ELECTRICAL LEAK LOCATION - ELL (SURVEYS & TESTING)
TOPICS

- Introduction – Conditions & Performance
- Research & Data
- ASTM’s & Methods
- Projects and Results
- State Regulatory Positions
- Summary
ELECTRICAL LEAK LOCATION CONDITIONS – PERFORMANCE:

- Conductive medium above the surface.
- Conductive medium through holes.
- Conductive medium below the surface.
- Medium above surface not in contact with medium below (isolation).
- Current only flows through leaks.
ELECTRICAL LEAK LOCATION: ADVANCED TECHNOLOGY
According to a landfill leakage and quality assurance study (Abigail Gilson Beck, 2012), if no geoelectric survey is performed, there is a 22.2% probability of exceeding the action leakage rate (ALR), and only a 7.1% probability exists if the Dipole Method is used. However, if both an exposed geomembrane test and a Dipole survey are performed, the probability is reduced to 0.00001%.
CQA & TESTING REDUCES RISK

Chance of exceeding typical ALR* in covered Applications

- Factory New
- Installed No CQA
- Good CQA
- CQA / Spark Test
- CQA / Spark / Dipole
OCCURANCE OF LINER DEFECTS

Survey Data - Liner Defect Occurrence, Nosko (1996)

- Preliminary Construction Phase - 24%
- Final Construction Phase - 74%
ASTM’s & METHODS
ASTM’S FOR ELECTRICAL LEAK LOCATION

- ASTM D6747 – Selection / Method
- ASTM D7002 – Exposed Water Puddle Method
- ASTM D7703 – Exposed Water Lance Method
- ASTM D7953 – Exposed Arc Testing Method
- ASTM D7240 – Spark Testing Method
- ASTM D7007 – Covered Earth / Water Method (Dipole Method)
Good starting point: Getting familiar with methods.
Test Methods and Applications
Exposed / Covered
Comparisons & Limitations
Each method has advantages and limitations and certain methods can be more suitable for certain conditions; the leak location practitioner should be allowed to select from available methods.
EXPOSED WATER PUDDLE METHOD

- Can detect leaks as small as 1 millimeter diameter.
- Constant water source required.
- Installation or manufacturing defects not construction damage.
- Most suited for flat surfaces and slopes no steeper than 2H:1V.
Want big impact? USE BIG IMAGE.
EXPOSED WATER LANCE METHOD

- Can detect leaks as small as 1 millimeter diameter.
- Constant water source required.
- Installation or manufacturing defects not construction damage.
- Most often used on slopes but can be used on flat surfaces.
EXPOSED ARC TESTING METHOD (HOLIDAY TESTING)

• Sensitivity testing procedures same as other exposed survey methods (holes as small as 1 millimeter diameter can be detected).
• Biggest advantage: does not require application of water.
• Biggest disadvantages: no ponded water and the geomembrane has to be relatively clean.
CONDUCTIVE GEOMEMBRANES

SPARK TESTING

- For double-lined installations, electrical liner integrity surveys can’t always be used, or are not as economical as spark testing.
- Only for new construction – must specify conductive-backed geomembrane.
- Works only on bare, conductive–backed geomembrane.
- Exposed seams can present issues with ELL.
SPARK TESTING – ASTM D 7240
SPARK TESTING – ASTM D 7240

[Diagram showing power source, grounding pad, and test wand, with an image of a spark event]
SPARK TESTING NEAR FUSION WELDS

CONDUCTIVE GEOMEMBRANE HAS FALSE POSITIVES

- Created when electrical current passes through the weld
- Alerts as though a leak was found
## EXPOSED ELECTRICAL LEAK LOCATION (ELL) SURVEY COMPARISON

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Performed By</th>
<th>Water Required</th>
<th>Favorable Subgrade Required</th>
<th>Inspection During Construction</th>
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<td>ASTM D7240 (Spark Testing)</td>
<td>Installer/Contractor</td>
<td>No</td>
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DIPOLE METHOD (COVERED)

- Performed after the cover materials are placed (water or soil/aggregate).
- Primarily used to detect large holes due to construction damage.
- Can detect holes as small as ¼-inch diameter.
DEMONSTRATION OF DIPOLE METHOD CONCEPTS:

TESTING
ELECTRICAL LEAK LOCATION SURVEY RESULT – CONTOUR MAPPING

(ASTM D7007 – DIPOLE METHOD)
DAMAGE FOUND WITH DIPOLE TEST

Figure 6: Dozer Rip

Figure 7. Corresponding Anomaly in Voltage Map at Figure 6 Leak Location
PROJECTS & RESULTS
DIPOLE METHOD

12-INCH AGGREGATE COVER ON HDPE GEOMEMBRANE (TEAR / RIP)
DIPOLE METHOD

12-INCH AGGREGATE COVER ON HDPE GEOMEMBRANE (TEAR / RIP)
DIPOLE METHOD

12-INCH AGGREGATE COVER ON HDPE GEOMEMBRANE (PUNCTURE)
ARC TESTING METHOD

EXPOSED HDPE GEOMEMBRANE (PUNCTURE)
ARC TESTING METHOD

EXPOSED HDPE GEOMEMBRANE (PUNCTURE)
ARC TESTING METHOD

EXPOSED CONCRETE BASIN WITH PAINT COATING (CRACKS IN CONCRETE FLOOR SLAB)
ARC TESTING METHOD

EXPOSED CONCRETE BASIN WITH PAINT COATING
(METAL PENETRATION IN CONCRETE FLOOR SLAB)
CONSIDERATIONS

- **Location**: South Carolina
- **Product**: 60 Mil HDPE
- **Special Conditions**: Project required to perform Electrical Leak Location under a Consent Agreement.
- **Result**: Multiple punctures found and repaired. Project engineer now requires Electrical Leak Location on all projects.

- **Location**: North Carolina
- **Product**: 60 Mil HDPE
- **Special Conditions**: NCDEQ Allowed for a reduction in cover soil placement from 2’ to 1’ provided an Electrical Leak Location Survey is Performed.
- **Result**: Five punctures were located and repaired following survey.
STATE REGULATORY POSITIONS
### Table 3 - Results of 2016 Survey of State Environmental Agencies with Regard to Use of the Electrical Leak Location Survey (ELLS) Method

<table>
<thead>
<tr>
<th></th>
<th>Is Your agency familiar with ELLS?</th>
<th>What is your position on its use in a GM landfill?</th>
<th>Where in the cross section is your agency's focus?</th>
<th>Which stage of construction is ELLS to be performed?</th>
<th>What is your agency's position on ELLS for locating leaks in surface impoundments?</th>
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CHECKLIST

- Responsibilities – All parties involved / acknowledgments.
- Laborers – Assistance needed during the survey.
- Equipment – Machines and operators if necessary.
- Isolation & Conductivity – Maximize results.
- Power Supply
- Safety
Provisions for Electrical Leak Location should be addressed as part of the construction contract.

More and more states including North Carolina are requiring ELL surveys on all New Landfills, or on a site by site basis depending on need.

Electrical Leak Location Contractor needs to review plans and specs carefully and communicate with the General Contractor early in the project.

Beware of using marketing material as your specifications.

Never specify a maximum allowable or minimum detectable hole size (use ASTM for guidance and direction).

Do not specify a certain method be used. Rather, specify that ASTM D6747 be used to make the selection.
QUESTIONS?
Andrew Colby
Engineering Associate
Bunnell-Lammons Engineering, Inc,
Mobile Phone Number: 864.380.8545
Office Phone Number: 864.288.1265
andrew.colby@blecorp.com