B-154N / C-155N – King Street Tap Asset Condition Refurbishment

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National Grid

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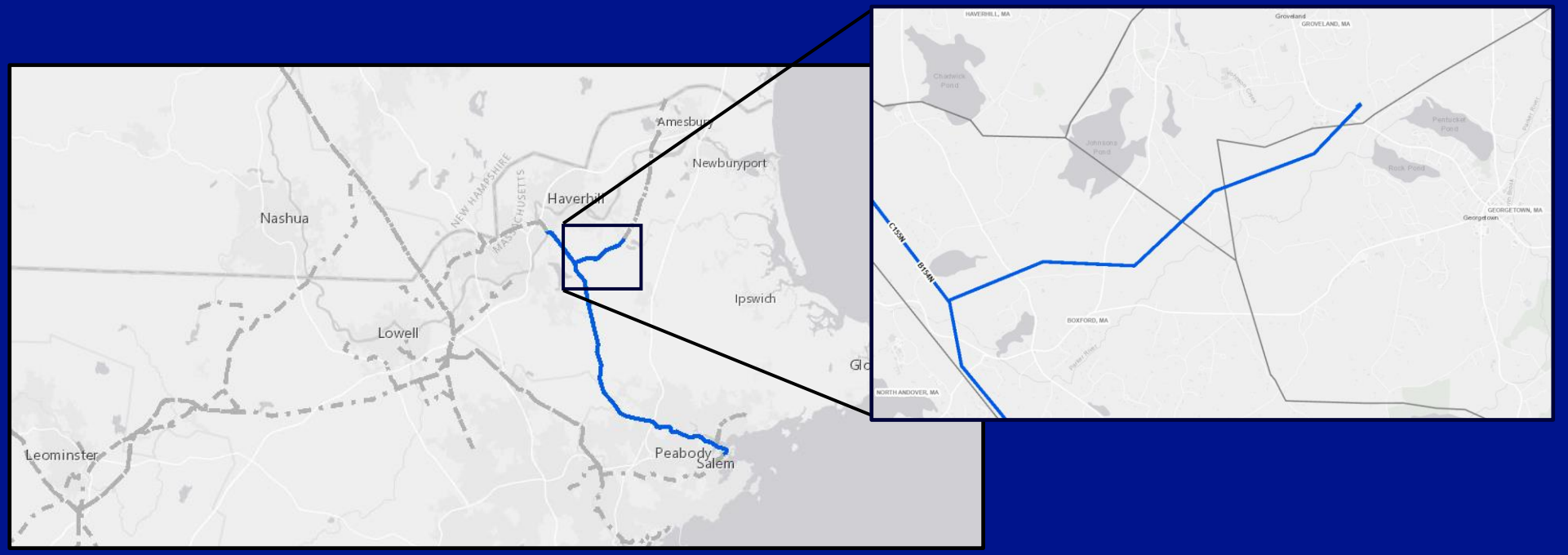

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Project Summary

Project Drivers
Asset Condition

Alternatives Considered		
Alternative	*Description*	*Cost Estimate*
Base Alternative	Replace Wood Structures, and Install OPGW	$62.000M PTF: $38.878M non-PTF: $23.122M (+200%, -50%)
Alternative 2	Replace All Structures, Reconductor, and Install OPGW	$74.399M PTF: $46.653M non-PTF: $27.746M (+50%, -25%)

Preferred Alternative		
Alternative	*Reason for Recommendation*	*Cost Estimate*
Alternative 2	• Avoids potential future projects and damage failure replacements by performing a full rebuild • Addresses time sensitive need identified by Boston 2033 Needs Assessment	$74.399M PTF: $46.653M non-PTF: $27.746M

Background Information – B-154N KING ST TAP

Key Details	
Location	**From: King St Tap** **To:** King St
Line length	**3.96 miles**
Operating Voltage	**115 kV**
Age and upgrade history	• **Originally constructed in 1963** • **Reconductored in 1993** • **This tap is PTF**
Prior PAC presentations	• **None**

Existing structures			
Material	*Configuration*	*Number*	*Avg. age*
Line Section 1			
Wood	**Chair frame**	**52**	**30 years**
Steel	**Chair frame**	**1**	**5 years**

Existing conductor		
Type	*Length*	*Avg. age*
Line Section 1		
795 ACSR Condor	**3.96 miles**	**21 years**
1 3/8” 7 Strand Extra Galvanized Steel Shield Wire	**3.96 miles**	**61 years**

Background Information – C-155N KING ST TAP

Key Details	
Location	**From: King St Tap** **To:** King St
Line length	**3.96 miles**
Operating Voltage	**115 kV**
Age and upgrade history	• **Originally constructed in 1956** • **Reconductored in 1993** • **This tap is non-PTF**
Prior PAC presentations	• **None**

Existing structures			
Material	*Configuration*	*Number*	*Avg. age*
Line Section 1			
Wood	**Chair frame**	**53**	**28 years**
Steel	**Chair frame**	**2**	**5 years**

Existing conductor		
Type	*Length*	*Avg. age*
Line Section 1		
795 ACSR Condor	**3.96 miles**	**21 years**
1 – 7#9 Alumoweld Shield Wire	**3.96 miles**	**68 years**

Project Needs and Drivers – Structures

Structure Concerns	
Primary Concerns (must be addressed)	
Wood structure rot and decay	• Recent inspections performed in 2019 and 2020 have identified 103 wood structures with woodpecker damage, pole top rot, cracked crossarms, splitting poles, and other forms of decay • These structures must be replaced to maintain reliability and ensure ongoing integrity of the line • **Affected structures average 30 years old and are reaching the end of the typical useful life for 115 kV natural wood structures (40 – 45 years)** • **Woodpecker damage is a concern for premature pole failure across the entire circuit** • **Six remaining structures have wood pole arm crossarms that represent a failure concern**
Steel structure performance	• **Steel structures do not conform to current design standards to ensure reliable lightning performance**
Secondary concerns (may be addressed)	
Structural Stress	• **Intermittent structure replacements with a different framing standard cause stress on structure and conductors by widening and narrowing the conductor footprint over a short distance of forward and back spans**

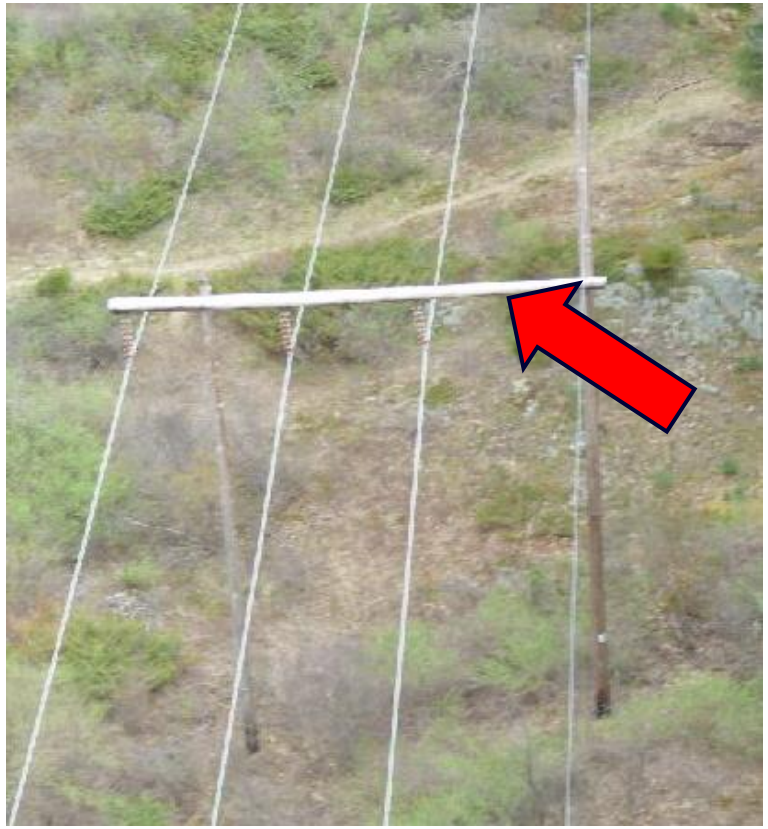
Summary of Current Structure Grades

Category	Recommended Action	Number of structures
A	No replacement required due to deterioration	5
B	Consider replacement in conjunction with other structure replacements	59
C	Initiate planned structure replacement project or Replace as part of upcoming structure replacement project	44
D	Replace immediately (emergency replacement)	0
Total		108

Project Needs and Drivers

Pole Arm Crossarms

B-154N Structure 44



B-154N Structure 50

B-154N Structure 84

These structures use a wood pole as a crossarm which is prone to failure. Water collects in the side grain on the upper side of the arm and rots the wood prematurely.

Project Needs and Drivers

Deteriorated Poles

The poles for these structures are showing signs of decay and deformation

B-154N Structure 57

The shield wire leg is deflecting and leaning away from the rest of the structure as the wood deteriorates

B-154N Structure 88

B-154N Structure 53

The legs on these structures are more deteriorated. The opposing leg was replaced in prior maintenance work and the remaining poles are deflecting as they continue to weather

Project Needs and Drivers

Conductor

Conductor Concerns	
Primary Concerns	
Summary	• **Structure replacements for each circuit would require the addition of numerous additional splices to an already existing conductor, greatly increasing the risk of failure** • **Poor shielding angle on outer phases needs a replacement of all structures on both the B-154N and C-155N King St Taps. This would introduce a large number of splices and stress in the existing conductor.** • **Conductor replacement needed to achieve full life-extension desired by this ACR project on B-154N and C-155N taps**
Secondary concerns	
Summary	• **A time-sensitive need has been identified for the B-154N Tap to King St (discussed later) which would also require conductor replacement**

Discussion and Additional Information

- In addition to poor condition, these circuits suffer from poor reliability, especially during weather events. The location of a single shield wire to the side of horizontally oriented phase conductors leaves the outer phases exposed and unshielded.
- The most effective solution is to reconfigure the structures to bring all phases within the shielding envelope. This cannot be done intermittently. Changes in wire separation and phase spacing back and forth between new and old construction styles cause stress to both structures and wire by continually expanding and reducing the structure footprint without adjusting the conductor length.

Project Needs and Drivers

Insulators

Insulator Concerns	
Primary Concerns	
Summary	• Flashed insulation is present, especially on outer phases away from shield wire • Insulation on structures in this section of the line is insufficient and not to current standards, less than remainder of line. This leads to poor reliability. Simply adding additional insulation will cause clearance problems with the existing structures.
Secondary concerns	
None	

Discussion and Additional Information

- Repeated flashover of insulators not properly protected by a shield wire degrades the insulator's ability to provide an electric barrier

Project Needs and Drivers

Shield Wire

Shield Wire Concerns	
Primary Concerns	
Summary	• Structure design leaves outer phases unshielded and contributes to poor circuit performance
Secondary concerns	
Summary	• **Existing shield wire does not address communications needs to bring King St station into internal network**

Discussion and Additional Information

N/A

Project Needs and Drivers

Telecommunications

Telecommunication Concerns	
Primary Concerns	
Summary	• The King St taps will be the link required to bring private communications network connectivity to King St substation.
Secondary concerns	
Summary	• **New England Power (NEP) is seeking additional opportunities to make fiber connections into surrounding areas/regions to support the development of a more robust fiber sharing network. This network will strengthen communications ties to our partners and create greater network redundancy.** • **King St substation will extend our fiber communication network closer to NH interconnections.**

Discussion and Additional Information

N/A

Project Needs and Drivers
System Planning

Planning Concerns	
Primary Concerns	
Summary	• **The current conductor only provides 289 MVA long-term emergency rating. B-154N can potentially serve the entire 23 kV network out of King St as well as West Amesbury load under certain contingencies. With the observed load growth in the area, this conductor will overload under certain scenarios.**
Secondary concerns	
None	

Discussion and Additional Information
N/A

Project Needs and Drivers

Operations

Operational Concerns	
Primary Concerns	
Summary	• The King St Taps share the right of way with the 394 345kV transmission line. Work on the B-154N/C-155N taps conflict with projected improvements to the 394 line and need to be coordinated. • **Any work requiring an outage of the B-154N between Ward Hill and Woodchuck Hill, or an outage on C-155N between Ward Hill and South Danvers will put a significant amount of NEP customer load at risk.** • **Once proposed sectionalizing switches are installed, much more main line work could be done without single-sourcing King St. Switch installations are prioritized early in the construction sequence and at an advantageous time in the outage season. Note that due to the lack of isolation points, the presence of the K-163 line from West Amesbury to King St cannot provide a third independent source to King St.**
Secondary concerns	
Summary	• **Outage availability for B-154N/C-155N is limited to spring/fall timeframes**

Discussion and Additional Information

N/A

Review of Relevant Transmission Studies

Transmission Study Status
Was this line overloaded in recent Attachment K studies (Reliability Needs Assessments, Longer-Term Transmission Studies, etc.) or other recent studies?
Yes. In the Boston 2033 Needs Assessment, line B-154N tap from King St. tap to King St. was overloaded both for 2033 and 2026 load levels making it a time-sensitive need. The worst contingencies were the combinations that would disconnect West Amesbury from the 345 kV network and loss of C-155N line.
Have modifications or upgrades to this line been identified as potential solutions in any of those studies?
No. During the Boston 2033 Solutions Study, NEP informed ISO-NE of this asset condition project that would also resolve the overload stated above. As such, ISO-NE did not proceed with finding a separate solution for this overload that would've likely been the reconductoring of the line.
Have modifications or upgrades within this ROW been identified as potential solutions in any of those studies?
No. During the Boston 2033 Solutions Study, NEP informed ISO-NE of this asset condition project that would also resolve the overload stated above. As such, ISO-NE did not proceed with finding a separate solution for this overload that would've likely been the reconductoring of the line.

Evaluated Solution Alternatives

Base Alternative

Replace Wood Structures, and Install OPGW	
Description	• Replace 44 wood structures with steel H-frame • Replace insulation at all 108 structures • Remove approximately eight (8) miles of shield wire and install (2) ½" OPGW (one per line)
Primary Needs Addressed	Structure, Shield wire, Insulators, Telecommunications
Secondary Needs Addressed	None
Advanced transmission technologies to be considered	None
Cost Estimate and Accuracy	$62.000M PTF: $38.878M non-PTF: $23.122M (+200% / -50%)
Longer-term transmission needs addressed	No, this option does not address the time-sensitive need identified as part of the Boston 2033 Needs Assessment study
Key standards or criteria affecting design if different than current design	• Changing to more durable H-frame structures unnecessary design loads on remaining original structures as well as on the conductor and shieldwire due to intermittent changes to conductor orientation without adding extra wire length. • Design does not address limitations to shield angle on outer phases

Evaluated Solution Alternatives
Alternative 2

Replace All Structures, Reconductor, and Install OPGW	
Description	• Replace 105 wood structures with steel • Replace 3 steel structures • Install three (3) new drop down switches • Remove approximately eight (8) miles of 795 ACSR conductor • Reconductor with approximately eight (8) miles of 1590 ACSS conductor • Remove approximately eight (8) miles of shield wire and install (4) ½" OPGW (two per line)
Primary Needs Addressed	Structure, Conductor, Shield wire, Insulators, System Planning, Telecommuncations, Operations
Secondary Needs Addressed	None
Advanced transmission technologies to be considered	Advanced Conductor
Cost Estimate and Accuracy	$74.399M PTF: $46.653M, non-PTF: $27.746M (+50% / -25%)
Longer-term transmission needs addressed	Yes, this option does address the time-sensitive need identified as part of the Boston 2033 Needs Assessment study
Key standards or criteria affecting design if different than current design	NESC-Heavy

Comparative Analysis of Alternatives

Comparison		
Key Criteria	**Base Alternative**	**Alternative #2**
Addresses Primary Need(s)	No	Yes
Secondary Needs Addressed		
Cost	$62.000M PTF: $38.878M non-PTF: $23.122M	$74.399M PTF: $46.653M, non-PTF: $27.746M
Constructability concerns or advantages	• Intermittent structure replacement stresses remaining assets. • Does not improve circuit performance.	• Uniform construction parameters do not cause stress points on circuits. • Dual shield wires provide superior lightning performance
Siting, Environmental and regulatory issues	Less permitting without reconductoring	Slightly more permitting for reconductoring
Governmental or Community Goals addressed	Same for both options	Same for both options
Future-Proofing	• Does not address Boston 2033 Needs Assessment • Leaves remaining wood structures vulnerable to woodpeckers • Does not target lightning performance	• Addresses Boston 2033 Needs Assessment • Addresses performance issues
Schedule and Outage Coordination	Outage windows are similar. Slightly less time required to not reconductor	Outage windows are similar. Slightly more time required to reconductor
Other Criteria		

Conclusions: The Base Alternative does not address constructability/condition concerns on the conductor and does not address the time-sensitive need identified as part of the Boston 2033 Needs Assessment. That is the reason Alternative 2 is the preferred option.

Schedule

Planned Schedule	
Comment Deadline	November 6th, 2024
Contact	Rafael Panos: rafael.panos@nationalgrid.com pacmatters@iso-ne.com
Follow-up PAC Presentation	N/A
Start of Major Construction	Q3 2026
Project in Service	Q4 2027

Questions

B-154N / C-155N
King Street Tap
Asset Condition
Refurbishment

This document has been reviewed and does not contain Critical Energy/Electric Infrastructure Information (CEII).

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