External corrosion
Direct Assessment Seminar

Houston 2009
NACE ECDA Seminar

ECDA ‘Clean’ Data & D.E. Success Rate
Agenda

- Union Gas (A Spectra Energy company)
- ECDA Step Overview
- Indirect Inspection - 'Clean' Data
- Direct Examination 'Success'
- Questions?
Union Gas Ltd.

- Transmission, Distribution, and Storage
- Transmission integrity program per Canadian Regulations
- Utilizes ILI and ECDA
- ECDA
  - Started in 2004
  - To date 34 pipelines (or partial pipelines) and 142 DE (111 excavations)
ECDA Steps Overview

- Pre-Assessment
- Indirect Inspection
- Direct Examination
- Post Assessment

Note:
- Excellence in Data
- Accountability Steps 1-4
Indirect Inspection – ‘Clean Data’

- Influence testing
- CIPS / DCVG (ACVG)
- AC Attenuation
- Soil Resistivity
- AC Voltage
Indirect Inspection

Influence Testing

- Line needs to be ‘clean’
- All influencing rectifiers are simultaneously interrupted
- No dynamic stray currents (tellurics)
Checking that the Line is “Clean”

- Record a waveform during the OFF cycle and search for single-phase and three-phase rectifiers fingerprints.
- Install recorders for tellurics
- Check for obvious “false OFF” potentials
- Assess the magnitude of lateral gradient in Off cycle
- Complete telluric compensation as required
Waveform
(As Captured by a Field Oscilloscope - OFF Cycle)
Frequency Spectrum
(As Displayed by the Instrument)
Spectrum Analysis

DC Component – Matches survey value
60 Hz Component – Filtered by the survey equipment
120 Hz Component – Fingerprint of a single-phase rectifier left ON or out of sync. With a 270 mV value, the line is not “clean”.
180 Hz component - Fingerprint of a three-phase rectifier left ON or out of sync and/or harmonics of 60 Hz. A 340mV value versus 1620 mV 60 Hz is probably a harmonic.
Tellurics
CIPS Data. As Measured.
Tellurics
CIPS Data. Tellurically Compensated.
Problems During Indirect Inspections

Interrupter Failure (Telluric Record at Remote TP)
Problems During Indirect Inspections

High Contact Resistance

( CIPS in Northern Ontario)
When the contact resistance ($R_c$) is within the same range as the internal resistance of the voltmeter ($R_v$), the measured value would be only half of the real potential.

\[ V_{meas} = \frac{V}{1 + \frac{R_c}{R_v}} \]
The area was ‘surveyed’ twice (once using a 1MΩ spoiler) and the “true potential” was calculated using simple math.
Problems During Indirect Inspections
Low Shifts during DCVG Survey
(CIPS/DCVG in Northern Ontario)
Problems During Indirect Inspections

Low Shifts during DCVG Survey
– Direct Measurements

\[
\% IR = \frac{\Delta G_{OL-RE}}{\Delta V_{RE}}
\]

To validate the calculated \(\% IR\), we measured both the lateral gradient and the pipe-to-soil potential to remote earth.
The results show a very good match.
Problems During Indirect Inspections

- Low Shifts during DCVG Survey
  - DE Results (Photo)

- Extended Coating Damage at Chainage 1101.6
Problems During Indirect Inspections

- Low Shifts during DCVG Survey – DE Results (Coating Inspection)

LEGEND

- Disbonded Coating
- Bare Pipe & Disbonbed Coating
- Unexcavated

Note: Part of the disbonded coating came off during excavation. The entire coating was removed.
Problems During Indirect Inspections

Coating Quality Under New Asphalt
(No Permission to Drill Holes)

AC Attenuation. Rate of Loss.
Indirect Inspection

• Criteria for identification of indications
• Criteria for classification of indications

Direct Examination

• Prioritization
• Select D.E. sites

Flag:
  – How well we do on DE?
  – Need to predict what we expected to find!
# Prioritization Table Sample

<table>
<thead>
<tr>
<th>DC Voltage Gradient Indication</th>
<th>Close Interval Potential Survey Indication</th>
<th>DC Interference (DCI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SV</td>
</tr>
<tr>
<td>DCVG-SV</td>
<td>CIPS-SV 1</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>CIPS-MD 2</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>CIPS-MN 3</td>
<td>I</td>
</tr>
<tr>
<td>DCVG-MD</td>
<td>CIPS-SV 4</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>CIPS-MD 5</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>CIPS-MN 6</td>
<td>I</td>
</tr>
</tbody>
</table>
## Prioritization Table (Cont’d)

<table>
<thead>
<tr>
<th>DC Voltage Gradient Indication</th>
<th>Close Interval Potential Survey Indication</th>
<th>DC Interference (DCI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SV</td>
</tr>
<tr>
<td>DCVG-BT</td>
<td>CIPS-SV 10</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>CIPS-MD 11</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>CIPS-MN 12</td>
<td>I</td>
</tr>
<tr>
<td>DCVG-NI</td>
<td>CIPS-SV 13</td>
<td>I*</td>
</tr>
<tr>
<td></td>
<td>CIPS-MD 14</td>
<td>I*</td>
</tr>
<tr>
<td></td>
<td>CIPS-MN 15</td>
<td>I*</td>
</tr>
</tbody>
</table>

*Consider excavating a short section of line under severe risk of external corrosion, even if DCVG indications were not found.*
Direct Examination Success

- Expectation of findings from the predictions (for each DE)
- Actual findings from each DE excavation
- Compared the predictions to the actual findings
Direct Examination - Prediction

Coating Condition and Metal Loss
(Only two areas to predict)

- Relatively simple, straightforward statements in ECDA reports
- Variety of terms used in the reports to describe the severity of each area on 122 ‘recommended’ sites
Direct Examination - Findings

Coating Condition and Metal Loss

- Detailed findings documented by measurements & photos for each area in the reports
- Again a variety of descriptive terms used
Direct Examination - Comparison

Coating Condition and Metal Loss

• Categorized and scaled the descriptive terms used from both coatings and metal loss
• Done for both predictions and findings
• Made relative evaluations within and between all categorizations
<table>
<thead>
<tr>
<th>DE Descriptor</th>
<th>Expectation</th>
<th>Finding</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE#2. 8&quot; Augusta Lateral Ch. 4504.70 m</td>
<td>- Minor holidays</td>
<td>- Four very small holidays (jeep indications) (two pinholes, 0.5x0.1cm, 0.2cm diameter)</td>
<td>90</td>
</tr>
<tr>
<td>DE#2 Ch. 1009.40 m</td>
<td>- Minor holidays</td>
<td>- Eight very small holidays (jeep indications) (two 0.3cm, 0.4cm, 0.8cm, 1cm diameters; 0.4x0.2cm, 1.0x0.5cm, 1.3x0.5cm) - Some of the jeep indications appeared fresh and may be the result of probing the line during excavation - Five of the jeep indications were on the longitudinal weld</td>
<td>100</td>
</tr>
<tr>
<td>DE#5 Ch. 3896.40 m</td>
<td>- Small holidays</td>
<td>- One small holiday (5cm diameter) and nine very small holidays (jeep indications) (0.1 to 0.5cm diameter dents, 0.5x0.1cm scratch)</td>
<td>100</td>
</tr>
<tr>
<td>DE#4 Ch. 1454.90 m (Validation with indication)</td>
<td>- Minor holidays</td>
<td>- Five &quot;minor&quot; coating holidays (3cm, 4cm, and three 5cm diameters) in field applied Denso tape, 20-30% damaged</td>
<td>100</td>
</tr>
<tr>
<td>DE#1 Ch. 256.60 m</td>
<td>- Minor holidays</td>
<td>- Eight very small holidays (jeep indications) covered by calcareous deposits (3cm, 6cm, 6cm, 10cm, 10cm, 15cm diameters; 10x3cm, 30x20cm) - Extent of coating damage could not be measured due to adherent calcareous coverage - Spot of poor adhesion (1-2cm dia.) was found at jeep indication with largest deposit</td>
<td>100</td>
</tr>
</tbody>
</table>
Direct Examination - Comparison

For each Direct Examination

• Compared coating expectation to finding
• Compared metal loss expectation to finding
• ‘Scored’ the comparison by %
• Averaged the two % comparison
Direct Examination - Results

Prediction vs. Finding

- 27 pipelines
- 122 DE (some validation)
- Approx 4 DE = n/a
- Overall success rate of 95%
Questions?

• Questions?