not detected by ordinary overcurrent or ground fault protection. This type of fault is called a high impedance fault (HIF). These faults can occur when a conductor comes in contact with an object such as a tree, or falls on a surface of poor conductivity or a vehicle. Typically, a high impedance fault on a high voltage distribution system exhibits discontinuous arcing and flashing at various points of contact.

High-impedance faults generally do not create imminent damage to power systems due to the fact that the magnitude of the fault current gen- erated is often too low to harm most electrical apparatus, however, unde- tected HIF's can cause fire, electric shock or electrocution. The signifi- cance of these hard to detect faults is that they represent a serious public safety hazard as well as a risk of arcing ignition for fires.

HIF detection devices are becoming available to utility companies but these detection devices require an extended time depending in part on the algorithm (sometimes up to a minute) to reliably differentiate an HIF from a normal load disturbance. Field-testing is one solution to detect these anomalies.

Case Studies of Downed Power Line Incidents and Electrocutions

1. 7200 V AC Line on ground electrocutions
2. 480 V AC Street light wire electrocution
3. 120 V AC Street light wire electrocution
4. 220,000 V AC Line in contact with tree
5. 13,200 V AC Line on asphalt/electrocution
6. 27,000 V AC Line /railway property damage

High Impedance Faults – Relay Protection Systems

1. Some current relay systems are equipped with the latest High Impedance Fault (HIF) Detection technology including detection algorithms that attempt to detect current voltages associated with high voltage downed conductors on soil, gravel, concrete, sand, and other sur- faces by analyzing the frequency spectrum of the current waveform and voltage too.
2. The relays contain advanced microprocessor based digital protection, control, metering and monitoring systems and use waveform sampling. Data filtering of the current and voltage inputs together with appropriate 2nd order statistical based systems, wavelet based systems and neutral networks.

Causes of Downed Power Lines

Some causes of downed power lines are:

1. Vegetation/Tree Interference – Trees and branches can cause conductors to short circuit, separate, fall to the ground and remain energized. The fault current magnitudes are sometimes too small to operate some protective devices or the protective devices are oversized.
2. Galloping – Under certain wind, geographic and configuration conditions, overhead conductors can oscillate in the wind and ultimately lead to a downed power line.
3. Storms/Hurricanes – Wind borne large objects can blow down entire spans of lines. Poorly guyed pole lines can fall over. Winds in excess of 120 m.p.h. can damage lines and poles.
4. Hot Spots on Splices and Connections – Overheating splices and connectors can melt conductors and cause them to fall to the ground and remain energized.
5. Lightning Damage – Conductors by lightning are sometimes damaged to such a degree so as to cause them to break immediately or at a later date.
6. Overloaded Lines – Overloaded lines can sag into under-built circuits, short circuit and fall to the ground.

Downed Power Lines, Electrocutions, HIF Relays

 ** Presenting Author*