



Contact Voltages due to Inadvertently Energized Conductive Objects and Surfaces

**A Summary of Materials
Presented at Annual Jodie Lane
National Conference**

November 2009

'09

The Fifth Annual Jodie Lane Conference on Contact (Urban Stray) Voltage was Held Oct 19th 2009 at the Consolidated Edison of NY, Headquarters, with over 100 Attendees

2009 Jodie Lane National Conference

for Stray Voltage Detection, Mitigation and Prevention

About the Jodie Lane Annual Conference

- This annual conference brings together electric utilities, regulators and other interested parties at a forum intended to promote public safety as it relates to pedestrian shock hazards and other safety concerns
- The conference typically includes presentations on:
 - Utility best practices for measurement and mitigation of shock hazards
 - Statistics on annual contact voltage detections in the State of New York and in other electric service territories
 - Industry standards and regulatory activities
 - R&D advancements in detection of contact voltages
 - R&D advancements in mitigation of contact voltages

Contact Voltage – Definition – Background



- Anytime a phase conductor comes in contact with a conductive object such as a metal service box, a street lamp, a manhole, a conduit, etc., it can become an electric shock hazard for humans and animals
- The energization may be a “direct contact” of the phase conductor to the object or it may be “indirect” via salt, snow or moisture in the circuit path
- Contact voltages are typically considered shock hazards, so this is different from the perception and aversion concerns due to stray voltage
- The two terms “stray” and “contact” voltage are used interchangeably in the press, thereby creating confusion

Recapping a few Presentations from the 2009 Jodie Lane Annual Conference...

- Overall, 12 presentations on public safety topics were presented at this year's conference
- The agenda and all 2009 presentations can be obtained by request: lwolfenbarger@epri.com
- The following slides contain excerpts from the presentations given at the 2008 and 2009 conferences to include:
 1. The public perspective by Roger Lane (Jodie Lane's Father)
 2. Toronto Hydro presentation on their February 2009 level III emergency
 3. The State of New York Public Service Commission rulings
 4. Con Edison data on contact voltage events
 5. EPRI R&D on contact voltage related research

Roger Lane - Keynote Presentation: “Shock hazards are an inherent risk – the risk is quantifiable – it can be minimized through proactive system inspection and scanning”

<http://strayvoltagegenyc.org/>

[home](#) [about](#) [stray voltage](#) [improving public safety](#) [nyc maps](#)

Jodie S. Lane Public Safety Foundation

On January 16th, 2004 Jodie Lane was electrocuted on 11th Street and 1st Avenue in New York City as a result of stray voltage. In struggling to make sense of this tragedy, Jodie’s family determined three objectives they wanted to achieve in her memory:

- A monetary settlement with Con Edison, the power utility responsible for Jodie’s death;
- A scholarship in Jodie’s name, as she was pursuing her PhD in clinical psychology;
- Improved public safety in New York City, Jodie’s home and the city she adored.

Through eleven months of negotiations with Con Edison, Roger Lane, Jodie’s father, and his close friend Stanley Witkow, set the framework for achieving these objectives.

Jodie was a doctoral student at Teachers College-Columbia University, pursuing her lifelong goal of obtaining a PhD in clinical psychology to work with children and adolescents. Since Jodie’s pursuit of a PhD was cut short, her family wanted to ensure that other students could achieve her dream with the help of a scholarship named in her honor. The Lane family created a \$1 million dollar scholarship program at Teachers College-Columbia as part of the settlement with Con Edison. This scholarship program has helped dozens of clinical psychology PhD students realize their goals since 2006.

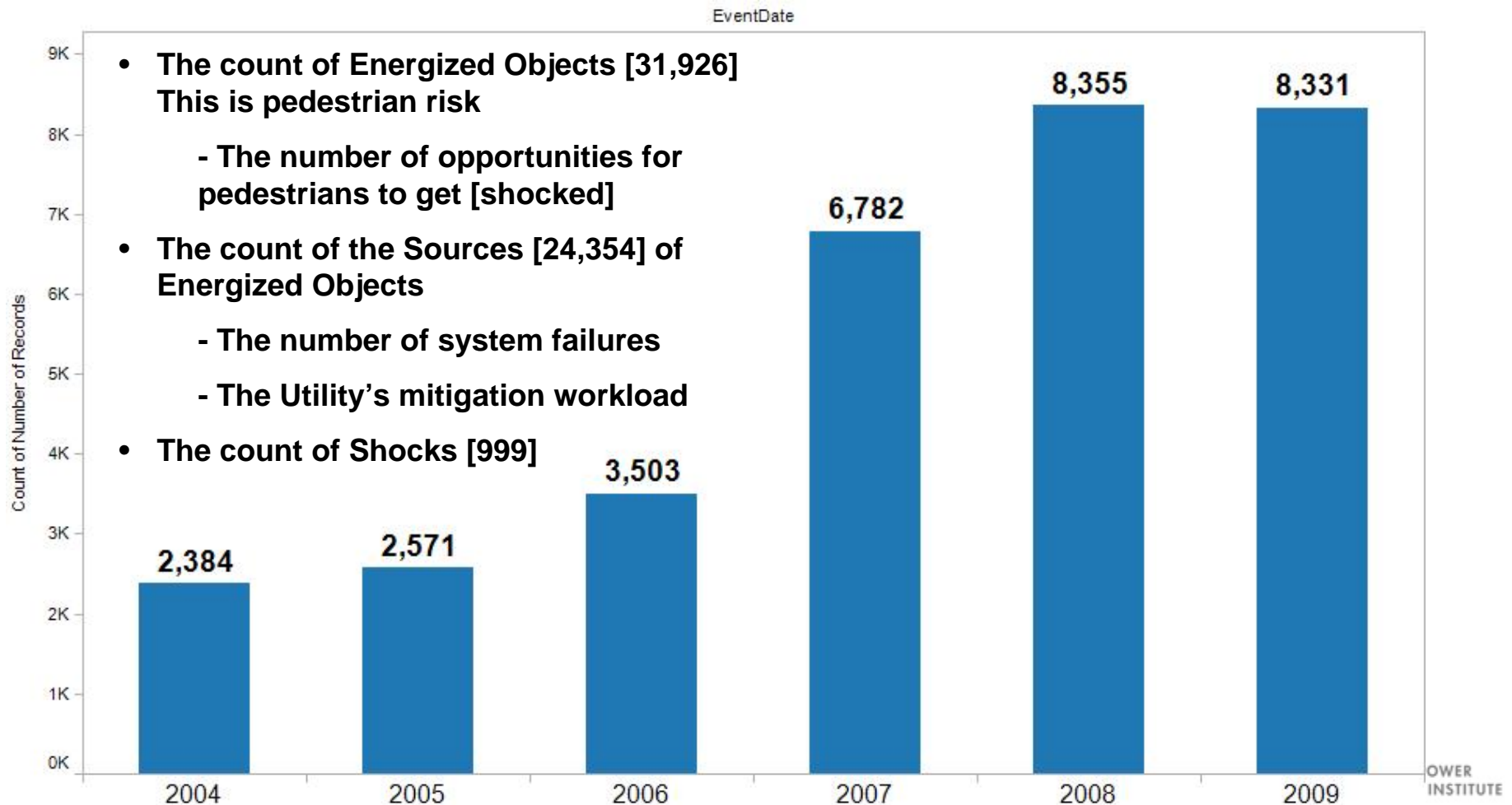
about

- [public safety foundation](#)
- [donate](#)



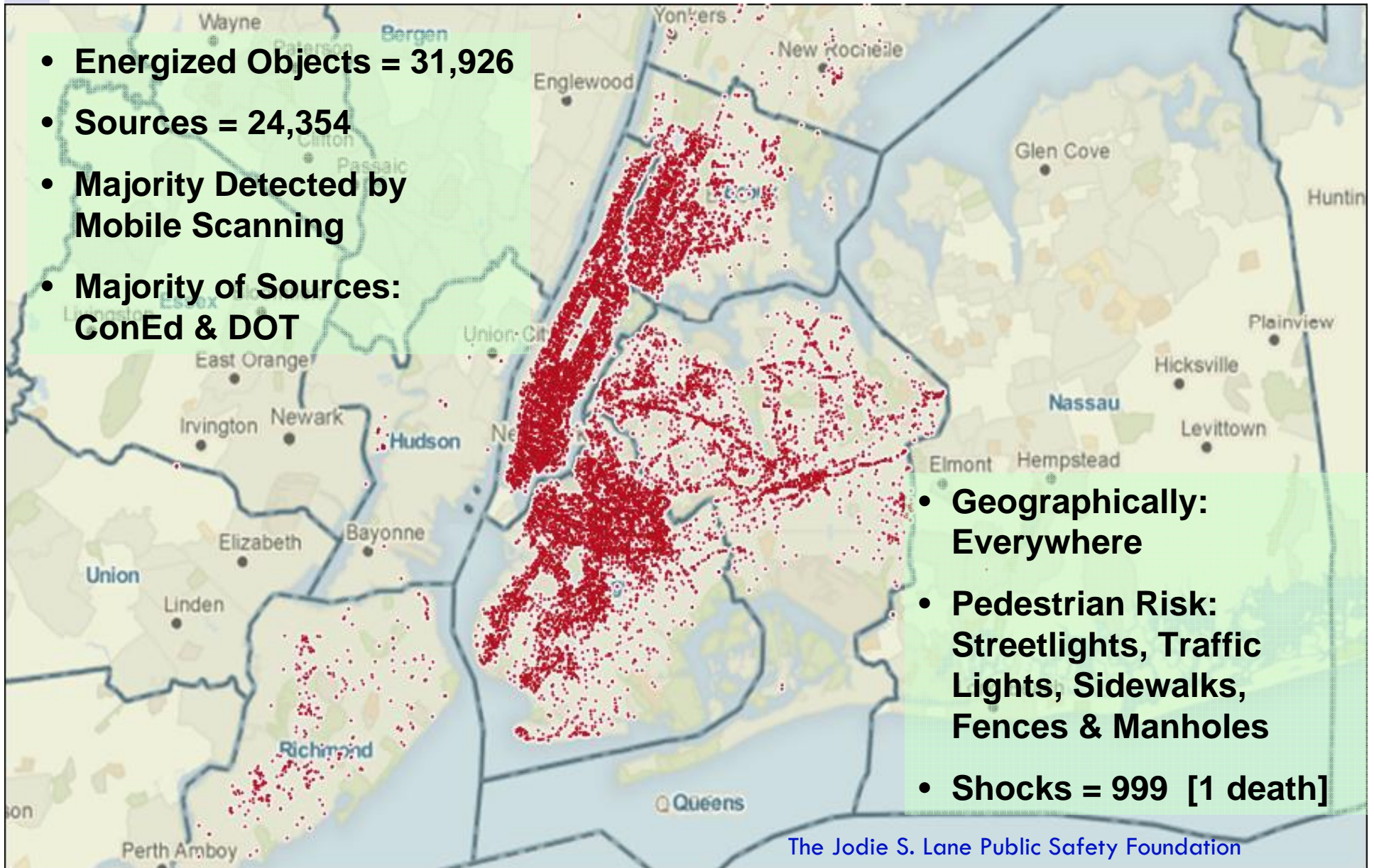
Raw Data Provided to the J.S. Lane Foundation by Con Edison (Nearly 32,000 energizations < 5 yrs.)

- **31,926** energized object detections from 2004 through September 2009 in NYC including **999** Shocks.

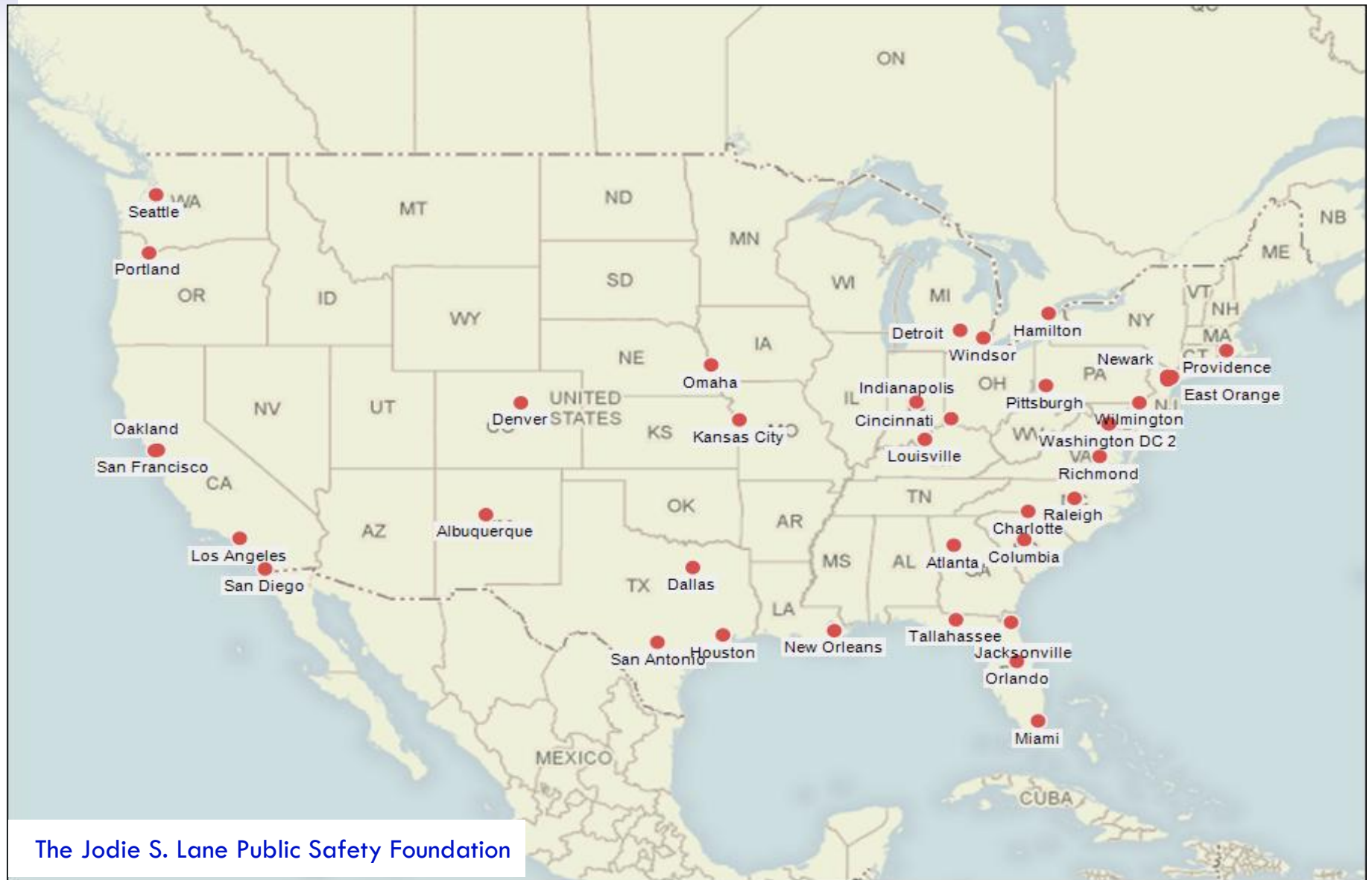


Geographically Where are the Energized Objects Found? – Everywhere Measurements were Taken

- Energized Objects = 31,926
- Sources = 24,354
- Majority Detected by Mobile Scanning
- Majority of Sources: ConEd & DOT



Concern is Nationwide – Cities Where E Field Scanning Detected Inadvertently Energized Objects



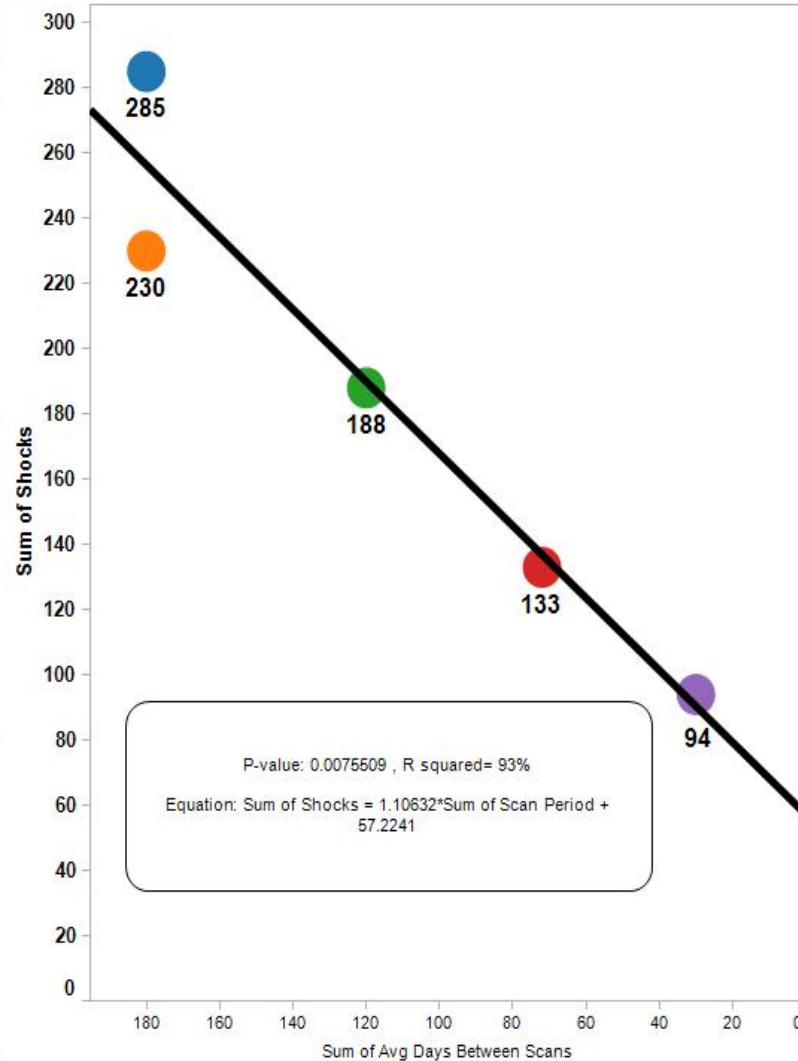
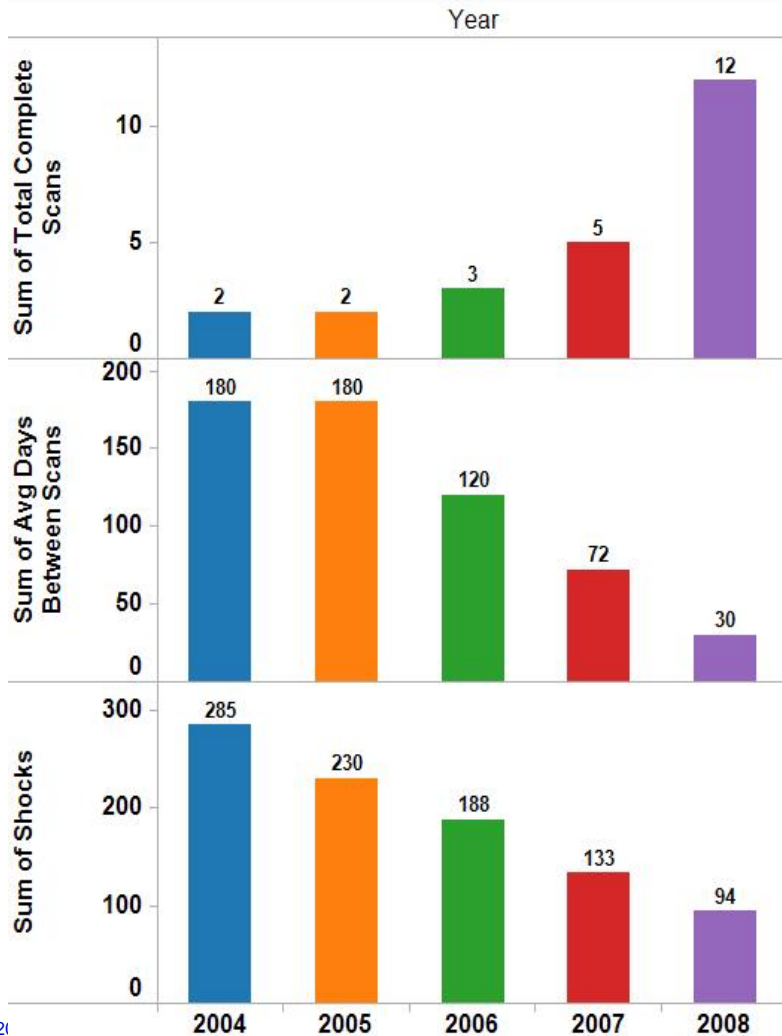
Overall Perspective of the J.S. Lane Foundation – Look, Find, Mitigate → Reduce Shocks

The Jodie S. Lane Public Safety Foundation 12/17/2009

How Can Pedestrian Risk Be Reduced?
Look, Find, Mitigate ==> Reduced Shocks

Look frequently, Find frequently, Mitigate always Reduce shocks

- Year
- 2004
 - 2005
 - 2006
 - 2007
 - 2008
 - 2009 Ytd
 - Total



Excerpts from the Toronto Hydro Presentation

Contact Voltage at Toronto Hydro

A Historical Perspective



Overview

- Toronto Hydro declared a level III emergency in Jan 2009 after:
 - 2 dogs electrocuted
 - 5 children shocked
- All within a three month time window
- The subsequent system assessment uncovered 1,600 energized conductive objects and surfaces

Toronto Hydro Excerpts – Historical Perspective

Prior to fatal shock incident in NYC (2004)

- ✓ Frequency & impact of shocks very, very low
- ✓ No preventative maintenance to address contact voltage (CV)
- ✓ Shocks were treated as isolated incidents
- ✓ Not perceived to be a systemic concern
- ✓ Still the case in many situations and jurisdictions

Post fatal shock incident in NYC (2004)

- ✓ Increase legislative burden, proof of ‘due diligence’
- ✓ Increase in regulatory intervention/awareness
- ✓ Triggered wide scale media attention
- ✓ Erosion of public trust
- ✓ Created industry focus on the issue of CV
- ✓ Triggered formation of Working Groups (IEEE, EPRI)
- ✓ Genesis for the creation of “Jodie Lane Conference”

Timeline and What Was Accomplished?

Handwells Inspected	11,765
Poles Inspected	39,821
# of calls reporting contact voltage	268
Individual Pieces of Material/Equipment Purchased	160,000
Number of Maps Used	1,543
People Involved	>1,200
Total Hours Spent	98,401

2006 & prior – no known records of CV incidents

2007 – Pedestrian shocked by bridge handrail

2007 – Dog sustains shock from handwell

November 20/08 – 1st Dog fatally shocked

January 13/09 – 2nd Dog fatally shocked

January 09 – Engaged PSC to scan for CV

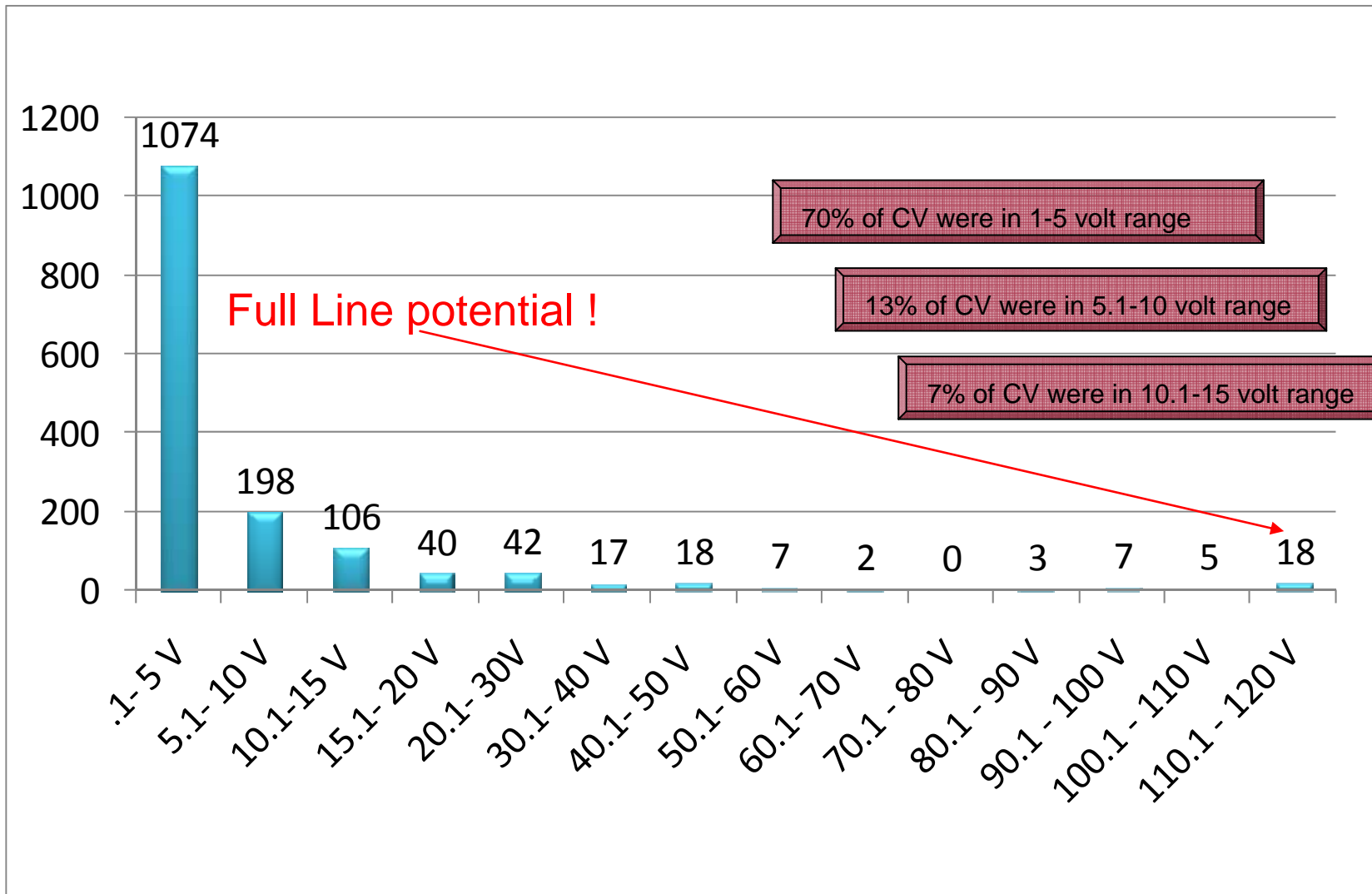
January 29/09 – Five School children shocked

January 29/09 – Engage Ontario Regulator

January 30/09 – Declared Level III Emergency



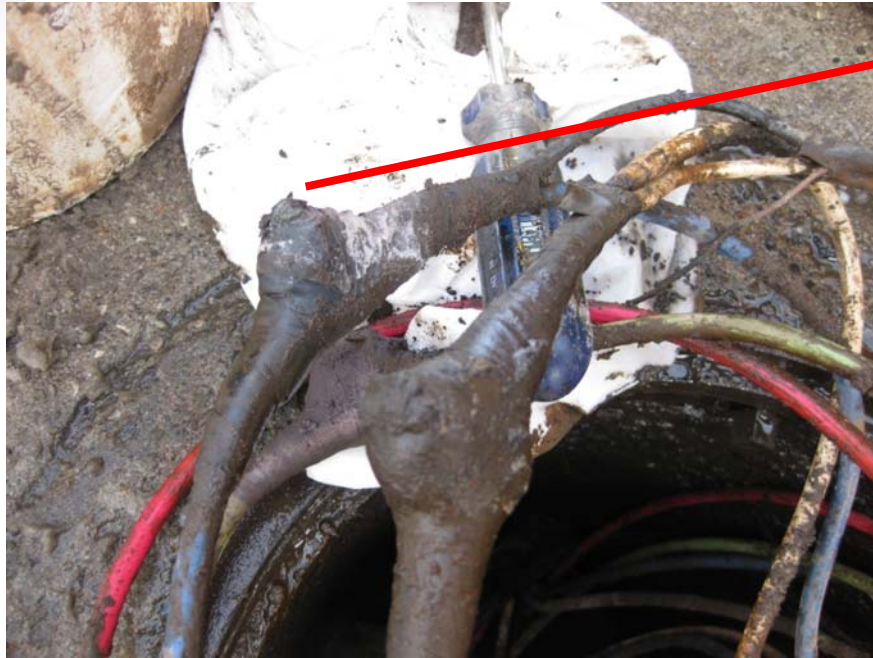
Contact Voltage Histogram



Common Locations of Contact Voltage

- ✓ **Metallic plates and covers**
 - Direct contact with exposed conductor or indirectly through another medium (i.e. salt water)
- ✓ **Concrete/Steel Poles**
 - Direct contact with exposed conductor
- ✓ **Concrete Structures (including sidewalks, bridges, etc...)**
 - Conductive salt water saturates concrete and forms a voltage gradient
- ✓ **Signalized Intersections**
 - Integrity of the grounding grid is suspect or insufficient

Examples of Inspection Findings



120 volts
measured

- Split-bolt tape insulation has degraded

Exposed
conductor

- PVC tape on split-bolt splice improperly applied



Examples of Inspection Findings



Excavated handwell
with live conductors

Handwell w/ live supply was paved over

Rebar from sidewalk
has penetrated the
handwell walls

Damage from civil contractor



Excerpts from the Con Edison Presentations

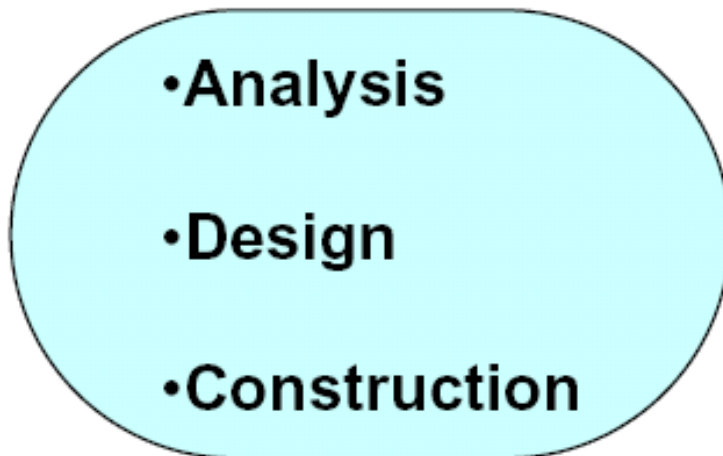
Overview

- Each year, Con Edison of New York typically presents on 4 or 5 topics relevant to detection, mitigation and prevention of contact voltages
- Key Highlights from the Con Edison presentations
 - Con Edison is using mobile E Field Detection to accomplish 12 mobile scans of the roughly 600 square miles of underground areas in their service territory – 14 trucks used 5 days each week
 - Once a detection is found to have a contact voltage of 1 Vac or greater, the area is secured until a trouble crew can arrive to diagnose the voltage and either repair the condition or declare it safe
 - A new “advanced detection” procedure is being implemented that more accurately identifies contact voltage sources
 - Con Edison can correlate their activities in the advanced detection area to a reduction in shocks and energized object detections

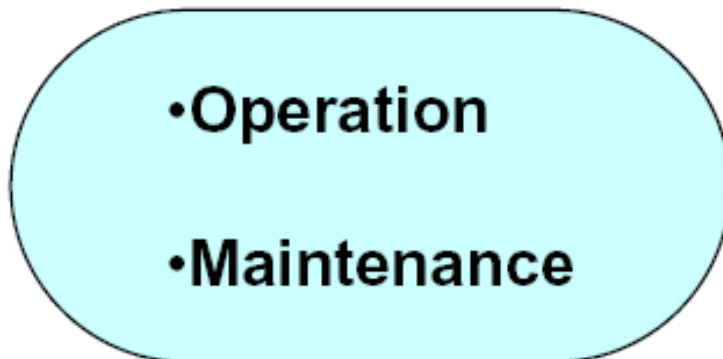
The System Safety Approach

System Safety Approach...

...Leads to:



Prevention



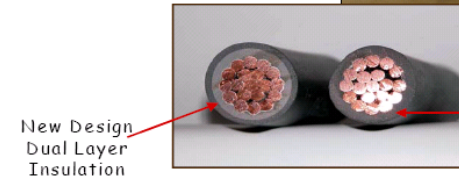
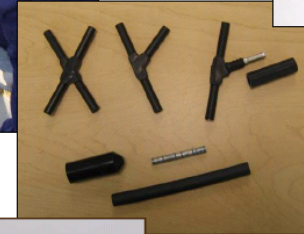
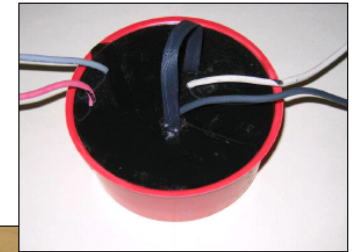
**Detection &
Mitigation**

Analysis



- Statistical analysis for identifying trends in failures
- Root cause analysis to find out what causes these failures
- Apply analysis to create better design and construction practices

Design and Construction



Operations

- Mobile SV detectors
- Site Safety
- Electrician support



Maintenance



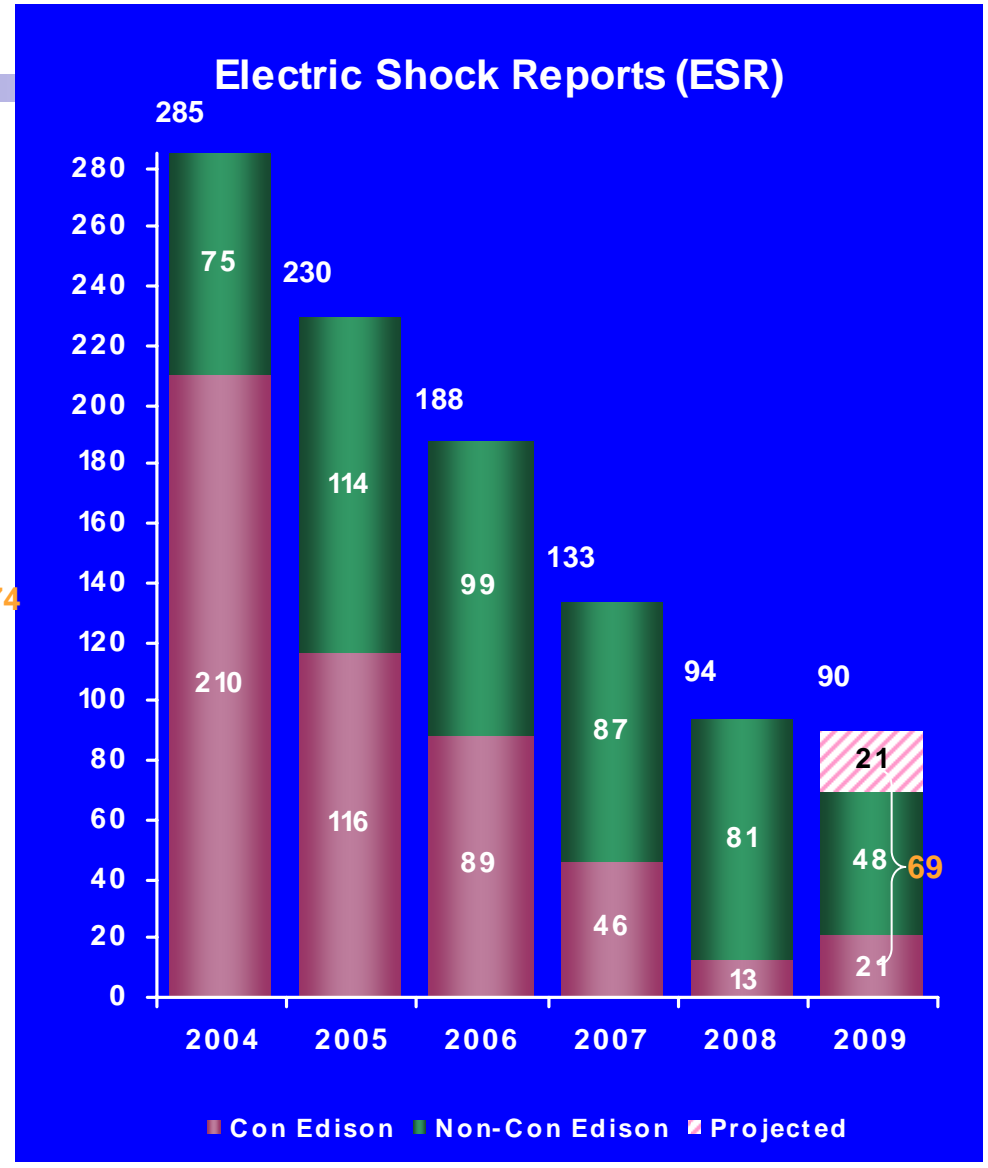
Inspection



Testing

The Big Picture

Excerpts from the Con Edison Presentations



Research and Development

- EPRI personal arc fault detector
 - Portable device
 - Intended for crews to use in manholes while performing work
 - Possible mobile application
- Texas A&M network arc fault monitor
 - Online system
 - Data collection and analysis ongoing
- Advanced Stray Voltage Detection initiative
 - Identify methods to deploy mobile detectors more effectively
 - Develop models to evaluate inspection and testing cycles to ensure that they are optimized
 - Collect and analyze harmonic data to better understand failure modes
 - Continue to invest in the development of new mobile detection technology

Excerpts from the State of New York PSC Presentation – (2008 presentation)

History

- Jodie Lane incident – January 2004
- Order for Con Edison – February 2004
- Proposed standards issued - July 2004
- Electric Safety Standards - Commission Order issued January 5, 2005
 - On PSC web site:
www.dps.state.ny.us
- **New Requirements:**
 - Compliance with NESC
 - Annual Stray Voltage Testing
 - Quality Assurance
 - Recordkeeping
 - Certification of testing results
 - Notification of shock reports
 - Annual reporting requirements
 - Performance Mechanism

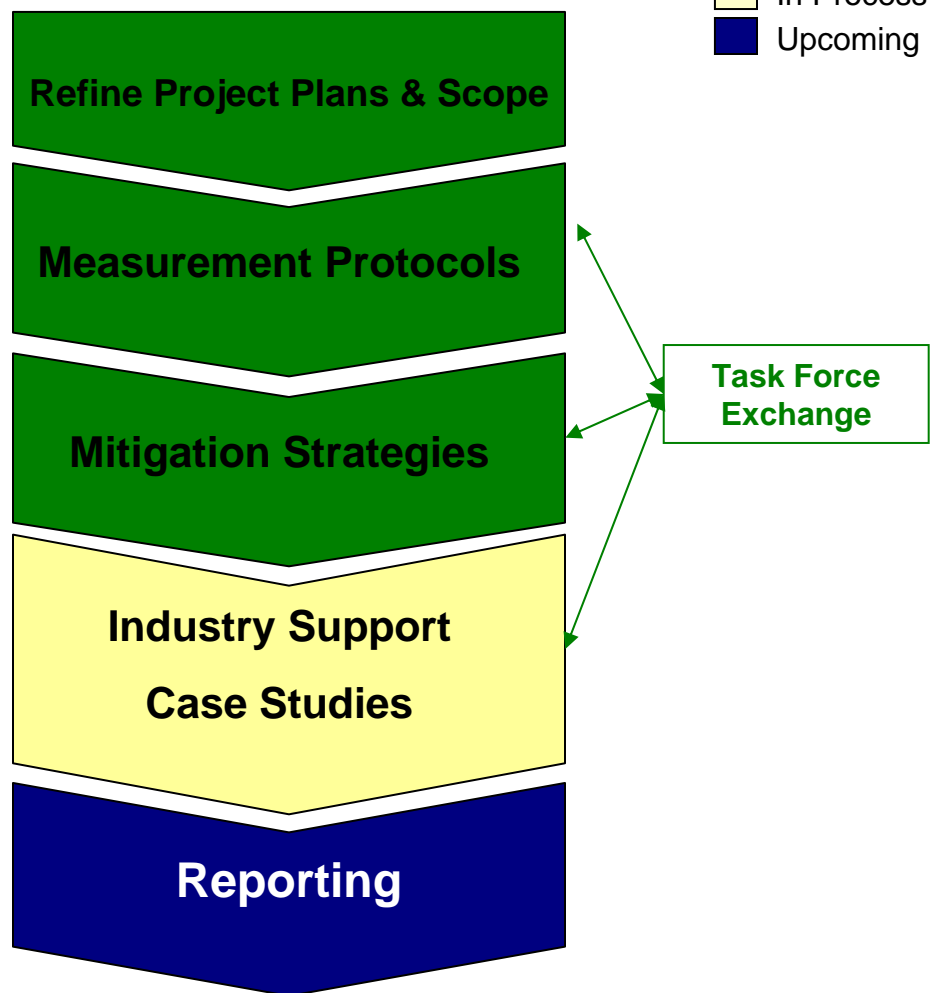
Stray Voltage Testing Requirements

- **Testing equipment**
 - The safety standards require use of testing devices certified to detect a range of 8 to 600V
 - Widely-used device (HD LV-S-5) has range of 4.5 to 600V
 - Experience indicates that it can detect voltage below 4.5V
 - Detections of voltages $\geq 1V$ are recorded and reported
 - Certification pending for mobile test device
- **If voltage is found**
 - Utility must make the condition safe before leaving
 - Permanently repair condition within 45 days
 - Notify responsible person if customer-owned equipment is the underlying cause

Excerpts from the EPRI Presentations

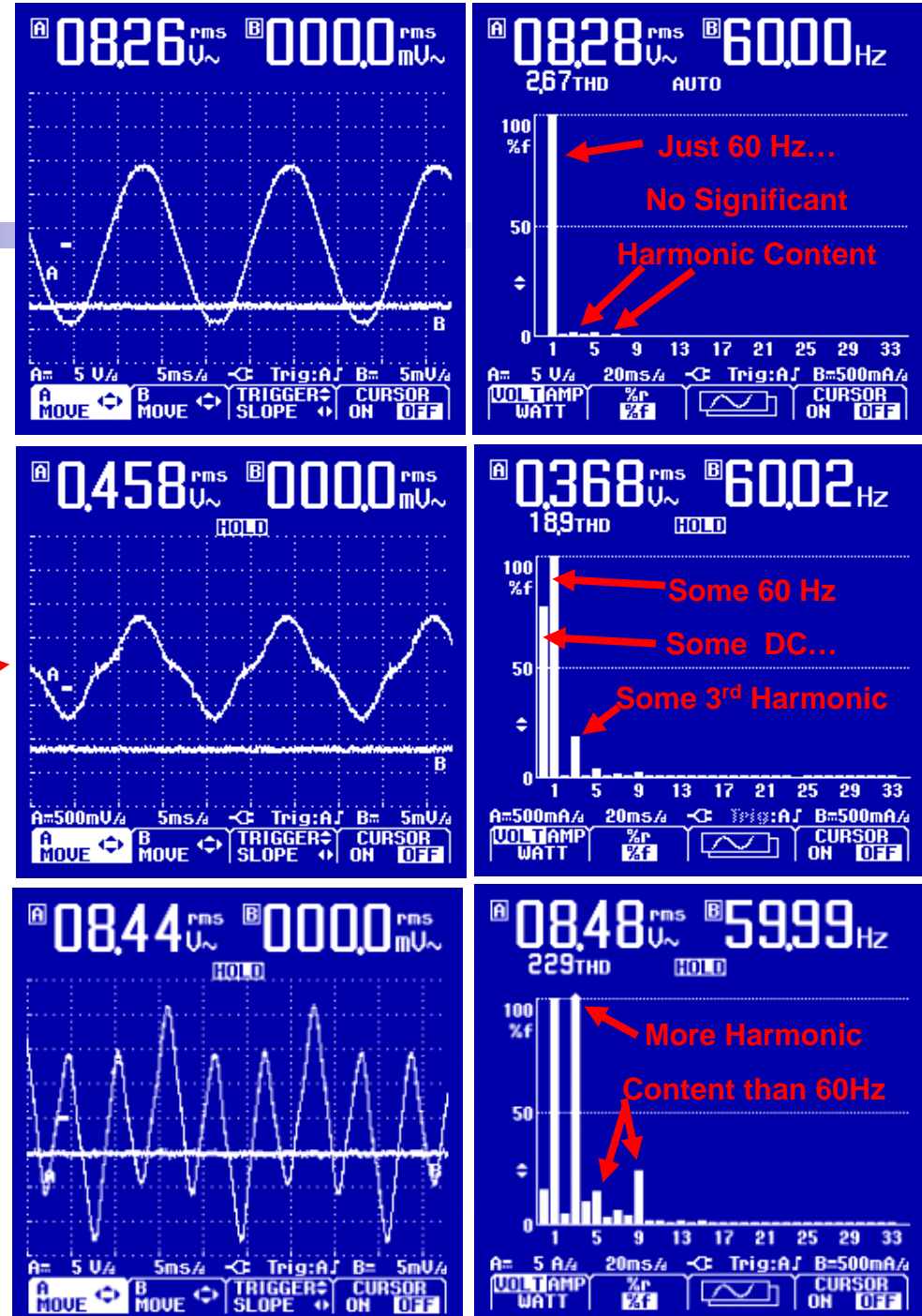
- EPRI has been conducting research on contact voltage concerns since the late 1990s
- Objectives of the EPRI program:
 - Provide credible, unbiased information to the industry on the subject matter
 - Conduct core research into areas of need as identified by the electric utility industry
 - Develop advanced diagnostic equipment to improve worker and public safety relative to the subject matter
 - Maintain an informational website and support industry forums (like the Jodie Lane annual conference)

Key Tasks and Milestones



EPRI Finding: Waveform Analysis Allows for ID of Contact Voltage Sources

- 60 Hz Faulted Phase Conductor
- Higher Harmonic Content Neutral to Earth Voltage
- Voltage Snapshot Gas Pipeline to Remote Earth



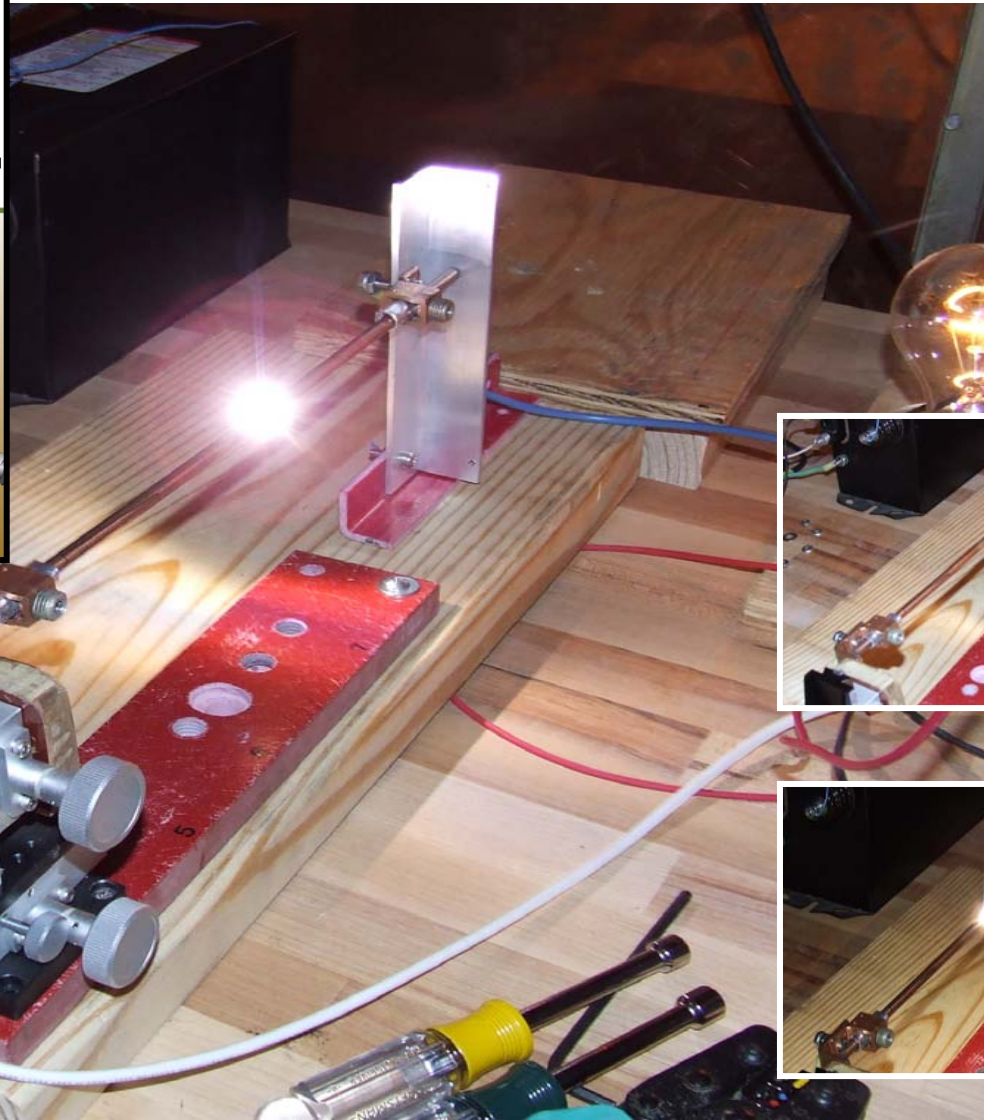
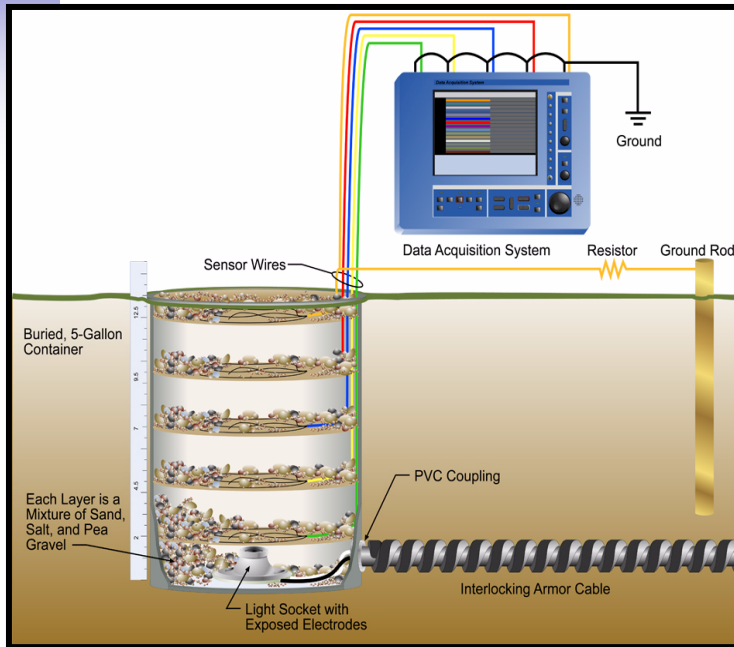
Excerpts from the EPRI Presentations

Excerpts from the EPRI Presentations

EPRI has Developed an Advanced E-Field Meter for Directional Location of Energized Objects



Algorithms to Detect Arcing before it Reaches the Surface of a Sidewalk



- Based on UL Arc Fault Breaker Test
- Stabilized Arc which allows for simplified measurements
- Waveform analysis provides clues for detection

EPRI Research Conclusions

- The P128.005 Base work will continue to develop case studies, support industry efforts and conduct core research into all types of contact voltage concerns (urban areas, residential and farms)
- Supplemental work has:
 - Developed prototype handheld and mobile sensors that are much lower cost than the state of the art with algorithms that filter out all the “false positives” like neon signs, walk don’t walk signs etc.
 - Developed algorithms that will allow the scans to be accomplished in areas where overhead distribution circuits interfere with the sensors
 - Developed arc signature algorithms that will enhance public safety for this work and for workers in manholes

Summary

- The fifth annual Jodie S. Lane Conference provided a unique forum to discuss and share experiences related to contact voltage and other public safety issues
- The full set of presentations is publicly available and can be obtained by request: lwolfenbarger@epri.com
- The selection of presentations from this conference suggest that the ability to evaluate, detect and mitigate causes of public shock concerns within or near distribution system assets has advanced considerably over the past five years – and continues to evolve
- For more information on this subject matter please contact the EPRI “Contact Voltage Research” Manager Doug Dorr – ddorr@epri.com
407-968-3010