Cost Analysis of Pipeline Cathodic Protection Remote Monitoring Systems

**Jose Oviedo and Nick Klaudt**
Corrosion Prevention Technical Services, Houston, TX
The Challenge

Develop a methodology to compare the cost of On-site Inspections vs Remote Monitor Inspections for Cathodic Protection current sources
The purpose of this presentation is to offer examples of the methods used to determine the costs of remote monitoring and on-site inspections.
What is Corrosion
A naturally occurring phenomenon commonly defined as the deterioration of a material (usually a metal) that results from a chemical or electrochemical reaction with its environment.

What is Cathodic Protection
A technique to reduce the corrosion rate of a metal surface by making that surface the cathode of an electrochemical cell.
Cathodic Protection Components

• **Rectifiers** are the power source for impressed Cathodic Protection systems *(6x per calendar year not to exceed 2.5 months)*

• **Bonds** are the safe path to transfer current back to a Foreign current source *(6x per calendar year not to exceed 2.5 months)*

• **Test Point** voltage readings measured during the Annual Survey verify the effectiveness of the Cathodic Protection System *(1x per calendar year not to exceed 15 months)*
Cathodic Protection Components
Options Considered for the Methodology

1) 100% on site Inspections
2) 100% remote monitor Inspections
3) Combination of 1 and 2:
   1) Option 3 requires considerations to prioritize locations for Options 1 or 2
      1) Geographic
      2) Critical Assets
      3) Available Qualified Personnel
      4) Cost of inspections
Methodology

- Determine the primary reason to use RM
- Interview the Suppliers and analyze responses
- Conduct a case study
  - Breakdown the costs
    - Annualize over 5 years
    - Cost Per Unit
- Cost Control Considerations
What is the primary reason you install remote monitors?

Answer Breakdown:

- Monitor the integrity of the CP system: 51.11% (23 responses)
- Cost savings: 28.69% (13 responses)
- Current Interruption: 15.66% (7 responses)
- I don’t use remote monitors in my area: 4.44% (2 responses)
- Total: 100% (45 responses)
Remote Monitor Supplier Questionnaire

• Reliability Data for Remote Monitor Equipment
  o Predict the number of repairs
    • Uptime vs downtime
    • Meantime between failures
    • Reliability Factor
    • Cost of Repairs
  • Product Reliability Test Results
    o Third Party Testing
Remote Monitor Supplier Questionnaire

• Existing policy to cover costs of units with high failure rates
  o Warranty
  o Replacement Costs
  o Downtime Costs
  o Time
  o Material
  o Travel
Remote Monitor Supplier Questionnaire

• Product Grades
  o Standard
  o Rugged
  o Price difference
    • Is the Reliability Factor affected
Remote Monitor Supplier Questionnaire

• Volume Discounts
  o Number of Units
  o Number of Transmissions
Remote Monitor Supplier Questionnaire

• Technical Support
  o Availability
  o Remote support
  o Site visit
  o Maintenance/Repair Service Plan
Remote Monitor Supplier Questionnaire

- Is it necessary to carry an inventory of Spare Units/Parts
  - Number of Units
  - Repair turnaround time
  - Delivery time if a new unit is needed
Supplier #1

- Claim 96.2% Reliability
- 1 year warranty
- Complicated Service Plans
- Data is readily available from the web site
- Limited number of channels
- Repairs – 2 weeks to 1 month turnaround
**Remote Monitor Supplier Responses**

*Supplier #2*

- Claim 99% Reliability
- 18 month warranty
- Flat Fee Service Plan
- Data is readily available from the web site
- Multiple channels available
- Repairs – Turnaround of 1 week from receipt
Remote Monitor Supplier Responses

Supplier #3

- Claim 98% Reliability
- 5 year warranty
- Simple price structure
- 25% competitor product trade in
- Limited channels requiring multiple units
- Small Support Group
- Repairs - 6 days turnaround + shipping
The inspection cost analysis was completed in an area with 61 current sources and 66 remote monitors (5 spares)

The capital cost of the remote monitors (>134K) annualized over 5 years.
Case Study
On Site vs Remote - Periodic Inspection Cost Analysis

On Site Inspection

- Total Cost per Cycle (61) - $5,134
  - x6 = $30,802
  - x12 = $61,603

Includes
- Miles
- Vehicle Cost
- Labor Cost
- Lodging/Meals
Case Study
On Site vs Remote - Periodic Inspection Cost Analysis

Remote Monitor Inspection

• Annualized Cost for 66 Units
  • $36,055

  Includes

• 1/5th of Capital Investment
• Monthly Service Fee x 12
• Unit Replacement Costs
  • Reliability Factor 93.4
    ▪ Equivalent to 4.4 units per year
  • Repair Time/Travel Cost
Case Study
On Site vs Remote - Periodic Inspection Cost Analysis

On Site Inspection

- Annualized Cost/Site Visit (61)

  - X6 $505
  - X12 $1,010

Remote Monitor Inspection

- Annualized Cost/Remote Monitor (66)

  - $508
Case Study for Annual Survey
On Site vs Remote – Interrupted Survey Cost Analysis

On Site Interruption

Each current source should be visited prior to the Annual Survey

For an interrupted survey each current source will be visited twice

• Cost/Current Source (61)
  • Travel Costs $168
  • Current Interrupters* $118
  • x61 $17,466

*Cost of 20 portable interrupters annualized over 5 years
Remote Interruption

Current sources can be confirmed to be operating via the website

Interruption can be started for all current sources via the website

- Cost/Current Source (61)
  - Transmissions $ 31
  - x61 $1,891

Case Study for Annual Survey
On Site vs Remote – **Interrupted Survey** Cost Analysis
### Case Study Result

**On Site vs Remote – Annual Cost**

<table>
<thead>
<tr>
<th><strong>On Site Cost</strong></th>
<th><strong>Remote Monitor Cost</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost/Current Source (61)</strong></td>
<td><strong>Cost/Current Source</strong></td>
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<tr>
<td>- 6 Periodic</td>
<td>- Periodic</td>
</tr>
<tr>
<td>- $505</td>
<td>- $508</td>
</tr>
<tr>
<td>- Interrupted Survey</td>
<td>- Interrupted Survey</td>
</tr>
<tr>
<td>- $286</td>
<td>- $31</td>
</tr>
<tr>
<td><strong>12 Periodic</strong></td>
<td><strong>Case Study Annual Total</strong></td>
</tr>
<tr>
<td>- $1,010</td>
<td>- $35K</td>
</tr>
<tr>
<td>- Interrupted Survey</td>
<td>- $79K</td>
</tr>
<tr>
<td>- $286</td>
<td>- $x12</td>
</tr>
</tbody>
</table>

- **Case Study Annual Total**
  - $48K - x6
  - $79K - x12

**Annual Cost -27%**
### Other Considerations - Periodic Inspection

**On Site Inspection**

**Pros**
- On site visual inspection
- Routine cleaning and maintenance
- Repairs can be done while on site

**Remote Monitor Inspection**

**Pros**
- Reduces risk:
  - Driving to remote sites
  - Unsafe areas
  - Weather extremes
- Redirects time:
  - Reduces the process time to collect data
  - Allows more time to analyze data
  - Reduces the need for third party data collection (O&M, Contractor)
## Other Considerations – Inspection Data

<table>
<thead>
<tr>
<th><strong>On Site Inspection</strong></th>
<th><strong>Remote Monitor Inspection</strong></th>
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<tbody>
<tr>
<td><strong>Pros</strong></td>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>• Data recorded on site</td>
<td>• Data accuracy:</td>
</tr>
<tr>
<td></td>
<td>• Redundant storage</td>
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<tr>
<td></td>
<td>• Manual data entry can be</td>
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<tr>
<td></td>
<td>eliminated</td>
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</tbody>
</table>
# Monitoring Considerations – Integrity of the CP System

<table>
<thead>
<tr>
<th>On Site Monitoring</th>
<th>Remote Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>• On site visual inspection</td>
<td>• 24/7 Monitoring for the integrity of the CP System</td>
</tr>
<tr>
<td></td>
<td>• An alarm is sent when output parameters are not met or exceeded</td>
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<tr>
<td></td>
<td>• The data is readily available to the Technician</td>
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<tr>
<td></td>
<td>• Current sources can be quickly verified prior to starting an annual survey</td>
</tr>
</tbody>
</table>
## Annual Survey Considerations – Current Interruption

<table>
<thead>
<tr>
<th>Remote Monitor Interruption Pros</th>
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</thead>
<tbody>
<tr>
<td>• Multiple current sources can be interrupted from the website</td>
</tr>
<tr>
<td>• Reduces the inventory of portable interrupters</td>
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<tr>
<td>• Reduces the windshield time to deploy interrupters</td>
</tr>
<tr>
<td>• Complete interruption requests from other companies</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>On Site Interruption Pros</th>
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<tbody>
<tr>
<td>• On site visual inspection</td>
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<tr>
<td>• Routine cleaning and maintenance</td>
</tr>
<tr>
<td>• Repairs can be done while on site</td>
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# Inspection and Monitoring Considerations

<table>
<thead>
<tr>
<th></th>
<th>On Site</th>
<th>Remote Monitor</th>
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</thead>
<tbody>
<tr>
<td><strong>Cons</strong></td>
<td>• The current source can be off between visits</td>
<td>• The initial cost of the equipment</td>
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<td></td>
<td>• Time and Travel required for periodic inspections</td>
<td>• The maintenance or repair of additional equipment at a remote site</td>
</tr>
<tr>
<td></td>
<td>• Multiple site visits to set portable interrupters</td>
<td>• Site visits to investigate alarms</td>
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</tbody>
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Cost Control Considerations

• Model Evaluation
  • Match to application
    • Two Way Communication (Higher Capital Costs)
      • Monitor Alarms
      • On Demand Readings
      • Interruption Capabilities
    • One Way Communication (Lower Capital Costs)
      • Monitor Alarms
      • Scheduled Reading Transmissions
Cost Control Considerations

• Billing Plans
  • How many transmissions are needed per month
  • How many transmissions per plan
  • What is the cost per transmission over plan
Cost Control Considerations

- Monthly Cost Monitoring
  - Transmission Overages
  - Interruption Cycles
  - Alarms
- Is there a monthly service charge for units not transmitting
  - Shelved Units
  - Units in for Repair
Cost Control Considerations

• Inventory Controls
  • Is there a need for spare units
  • Inventory Management
  • Damage Control
  • Monitor shelf life (battery, firmware)
Conclusions

• The Methodology developed represents an effective tool to evaluate the costs of On Site inspections and Remote Monitor inspections

• The Methodology revealed the need to consider additional factors for individual Case Studies
Questions/Comments