“Innovations in Sewer Inspection Technologies”

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Ace Pipe Cleaning Inc.
“Innovations in Sewer Inspection Technologies”

Lidar, Sonar, HDCCTV

Mapping Probes

Advanced Sonar

Laser, Sonar, HDCCTV

Acoustic Inspections

PPR Systems
Use of High Technology?

“If you’re going through the motions, do it the right way, the first time”
WHAT IS ADVANCED INSPECTION TECHNOLOGY?

• Any “Advanced Technology” is generally a platform that can detect various defects in Pipe that may be undetectable by conventional CCTV.

Ovality -21.2%
USES OF HIGH TECHNOLOGY?

- Systematically evaluate the current state- R.U.L
- High-Technology performs a thorough Condition (measured) and Capacity (debris) assessment.
- Corrosion Loss/Deterioration
- Critical data to calculate FUTURE Cap. $$

Pipe Collapse-Excessive Corrosion-$1.5 million Dollars E.R. vs planned $4-600,000.00 +/-
BENEFITS OF ADVANCED TECHNOLOGY

• Prevention of major collapses
• Quantifiable life expectancy of every asset
• Proactive Rehabilitation Plans
• Proactive Capital Expenditures Plans
• PLAN REHABILITATION- needs & methodology
• Competitive Engineering Design
• Competitive Rehabilitation-$$
• Competitive Pipe Cleaning rates-$$
SSO NATIONWIDE STATISTICS

- Infrastructure SUSTAINABILITY costs? 1+TRILLION
- Annual Sanitary Sewer Overflows
  2,000,000+- Unknown
- Sewage Discharged into Rivers and Streams
  50 billion US gallons
- One City, (just one) “Akron’s 2012- 34 remaining (CSOs) dump about
  2 billion gallons a year of untreated waste into the Cuyahoga and
  Little Cuyahoga rivers and the Ohio & Erie Canal”
- “Underdeveloped Countries”- 10 trillion US gallons of untreated
  sewage per year.
WHY PERFORM “INSPECTIONS”

- Identify
- Inventory
- Location of assets
- Condition of assets
- Investigate the functionality of a System
- Estimate the remaining service life
- Voluntary Initiative Plan (CMOM)
- Involuntary “Decree”
SIX COMMON TYPES OF INSPECTIONS

Basic Level (Level 1 Inspection)
- CCTV
- Acoustic Inspections

Advanced
- CCTV and Laser
- CCTV and Sonar
- Advanced Sonar

“Smart” Technologies
- Combination; Sonar/Lidar/Laser/HDCCTV
- PPR, GPR”*
LATERAL INSPECTION TECHNOLOGIES

- 40%+- I&I Cross bores
- Lateral; GPS-Condition Inspection
LATERAL INSPECTION - CROSS BORES

- Cross Bores in Sewer Mains and Laterals
- 2" High Pressure in Main
- 24" Jet Fuel Large High-Pressure Transmission main
- Small High-Pressure Transmission main
- 24" Jet Fuel Large High-Pressure Transmission main
RAPID ACOUSTIC BENEFITS

• Focus cleaning crews in correct locations
• <3 min. test duration
  ▪ Eliminate downstream overflows caused by upstream cleaning
  ▪ Avoid repeat overflows in known “Hot Spots” locations
  ▪ Quality Assurance of Post Cleaning
ADVANCED SONAR INSPECTION

• Sonar Submarine
  – Force Mains, Siphons
  – Surcharged Mains
  – Up to 4,500 per deployment
  – No Video cables
  – Designed to “float” at crown
MULTI PLATFORM CONFIGURATION

HD CAMERA
4 HD CAMERAS
LASER
HARD DRIVE
BATTERY
SONAR
Platforms identify:
- Corrosion in concrete
- Deflection in non-rigid pipes
- Deformation in rigid pipes
- Holes, gaskets, offset joints
- Protruding steel reinforcement
- Validate corrosion
- Structural defects
### Example of Findings: Corrosion

<table>
<thead>
<tr>
<th>DATE</th>
<th>Main Lateral</th>
<th>USID</th>
<th>DSID</th>
<th>Constructed</th>
<th>Dia</th>
<th>Material</th>
<th>PWT</th>
<th>Steel 1 (in.)</th>
<th>Steel 2 (in.)</th>
<th>MIN COR (in)</th>
<th>MAX COR (in)</th>
<th>MIN WALL LOSS (%)</th>
<th>MAX WALL LOSS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/19/2010</td>
<td>M292-014+70</td>
<td>014+70</td>
<td>005+17</td>
<td>5/15/1967</td>
<td>39</td>
<td>CONCRETE</td>
<td>4.25</td>
<td>1</td>
<td>3.25</td>
<td>1.70</td>
<td>3.00</td>
<td>40.00%</td>
<td>70.59%</td>
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</tbody>
</table>

1.25” of Pipe Wall Remaining
CLEANING SAVINGS - “SMART” vs. TRADITIONAL

ICAP PROGRAM CLEANING COST SAVINGS TO DATE = $2.9 MILLION

<table>
<thead>
<tr>
<th>Year</th>
<th>ICAP &quot;Inspect Then Clean As Needed&quot; Cost</th>
<th>Traditional &quot;Clean Completely Then Inspect&quot; Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>$391,666</td>
<td>$1,881,672</td>
</tr>
<tr>
<td>Year 2</td>
<td>$556,738</td>
<td>$1,974,789</td>
</tr>
<tr>
<td>To Date</td>
<td>$948,404</td>
<td>$3,856,461</td>
</tr>
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</table>
REMAINING USEFUL LIFE

- Remaining Useful Life developed for each concrete pipe wall specification
- Condition Score for concrete pipes based on location of steel reinforcement cage
- Developed in AutoCAD to maintain a 1:1 scale
Remaining Useful Life:
Example of Matrix Criteria

• **Rating 1**: 0 to 0.5 inch from inner pipe wall.
• **Rating 2**: 0.5 to face of first row of steel.
• **Rating 3** (Yellow): Face of 1\(^{st}\) row of steel to half distance to 2\(^{nd}\) row of steel.
• **Rating 4**: Half the distance to 1\(^{st}\) row of steel to face of 2\(^{nd}\) row of steel.
• **Rating 5**: Face of 2\(^{nd}\) row of steel to outer pipe wall surface.
Represents 23,561 out of 186,161 Linear Feet in need of Near Term Rehabilitation or Replacement.
EXAMPLE OF FINDINGS: CORROSION

- Outer Wall
- Estimated Original Inner Wall
- Measured Inner Wall (Purple Line)
- 1.25” of Pipe Wall Remaining
INTEGRATION INTO USE FRIENDLY SOFTWARE

Project: ICAP 2009, Original Contract: All Work Orders, Snapshot File: z:\icap 2009 contract 1 original contract all work orders\Media Files\...
PROVEN RESULTS
EXAMPLE – ADVANCED TECHNOLOGY 7 YR.

“IMMINENT COLLAPSE PREVENTION” Excludes the Environmental Impact, Fines and Related Consequences.”
Project size: 700,000’+

- Program Cost To Date (3 yrs) $3.83 Million
- Estimated Program Cost (7 yrs) $8.94 Million*
- Est. Cost Saving (7 yrs) $17.3 to $24.2 Million*
- Est. Cost Savings- Construction $33.4 to 59.5 Million
ADVANCED MULTI-SENSOR PLATFORM TECHNOLOGY

Brand X

3.1 MP CAMERA

LIDAR

SONAR
Pipeline X,Y,Z Mapping Systems

ACCURATE MAPPING PROBE
• The OMU is positioned inside the pipe and aligned as accurately as possible with the direction of the pipe.

• The OMU is then moved through the pipe from entry to exit point.

• Sensor data is used to calculate changes in:
  – X direction
  – Y direction
  – Z direction
  – Roll position
  – Import into G.I.S.

• Sampling occurs up to 100 Hz.
Pipe was actually about 15’ to the West vs. GIS Map and ran under loading docks
DEliverables of map probes

1) Site preparation:
   • The pipelines' entry and exit points were freely accessible by foot;
   • The pipelines were empty and a pulling cord is installed;
   • Coordinates of the TOPSIDE (see figure) of the pipes at entry and exit point were provided by CLIENT;

2) Measurement:
   • The DuctRunner probe DR-HDD-4.1 is prepared
   • The probe is pulled through the pipeline.
   • The recorded data is uploaded to a PC and checked,
   • The measurement was repeated at least once in the

3) Site restoration
   • The site was restored to its original condition.
Air Void in Joint
PPR REPORTING

Heat Map Highlights Problem Areas

Void Probability Metric Strip Chart
CORROSION LOSS CONSEQUENCES

Pipe Collapse due to excessive corrosion = $1.5 million dollars ER
Action Oriented Proactive Planning

• Engineer’s Action Plan
  – Remaining Life <5 years: Produce immediate rehabilitation plan
  – 5 to 15 years: Monitor corrosion every 2 years, consider budget for pipe replacement within 7 years
  – Remaining Life >15 years: Note any corrosion, time line and reschedule for resurvey in future~