Consolidated Edison Company of New York

SMART Robot

Presented by:
Dowlatram Somrah, ME, PE
Agenda

• Con Edison Steam System Overview
• Design and Integrity of System
• Steam Leaks and Repairs
• SMART Robot Design
• Field Application
• Benefits
Con Edison Steam System Overview

- 106 miles
- Peak 9,600 Mlb/hr
- 23.2 billion lbs
Design and Integrity of System

• Design basis
  – Pressures: 200 psig, 400 psig
  – 1” – 36” diameter pipes
  – 0.179 inch to 0.675 inch wall thickness

• In-service conditions
  – No external corrosion
  – Flange Leaks
  – Flow accelerated corrosion

• Leaks impact reliability
  – Repair within 6 months
  – Main isolation
  – Safety concerns, loss of product
Finding and Repairing Leaks

- Challenges finding leaks
  - Subsurface, conduits
- Finding steam leaks
  - History/design/pinpointing leaks
- 65 leaks require an excavation
SMART Robot – Smart Maintenance

• Assess 8”- 24” diameter pipes
• Maneuver up to 30° bends
• Withstand 350° F, 100% humidity
• Inspect 500 feet length in 4 hrs
• Record distance and elevation
• Measure wall thickness & ovality
• Quantify internal corrosion
• Record video of inspection
SMART Robot Design

Rear View

- UT Probe for wall thickness
- UT Couplant Tube
- Pneumatic air supply line
- Air cooling vortex tube
- Power and data connector
- Brass body containing high temperature electronics
- Durable, high temperature tracks with rubber cleats
SMART Robot Design

Front View

Cameras

LEDs

Circumferential laser profile generator
Field Application

- 16” diameter main
  - Installed 1924
- Inspected 250 feet
  - 150 feet east
  - 100 feet west
Deploying The SMART Robot
Wall Thickness Measurement

UT Probe
Field Application - Video
Field Application – Findings

Circumferential Weld - Fully Penetrated
Field Application - Findings

Circumferential Weld – Lack of Penetration
Field Application - Findings

- Dent
- Debris
Field Application - Findings

Cap – End of Pipe
Field Application - Findings

Expansion Joint
# Field Application – Navigating Capability

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Max Sweep Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>8”</td>
<td>Straight Pipe</td>
</tr>
<tr>
<td>10”</td>
<td>7°</td>
</tr>
<tr>
<td>12”</td>
<td>15°</td>
</tr>
<tr>
<td>16”</td>
<td>20°</td>
</tr>
<tr>
<td>20”</td>
<td>25°</td>
</tr>
<tr>
<td>24”</td>
<td>30°</td>
</tr>
</tbody>
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[Diagram showing a 90° Elbow]

![Robot with articulated arms ready for field application](image)
Benefits of Using SMART Robot

• Automated reporting
• Mapping of pipe features
• Pipe integrity assessments
• Real recorded pipe data
  – Input into failure models
  – Post failure analysis
• Improved safety, efficiency and reliability
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