Southern CT Loop
Line Structure Replacement and OPGW Installation

Planning Advisory Committee Meeting
June 21, 2017
Agenda

- Project Scope
- Project Background and Drivers
  - Reliability and Safety
  - OPGW
- 1655 Line: Characteristics, Asset Condition
- 1508 Line: Characteristics, Asset Condition
- 1342 Line: Characteristics, Asset Condition
- 1261/1598 Line: Characteristics, Asset Condition
- Summary and Conclusions
Project Scope

- Install 39 miles of OPGW from East Wallingford Junction, along a southern loop to Haddam Substation.
- Replace 258 structures for strength or asset condition reasons.
- All Circuits are PTF.
Project Background and Drivers

- Reliability and Safety
  - Structure Condition
  - Engineering Analysis
- OPGW
Reliability and Safety

- Structure Condition:
  - Structure inspections have identified asset conditions (degradation of structures and/or components) that have necessitated the need for repair or replacement to ensure safety of line workers and public.
  - In the Eversource system, failures of aged laminate wood arms have been recognized as a significant threat to system reliability. The integrity of the laminated wood cannot be measured by conventional visual inspection and the remaining strength cannot be estimated because most of the wood is rotting from within: not visible during an aerial inspection. Similar projects to address wood arms were recently implemented for the 1620 and 1975 lines.
  - The 1342 Line has had a recent laminated davit arm failure in the past few years, similar to those other lines.
Reliability and Safety (continued)

- Engineering analysis 1342/1508/1655 lines:
  - Recent analysis using a finite element analysis program shows that approximately 25 percent of structures on these lines are predicted to be overstressed considering the NESC in effect at the time.
  - If loaded according to that criteria, some structures could be expected to fail, and many would be very close to failing. Aging and wood deterioration must also be considered.
OPGW

- OPGW installation expands a private Eversource OPGW /SONET loop.
  - This will provide a controlled alternate fiber communication path supporting the long term build out initiative of the fiber optic network. This greatly reduces the reliance on leased services for protection, SCADA and future Phasor Measurement Units (PMU) and Dynamic Disturbance Recorders (DDR) installations (ISO-NE OP-22).
  - A private network is segregated from third-party Telecom services improving the overall reliability and security of the communications path to BES Cyber Systems.

- CIP: Fiber provides the necessary bandwidth for physical security monitoring and triaging of alarms for BES Cyber Systems at Medium and Low impact substations.
SCADA Load Shedding procedures are directed by ISO OP-7 and OP-13. SCADA load shedding is required for a rapid response to prevent cascading contingencies and/or equipment damage.

The DOE and EPRI recommend fiber as a means to strengthen the security and resilience of critical infrastructures on which the nation depends against the consequences of electro-magnetic pulse (EMP) attacks.

Fiber optic cable is a non-propagating media for electric and magnetic fields (EMF) and therefore is considered generally immune to the effects of geomagnetic disturbances.
1655 Line East Wallingford to Branford

- 10.3 miles originally constructed in 1958 and 1964
- Built with Single Circuit Wood H-Frames
- Installation of new OPGW to replace existing shield wire from East Wallingford Junction to Branford Substation
- Replace 66 of 89 Structures due to asset condition
- New structures will be light duty tubular steel poles
- Cost = $14.8 Million
Asset Condition Replacements

Structure 4701

Structure 4737
1508 Line Stepstone to Green Hill

- 5.6 miles originally constructed in 1982
- Single Circuit Wood Pole Structures (predominantly monopoles with laminated arms)
- Installation of new OPGW to replace existing shield wire from Stepstone to Green Hill
- Replace all structures due to asset condition
- Structures are to be replaced with Light Duty Tubular Steel structures
- Cost = $16.6 Million
Structure 5937 - Significant arm decay
Structure 5957 – Pole split, arm rot
Asset Condition

Structure 5909 – Woodpecker damage
1342 Line Green Hill to Bokum

- 11.3 miles originally constructed in 1976
- Built with Single Circuit Wood Poles with laminated arms
- Installation of new OPGW to replace existing shield wire from Green Hill to Bokum Substation (11.3 miles)
- Replace all structures due to asset condition
- Structures are to be replaced with Light Duty Tubular Steel structures
- Cost = $30.3 Million
Asset Condition

Structure 4866 - Woodpecker damage
Asset Condition

Structure 4825 - Arm rot, and moisture retention (aerial view)
Asset Condition

Structure 4859 – Woodpecker damage and pole top rot/splitting
1261/1598 Line Bokum to Haddam

- 11.8 miles originally constructed in 1967
- Comprised of Double-Circuit Wood H-Frames, Double-Circuit Steel Poles, and Quad-Circuit Lattice Towers (towers also support distribution) (115 structures)
- Installation of new OPGW to replace existing shield wire from Haddam Junction to Bokum Substation (11.5 miles)
- 10 structure replacements (out of 115)
  - 6 replaced due to increased OPGW loads
  - 4 replaced due to asset condition
- 7 structure modifications (X-braces and guy wires) due to increased OPGW loads
- Cost = $6.3 Million
Asset Condition Based Replacements

Structure 6979

Structure 6982
Asset Condition Based Replacements

Structure 6937

Structure 6956
# Summary and Conclusions

<table>
<thead>
<tr>
<th>Line</th>
<th>Length (mi)</th>
<th>Structures*</th>
<th>Cost Estimates ($M)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1655</td>
<td>10.3</td>
<td>66</td>
<td>14.8</td>
</tr>
<tr>
<td>1508</td>
<td>5.6</td>
<td>60</td>
<td>16.6</td>
</tr>
<tr>
<td>1342</td>
<td>11.3</td>
<td>122</td>
<td>30.3</td>
</tr>
<tr>
<td>1261/1598</td>
<td>11.5</td>
<td>10</td>
<td>6.3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>38.7</strong></td>
<td><strong>258</strong></td>
<td><strong>68.0</strong></td>
</tr>
</tbody>
</table>

* Structures to be replaced with tubular steel pole structures

** All estimated costs are (-25%/+50%)
Questions