K42 Transmission Line Replacement Project

vermont electric power company

VELCO

Planning Advisory Committee Meeting

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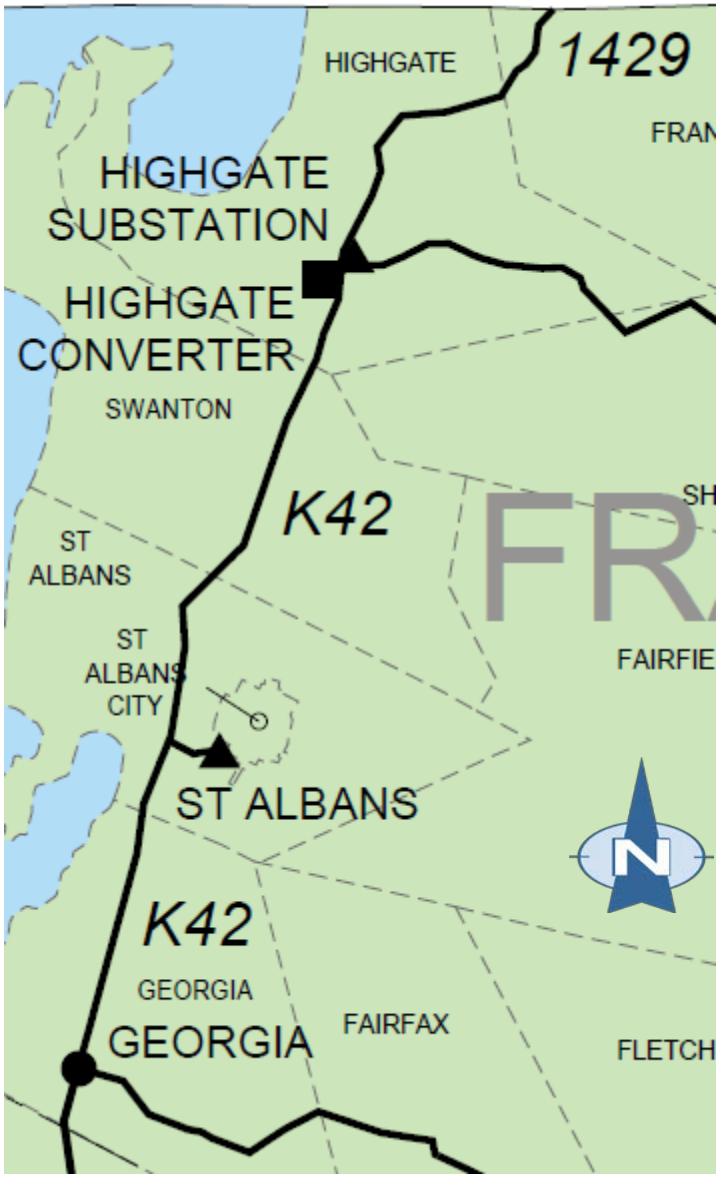
K42 Line Overview

- Constructed in 1958; majority of 212 structures are original build
- 115 kV wood H-frame line from Highgate to Highgate Converter Tap to St Albans Tap to Georgia (16.6 miles)
- Main transmission path for HVDC Converter and wind generation toward load center (Burlington)
- Significant wetlands, crop farming, and long access routes drive need for substantial matting



Background

- Asset condition presentation on Sept 22, 2020

  https://www.iso-ne.com/static-assets/documents/2021/09/a7_k42_line_refurbishment_project.pdf
- About 70% of the structures need replacement
- Solutions
  - Typical structure-by-structure replacement approach
    - About 30 line outages (full day outage)
      - Highgate and local wind generators shut down
      - Local and regional reliability concerns
  - Preferred: Build a replacement line with the existing line energized, then dismantle the old line
    - What conductor size?
- This presentation
  - Review loss savings analysis for the larger conductor option

Line rebuild options

Options	Resistance	System strength	Cost (+/- 25%)	Decision
Single 1351 ACSS	Standard conductor	No change	$ 42.59M	Base
Single 2515 ACSR	Resistance 45% lower Reactance 12% lower Charging 13% higher	Minor change	$ 48.98M	Reject
Double 1272 ACSR	Resistance 50% lower Reactance 33% lower Charging 45% higher	Noticeably better	$ 48.99M	Investigate further

- Loss reduction from double-bundle 1272 ACSR design
  - 50% reduction of annual historical losses is 11,762 MWh (SCADA info)
  - Reduction in system losses is higher at 14,068 MWh (PSSE simulations)

Cost-effectiveness test: Utilized Energy Efficiency evaluation approach

- EE total-cost evaluation approach is well-established

Load reduction method	Location	Valuation rates	Performance timing	Measure life
Energy efficiency	Distribution	Retail	When the appliance is on	Average 10 years
Loss reduction	PTF	Wholesale	When the line is in service	Many decades

- Incremental cost of $6.39M
- Annual revenue requirement of $922K
- Benefit-to-cost ratio needs to be greater than 1
- Benefit valuation rates based on AESC* report used in state total resource cost evaluations

* Avoided Energy Supply Component
https://www.synapse-energy.com/sites/default/files/AESC%202021_20-068.pdf

Calculated AESC annual valuations rates

Benefit	Rate *	Note
Avoided Electric Energy ($/kwh)	0.0304	1
~~**Avoided REC Costs ($/kwh)**~~	~~0.0057~~	2
~~**Avoided GHG and NOx Costs ($/kwh)**~~	~~0.0255~~	3
Energy DRIPE ($/kwh)	0.0136	4
Avoided Electric Capacity ($/kw-year)	31.9	1
Capacity DRIPE ($/kw-year)	18	4
Avoided Reliability Costs ($/kw-year)	0.2	
~~**Avoided PTF ($/kw-year)**~~	~~84~~	5

1 – Reduced by 1/3 by VELCO based on ISO-NE's view that prices will likely be lower due to the elimination of the MOPR
2 – Not applicable for transmission efficiency measures
3 – ISO-NE believes emission costs are already embedded in the energy and capacity prices
4 – DRIPE = Demand Reduction Induced Price Effect
5 – It is unclear whether future projects will be affected by loss reductions

* https://www.synapse-energy.com/sites/default/files/Appendix_B_20-068.xlsm

Benefit-to-cost analysis

Scenarios	Prices lowered by 1/3	Emission costs embedded in prices	Annual Benefit	Annual Revenue requirement	Benefit to cost ratio
1 *	No	No	$1,296,173	$922,212	1.41
2 **	Yes	Yes	$701,099	$922,212	0.76
3	No	Yes	$937,325	$922,212	1.02
4	Yes	No	$1,059,947	$922,212	1.15

* Consistent with VELCO's understanding

– Prices cannot drop to the point of jeopardizing resource adequacy and system reliability
  - ELCC and future market adjustments may increase prices
– Emission costs are not embedded in energy and capacity prices

** Consistent with ISO-NE's understanding

– Elimination of the MOPR is expected to lower prices
– Emission costs are embedded in energy and capacity prices

Recommendation

- We recommend the double-bundle 1272 ACSR design
  - Benefit-to-cost ratio is greater than 1.0
  - Increased reactive margin
  - Increased system strength
- Not all the benefits are quantified
- Should consider cost-effective modest transmission incremental efficiency spending in support of a cleaner system
- Consistent with FERC ANOPR holistic planning
- Further investigations needed with regard to MOPR impacts and consideration of emission benefits