AVANGRID

July 25, 2023

UI's 115kV Derby Junction to Ansonia Line Rebuild Project:

PAC Update

Presentation to:
ISO-NE PAC

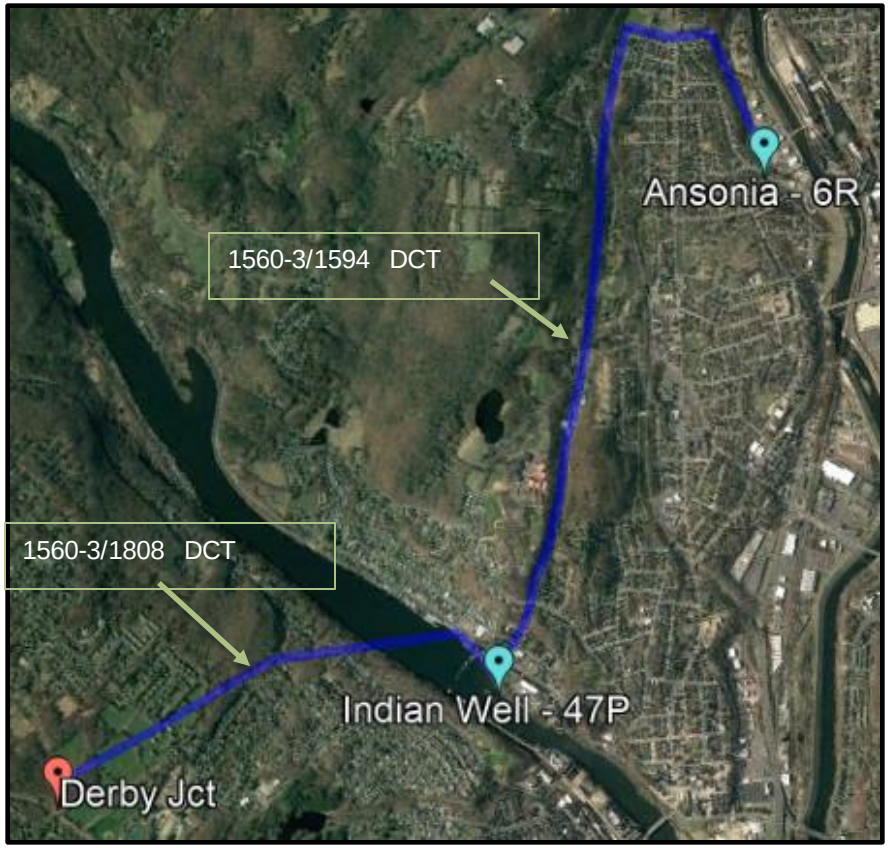
Project Timeline

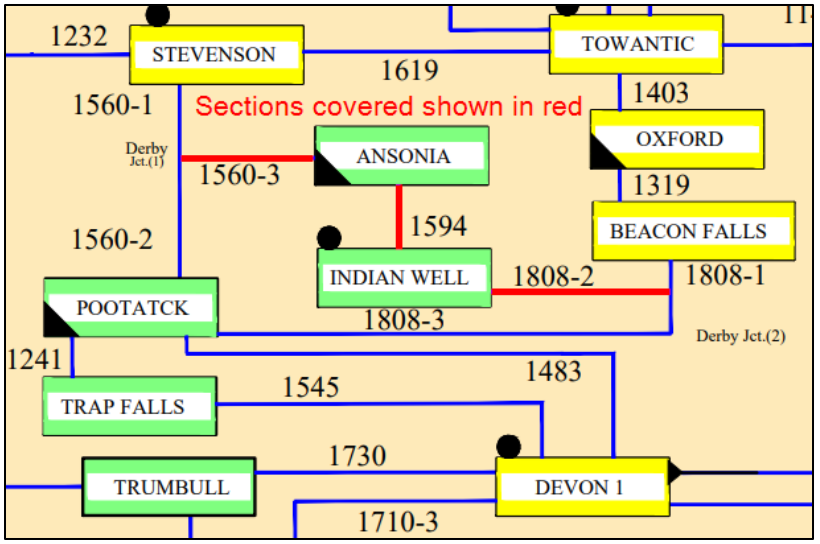
ISO-NE PAC Presentation[1]	➢ October 24, 2019
PAC Update[2]	➢ September 22, 2021
PPA Presentation (RC Approval)[3]	➢ March 14, 2023
PAC Update	➢ July 25, 2023
Construction Start	➢ Q1, 2024
Planned In Service Date	➢ January 2025

1. PAC Presentation
2. PAC Update
3. PPA Presentation – 1560-3, 1594, 1808-2

Overview - Location

- There are three 115kV Lines operated in the right-of-way between Derby Junction and UI's Indian Well & Ansonia Substations.
- The 1560-3, 1594 & 1808 Lines have a total length of 8.16 circuit miles.





Project Evolution - 2019

Background & Needs

ISO-NE PAC Presentation (10/24/2019)

- 115 kV lines consist of 34 lattice type & 7 monopole structure types *(4/0 CU)*
- Built in 1924 to be operated at 13.8 kV
- Upgraded to 69kV in the 1930's & to 115kV in 1968
- Foundation (cosmetic-only) repairs performed '08-'09

4/0 Conductor & Insulators determined to be at their end-of-life:

- 90+ year old conductor with observed surface contamination & pitting.
- Tensile strength tests performed indicating a loss in conductor strength capabilities.
- Sampled insulators failed electrical tests

Project Scope

- Reconductor with (300 kcmil ACSR[1])
- Reinforce/upgrade existing structure members
- Partial Structure Replacement (8 Monopoles)

$22.4 M (+50/-25%)

Note (1)-300 kcmil ACSR chosen based on similar physical characteristics and ampacity

Project Evolution - 2021

Additional[1] Needs Identified

Engineering Activities (2020-21)

Comprehensive field / eng. inspections:

- Foundations were found to have spalling & anchor-bolt/plate galvanic corrosion
- Tension only members were found in compression.
- Deficiencies such as deflected tower peaks, bent members/tower arms, and inadequate shield-wire support were identified.
- NESC clearance violations were identified

Structural and Foundation Analysis:

- Structural member failures identified (300 kcmil ACSR) against minimum NESC criteria.
- The majority of foundations were identified to have concrete breakout & pull out failures (in accordance with ACI / NESC criteria)

80% + structures in need of replacement / refurbishment

Project Scope

- Complete line rebuild
  - Utilize 795 kcmil ACSR conductor
  - Utilize steel monopoles

$36 M (+50/-25%)

***Note (1)**: The following were additional needs that were identified as a result of detailed engineering activities and are left unmitigated by the original project scope-of-work.*

Solution Alternative – Assessment[5]

Alternative #1: Partial Rebuild w/ 300 kcmil ACSR ***$53.2M (+50/-25%)[1]***

- Includes the *replacement of 30 structures*[2] (structural deficiencies, footing deficiencies[3], NESC clearance violations, and visual inspection failures).
- 90+ year old equipment remains in-service, less robust design, and uncertainty about remaining service life.
- The partial rebuild has a more complex construction sequence as well as a higher reliability risk, and uncertainty due to the reuse of existing structures.
- The partial rebuild marginally increases the existing Summer LTE rating by approximately 8% and requires a special coating that must be maintained.
- No industry data is available to inform how often this coating has to be maintained/replaced. Increased uncertainty on how this would be maintained across the Housatonic River.

Alternative #2 *(Selected)*: Full Rebuild w/ 795 kcmil ACSR ***$71M (+10/-10%)***

- This alternative replaces all structures and addresses all known deficiencies.
- The design of the line can start immediately with no need for onsite inspections or testing.
- A new standard 795 ACSR conductor and hardware can be used which increases the summer LTE rating by approximately 85%[4].
- This alternative is comparable in cost and will extend the life of this line by a minimum of 50+ years.

***Note (1)**: Cost estimate includes $5.7M to replace the 12 sets of foundations (6 sets of grillage and 6 sets of pier types) with new single pole caissons.*
***Note (2):** Replacements driven by a number of factors such as* structural / footing deficiencies, NESC clearance violations, and visual inspection failures
***Note (3):** 6-out-of-the-12 foundations (grillage) would require additional field excavation surveys, which could undermine these 90+ year old footings. This analysis assumes that refurbishment of grillage foundations is not viable and upgrades are required.*
Note (4): ACSS was evaluated but found to have unacceptable sag characteristics.
Note (5): This slide was presented at the September 22, 2021 PAC meeting with updated cost information included.

Cost Breakdown

	2021 Estimate, $M				2023 Estimate, $M				Net $M Variance*	Comments
	PTF	Non-PTF	Total	%	PTF	Non-PTF	Total	%		
Material	3.1	0	3.1	9%	5.85	0	5.85	8%	2.75	2020 estimate was rebuilding 8 new poles, reconductoring the lines, replacing insulators and related hardware, structure modifications. Scope has evolved into the removal of existing infrastructure and rebuild with 40 new structures with new conductor and hardware.
Labor & Equipment	10.3	0	10.3	29%	24.1	0	24.1	34%	13.8	Increase in cost is primarily due to growth and scope of Project between 2020 and 2023 as the current scope is to install 40 new steel structures, predominantly double circuit but in certain locations single circuit. Cost of Construction Contractor also factored into 2023 value.
Right of Way	6.21	0	6.21	17%	8.72	0	8.72	12%	2.51	With growth of design/scope from 2020 to approved design/scope in 2023 larger right of way needed along with purchase of 2 properties abutting Ansonia Substation (est ~$1.6M)
Engineering/Permitting/ Indirect	6.53	0	6.53	18%	22.78	0	22.78	32%	16.25	Increases from more clear understanding of environmental conditions (wetland impact - temp vs permanent, species, stormwater inspections).
Escalation	3.05	0	3.05	8%	0	0	0	0%	-3.05	
AFUDC	1.04	0	1.04	3%	4.22	0	4.22	6%	3.18	
Contingency	5.75	0	5.75	16%	5.31	0	5.31	7%	-0.44	Current project contingency at 7%.
Total	**35.98**	**0**	**35.98**	**100%**	**70.98**	**0**	**70.98**	**100%**	**35**	

*may not exactly sum due to rounding

Questions

Appendix - Inspection & Testing

Conductor (4/0 CU)

- Evaluation of tensile strength of sample conductor section

Insulators

- Thermal-mechanical cycling and combined mechanical-electrical testing

Structures & Foundations

- Climbing & visual inspections
- Mechanical loading & conductor sway simulations in PLS CADD / TOWER

Appendix - Key Findings

Conductor (4/0 CU)

- Surface contamination and pitting observed
- The tested breaking strength of the conductor has decreased and is reaching end of life

Insulators

- Several sampled insulating bells failed electrically

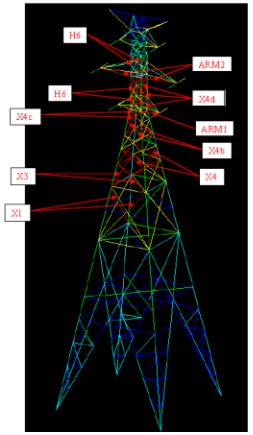
Appendix - Key Finding Updates

Structure Inspections

- Field inspections found a variety of deficiencies:
  - Tension only members in compression (10)
  - Deflected tower peaks (3)
  - Bent/deflected tower arms (expected from ice event)
  - Inadequate shield-wire support (21)
  - Exposed metal has led to corrosion on parts of structures (28)

Structure Modeling

- Structural modeling in PLS CADD / TOWER using NESC 1961 revealed 6 towers with members exceeding their capability with the 300 kcmil conductor
  - Information only: 2012 NESC identified 3 additional structures



Appendix - Key Finding Updates

Foundation Inspection

- Field inspections found a variety of deficiencies:
  - Spalling (6)
  - Anchor-bolt/plate galvanic corrosion (4)
- Various Foundations not easily accessible
  - Grillage-type and cannot be inspected without excavation (8)
  - Legs encased in concrete (3)
  - Customer back-filled over foundation (1)

Foundation Modeling

- Anchor Bolts
  - In-service anchor bolts do not have a corresponding ACI compliant pull-out calculation.
  - Review of 1920's vintage construction drawings show a very slight hook.
  - Non-standard anchors in tension (19)
- Failed concrete breakout checks (16)

Appendix - Key Finding Summary

Conductor/Hardware

- Existing 4/0 CU at end-of-life
- Insulators at end-of-life

36 Existing Transmission Towers (the following identify unique towers)

- Towers usage after reconductor:
  - 5 need to be replaced because overstressed w/1961 NESC
  - 3 need to be replaced due to NESC clearance violations
- Field Inspections:
  - 10 with asset cond. issues (bent arms/cages, corroded anc. Bolts, etc)
- Foundation Calculations:
  - 5 concrete breakout failures
  - 6 buried grillage foundations are in unknown status
    - Condition assessment would require excavation/radar/xray, etc.
- Misc.
  - 2 structures identified as not necessary

- Of the 36 existing structures only **5** remain without identified or potential issues
  - **1** out of 5 is lattice structure
    - 3 substation structures and 1 wide-flange column @ 99% usage