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Street Lighting Asset Guideline Introduction and Overview

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Today's Presentation

- Incidents, reactions
- SL Asset Symposiums, Committee, Guideline
- Contact Voltage

Incidents

- 2004: dog electrocution; energized manhole cover, fault in system
- 2007: pedestrian shock on sidewalk; streetlight cable fault; not bonded
- 2009: Grade school students shocked on snowy sidewalk; standing on handwell filled with concrete
- 2011: melted snow; 84v; bare wire under cloth

Incident Reactions: North America

- Boston:
  - Find it – Fix it: Six recommendations
  - See it – Report it: Three recommendations
  - Enforcement and Monitoring Measures: Six recommendations
- New York (mobile monitoring); Seattle, Vancouver (investigating)

Incident Reactions: Ontario

- Heightened media attention
- Increased public reporting
- Toronto experience
- ESA Symposium
- SL Asset Committee

Municipal SL Asset Symposium I

- Arranged by ESA
- Held 20 August 2009
- 137 attendees representing 79 organizations throughout Ontario; municipalities, utilities, contractors, vendors
- "The group overwhelmingly supported the establishment of a working group to develop Ontario guidelines for street lighting installations"
- Call for volunteers at Symposium

SL Asset Committee

- Initial Meeting: 14 January 2010
- Chair, Vice Chair elected
- Terms of Reference:
  - "create guidelines for the installation, operation and management of Street Lighting Assets"
  - Committee Representation:
    - Regulator/Government/Owner: 4 to 8
    - Operator/Contractor: 4 to 6
    - General Interest/Producer: 3 to 5

SL Asset Committee

- Actual Composition:
  - 20 active volunteer practitioner members representing municipal (Brampton, Mississauga, Hamilton, Markham) and provincial (Ontario) government, asset owners (Toronto Hydro), ESA, electrical utilities (Kitchener-Wilmot, Woodstock), contractors (EHMSI), General Interest (PSC) and engineering consultants (MRC, SNCL)

SL Asset Guideline

- Process
  - 10 meetings held from 14 Jan. 2010 to 22 March 2011
  - Chair met with OPCC (info) and UAC (info, recruitment)
  - Final draft R14, 56 pages
  - ESA, OPCC review: Spring/Summer 2011
  - Symposium II Autumn 2011 (07 Dec. 2011)

SL Asset Guideline, Continued

- Content
  - Introduction
  - Design and Installation
  - Operation and Maintenance
  - Management
  - Appendix

SL Asset Guideline: Introduction

- In Scope:
  - Roadway illumination equipment on public Rights of Way
  - Lighting on traffic signal poles
  - Includes poles, luminaires, brackets, photocells, lamps, relays, conductors, ducts, handwells, vaults, and associated hardware.

Guideline: Introduction Continued

- Out of Scope:
  - Non roadway illumination on or off Public R/W
  - All other illumination equipment not on Public Rights of Way
  - Specifically out of scope: traffic signals, flashing beacons, lighted pedestrian crossovers, park walkway lighting, parking lot lighting, sports lighting, area lighting and bus shelters
  - Acknowledged Contact Voltage may be present on out of scope items

Guideline: Introduction Continued

- Summary of Incidents
  - Background, Sources of Contact Voltage

Guideline: Design & Installation

- Components
  - Conductor/Cable, Connectors, Poles, Brackets, Luminaires (Ballast, Lamp, Starters), Receptacles, Protection & Control, Ducts, Handwells
- Seasonal Lighting
- Grounding and Bonding
  - Function/Role, Effective Ground/Bond (Components, Materials, Methods, Resistance, Testing, How to), Impact

Guideline: Design/Inst., Continued

- Voltage Drop
- Demarcation Points and Service Entrances
- Inspection and Verification
- Third Party Attachments & Reg. 22/04
  - Design, Construction

Guideline: Operation & Maintenance

- Minimum Maintenance Standards
  - OESC, CSA, Non-Routine (Critical Failure), Routine, Inspection, Locates, Targets
- Troubleshooting
- Detecting/Testing Contact Voltage
  - Equipment, Measurement, Characterization, Mitigation
- Safe Limits of Approach

Guideline: O & M, Continued

- Contact Voltage Detection Program
  - Yes or No?, Effective Methods, Frequency, Element Development, Personnel, Action

Guideline: Management

- Pole Testing and Replacement
- Condition Surveys
  - Poles, Brackets, Luminaires, Handwells, Trees
- Expected Life of Roadway Lighting Assets

Guideline: Appendix

- IEEE "Grounding of Distributed Low-Voltage Loads: The Street Lighting Systems."
- Definitions
- References
- Survey Summary

SL Asset Guideline: References

- OESC
- Municipal and Provincial Standards
- Guide to Municipal Standard Construction MEA Part 6 Street Lighting
- IEEE Standards 142 and 1100
- TAC Guide for the Design of Roadway Lighting
- CSA C22.3
- IES RP-8

Contact Voltage (CV)

- Often referred to as:
  - Stray voltage
  - Step/touch potential
  - Tingle voltage
- Prevalent on farms with farm animals
- Fault in internal wiring

CV, Continued

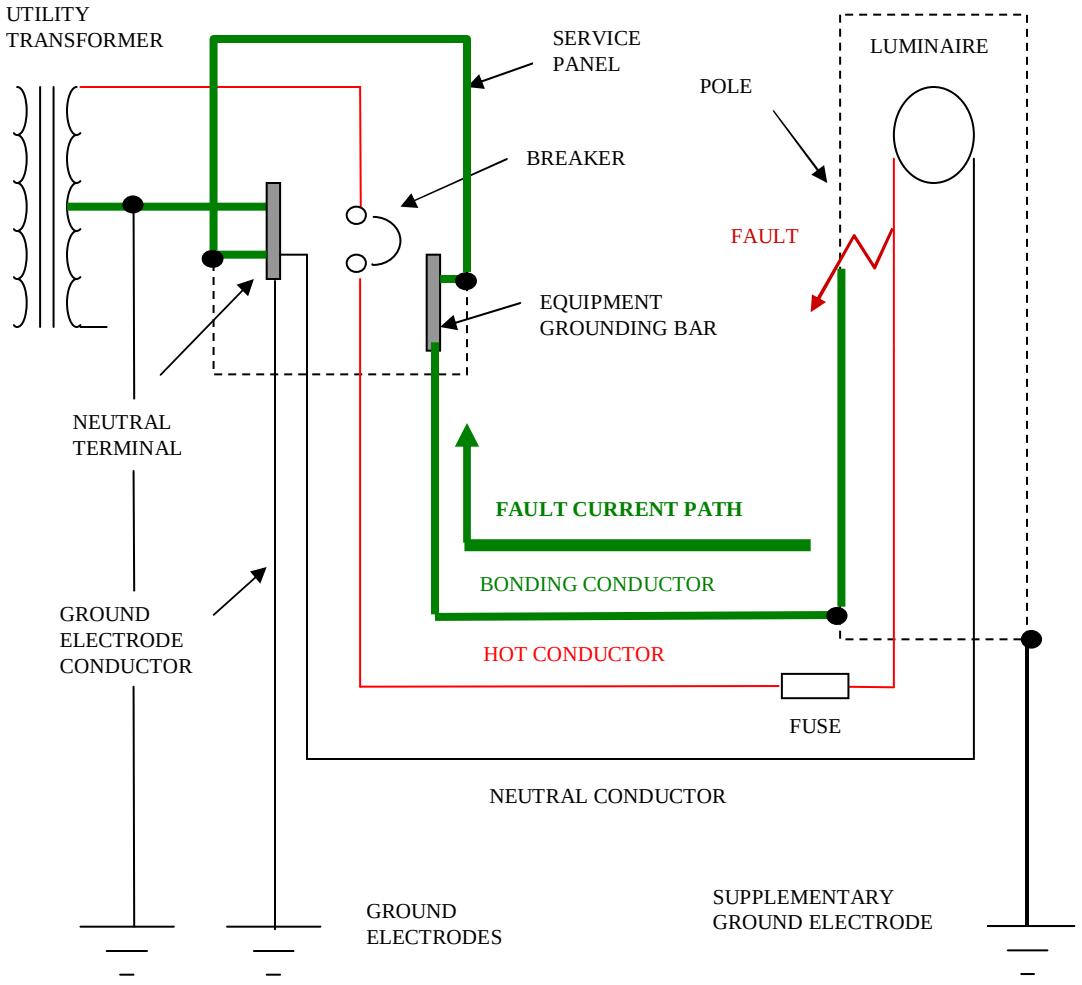
- Root Causes:
  - Insulation breakdown, improper wiring
  - Compromised or missing bond path
  - Compromised or missing up stream circuit protection
  - Aged infrastructure
  - Vehicular accidents with plant
  - Damage caused by rodents, vandalism
  - High impedance (Z) path for low fault current below protection threshold

CV, Continued

- Locations where CV is found in street lighting system:
  - Pole
  - Sidewalk
  - Handwell
  - Electrical panel
  - Luminaires

CV, Continued

- Fault Current Path Diagram
  - Bond path provides low Z path to ground
  - Alternative paths are high Z resulting in CV=IZ



CV, Continued

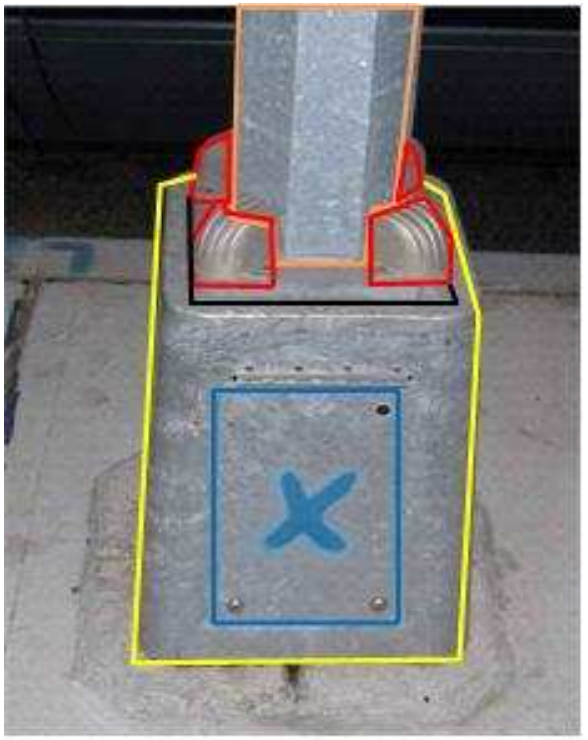
- Grounding (earth electrode) vs. Bonding (non current carrying conductive components)?
- Ground rod vs. ground plate vs. field ground? (all acceptable OESC methods)
- Multiple grounds (Service entrance, elsewhere)?
- Earth resistivity studies and acceptable level?

CV, Continued

- CV Detection:
  - Direct (programmed testing)
  - Causal (maintenance)
  - Incidental (public)

CV, Continued

- Direct Detection (Testing)
  - Mobile electric field detection
  - Electric low voltage detection
  - Pen detectors (5v)
- Test while circuits are energized
- Test all parts of SLS
- Verify with volt meters
  - ensure 0v ground reference (hydrant, electric field sensor)



CV, Continued

- Causal Detection (Maintenance)
  - Check for CV before troubleshooting
  - Perform maintenance
  - Check for CV on all parts of system before leaving call

CV, Continued

- Incidental Detection (Public)
  - Pets are the new "canary in a coal mine"
  - CV most prevalent with melting snow and salt, or wet conditions
- Test CV with a volt meter, ensuring sufficient distance between zero potential ground reference and CV location
- Report to local authority, e.g. ESA

CV, Continued

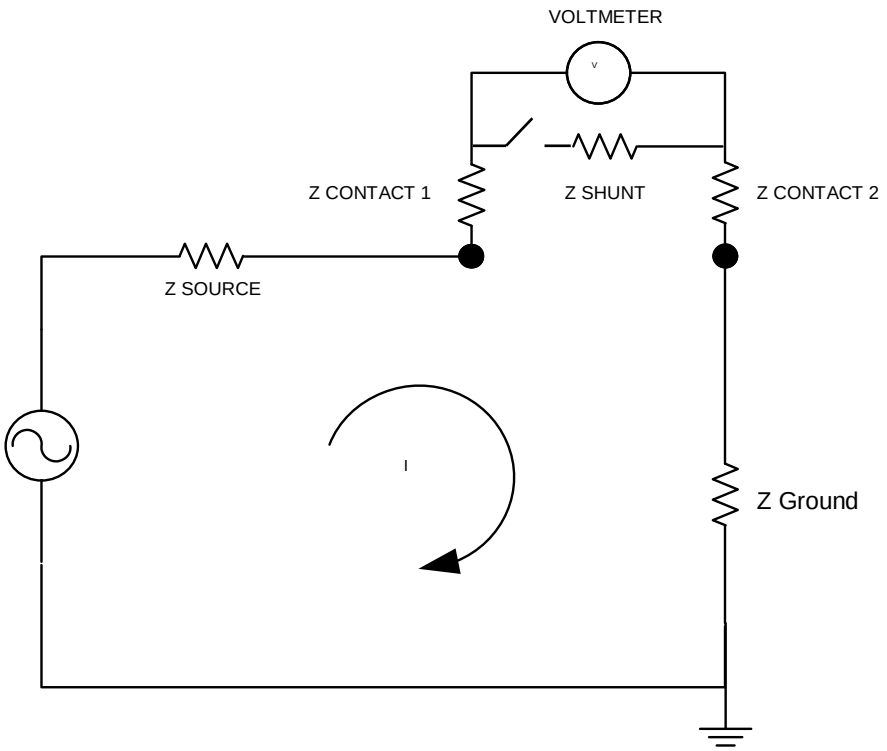
- Acceptable CV level?
  - 0v?
  - 10v?
  - Elevated neutral to earth voltage (NEV)?

CV Test Methodology

- Verify CV with a volt meter
- Locate zero potential ground reference (street furniture, hydrant, fence) and ensure it is not energized
- Use long (15m) ground leads
- Make contact with bare metal using strong clamps

CV Test Methodology, Continued

- Z Shunt Measurement:
  - Measure V with & without 3Kohm shunt Z and compare
  - If difference <90% without shunt, Z source > Z shunt, CV present
  - If >90%, Z source and Z shunt both high indicating false +, safe, capacitive coupling



CV Source Characterization

- CV
  - Faults in internal wiring
- Open Neutral
  - Return I sent through ground, energizing equipment proportional to I x Zground

CV Source Characterization, Cont'd

- Neutral to Earth Voltage
  - Neutral voltage rise: I x Zneutral
  - Normally occurring condition
  - Identified by > 10% THD harmonic distortion analysis
  - Alternatively, disconnect SL and bonds and re-measure
  - If close to 0, not NEV, may be CV

CV, NEV Trouble Shooting

- Rule out reverse polarity
- Remove fuse; if measurement falls to zero, fault downstream
- Load circuit (1,000w, heater, dryer, beast of burden) to check neutral integrity
- Identify location of CV source and make repairs

CV Mitigation

- Ensure integrity of bond path from load back to panel and have appropriate up stream circuit protection
- Bond all non-current carrying conductive components of the SLS with appropriate sized conductor
- Be aware: Some fault currents may not be high enough to trip up stream circuit protection yet high enough to create CV

CV Mitigation, Continued

- Use non-conductive handwells and covers
- Use handwells as cable pull points only, or eliminate completely if possible; no below grade connections in handwells

CV Mitigation, Continued

- Create barriers
- Use equipment for the purpose it is rated for, especially connectors
  - Ex.: Seasonal Lighting Weatherproof Receptacle Cover

CV Mitigation

Be Diligent!

Questions, Comments:

Thank You!