Greater Boston 2023 Needs Assessment and Solutions Study Status Update



new england

ISO

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Purpose

- Present the Greater Boston 2023 Needs Assessment using updated assumptions
- Provide an update on the Greater Boston Solutions Study

Agenda

- Greater Boston 2023 Needs Assessment
 - Objectives and study history
 - Comparison of assumptions to previous work
 - Results
- Solutions Study Update
 - Study history
 - Status
- Next Steps

GREATER BOSTON 2023 NEEDS ASSESSMENT OBJECTIVES AND STUDY HISTORY



Needs Assessment Objectives

- The objectives of the assessment have remained the same over time
- Identify reliability based transmission needs in the Greater Boston study area while considering
 - Future load growth
 - A range of generation patterns and system stresses
 - One and two unit OOS design cases
 - Retirement cases with an additional unit OOS
 - Adherence to all applicable transmission planning standards
- The previous needs assessment (Greater Boston 2018 Needs Assessment) was limited to steady-state and short-circuit. The current assessment includes Bulk Power System (BPS) stability testing

Geographical Map of the Study Area

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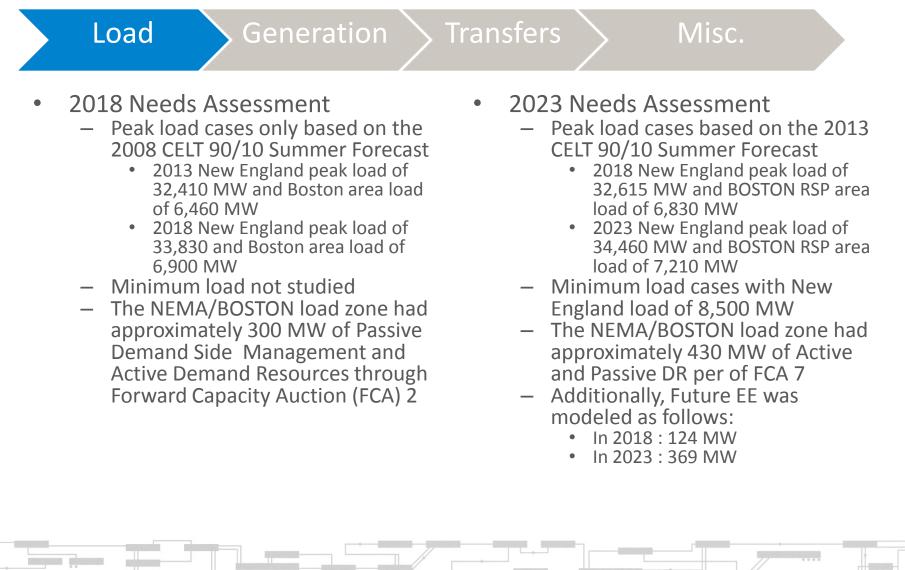
Study History

- Eleventh time the Greater Boston study has been to the PAC
 - First trip to the PAC was May 2008 with a presentation of the Needs Assessment Scope of Work
 - Steady state needs were presented in July 2009 (N-1) and in December
 2009 (N-1-1) with a Needs Assessment report issued in July 2010
 - Short-circuit needs and critical load level assessment were presented at June 2011 PAC
 - A complete Greater Boston AC preferred solution was presented to PAC in March 2012
 - Agreed to examine a hybrid HVDC / AC alternative (SeaLink) proposal made by New Hampshire Transmission, LLC (NHT)
- Links to all the PAC presentations can be found in Appendix A to this presentation

GREATER BOSTON 2018 AND 2023 NEEDS ASSESSMENT ASSUMPTIONS



2018 versus 2023 Needs Assessment



2018 versus 2023 Needs Assessment

Load Generation Transfers Wilsc.		Misc.		Transfers	Generation	Load	
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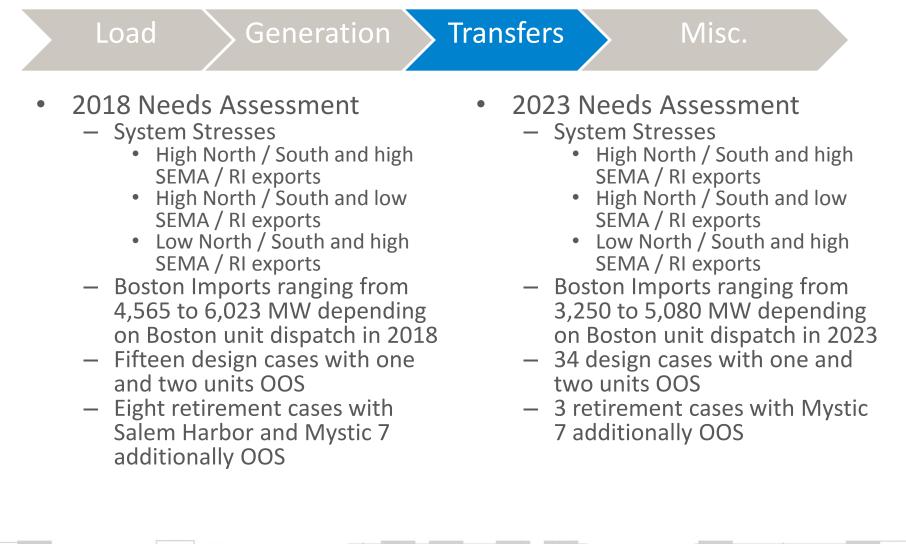
• 2018 Needs Assessment

Major Boston Generating Units > 100 MW	Qualified Capacity (FCA 2)	Com. Oper. Year	Age (yrs)
Mystic 7	566	1975	38
Mystic 8	682	2003	10
Mystic 9	678	2003	10
Salem 1	82	1952	61
Salem 2	80	1952	61
Salem 3	150	1958	55
Salem 4	431	1972	41
Kendall CT	157	2002	11

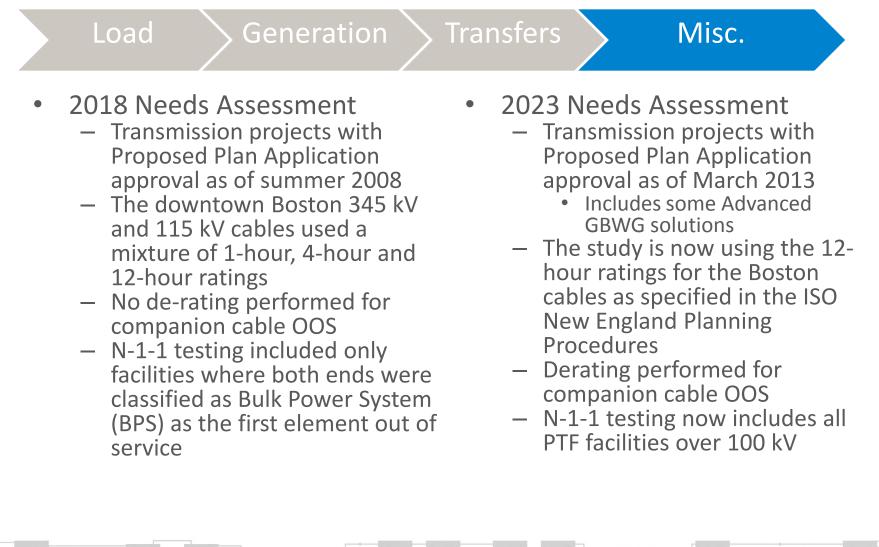
• 2023 Needs Assessment

Major Boston Generating Units > 100 MW	Qualified Capacity (FCA 7)	Com. Oper. Year	Age (yrs)
Mystic 7	578	1975	38
Mystic 8	691	2003	10
Mystic 9	703	2003	10
Footprint 1	337	2016	NA
Footprint 2	337	2016	NA
Kendall CT	154	2002	11

2018 versus 2023 Needs Assessment



2018 versus 2023 Needs Assessment



Minimum Load Needs Assessment Assumptions

2023 Needs Assessment Only

- 8500 MW load plus losses in New England
- Load power factor assumptions
 - Boston load (NSTAR Only) = 0.968 p.u. lagging on low side of distribution transformer
 - Other New England loads = 0.998 leading power factor on low side of distribution transformer
- Generation Assumptions:
 - All major Boston generators OOS
 - Pilgrim and Seabrook OOS
 - Low eastern New England generation
 - Pumped hydro units offline
- Stresses
 - Low North South in all cases
 - Three dispatches tested:
 - Phase 2 OOS high West-East
 - Phase 2 at 500 MW, high West-East
 - Phase 2 at 500 MW, lower West-East
- Contingencies Tested
 - 345 and 115 kV reactors in the Greater Boston area
 - 345/115 kV autotransformers in Greater Boston area
 - Selected overhead lines
- N-1 and N-1-1 testing
 - 25 initial elements OOS

Short-Circuit Needs Assessment Assumptions

2018 and 2023 Needs Assessment

- A short-circuit assessment was conducted to determine the fault current levels and breaker duty for the "as-planned" 2018 Greater Boston transmission system
- The base case included all approved transmission and generation projects
- Assessment was performed using the breaker rating module in Aspen
- Faults were simulated with an assumed pre-fault voltage "Flat" option of :
 - 1.05 p.u. for Public Service of New Hampshire (PSNH) system

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- 1.03 p.u. for NSTAR and National Grid system

Bulk Power System (Stability) Needs Assessment Assumptions

2023 Needs Assessment Only

- Utilized light load cases from the latest ISO database
- Five dispatches at different levels of Boston generation while stressing:
 - Maine interfaces
 - East to West interface
 - SEMA/RI interface
- BPS testing consists of 3-phase bus faults with remote clearing

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 Tested 63 stations throughout new England with the majority of stations being in and around the Greater Boston area

GREATER BOSTON 2018 AND 2023 NEEDS ASSESSMENT RESULTS



Peak Load Steady-State Results

• Results indicate there are numerous thermal overloads and voltage violations for N-0, N-1 and N-1-1 conditions

Thermal Only	N-1	N-1-1
Design	22	59
Additional Retirement Overloads	6	7

- The results are organized into the 8 sub-areas used in the 2018 Needs Assessment
 - The sub-areas are shown on the next page

Eight Greater Boston sub-area used in this study

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Thermal Results

- For each thermal violation, the Boston Critical Load Level was determined
 - Used linear regression method to determine a critical load level
 - Assumes uniform load growth on a percentage basis throughout Boston

- Most restrictive of N-1 or N-1-1 presented
- Full listing of each element is presented in Appendix B
- The highest 2023 loading also provided

2023 Needs Assessment 345 kV Highest Loading and Critical Load Level Results

Element ID	Highest 2023 % LTE Loading	Boston Load Level
337	118	5702
394	110	6010
358 / 351	155	4197
346 / 365	154	5037

Element ID	Highest 2023 % LTE Loading	Boston Load Level
3162 / 3163	103	6198
326	117	5910
349	103	6180
324 / 372	125	5663



2023 Needs Assessment Transformer Highest Loading and Critical Load Level Results

Element ID	Highest 2023 % LTE Loading	Boston Load Level
Sandy Pond T1	138	4387
Sandy Pond T2	104	6220
Woburn A	158	4869
Hyde Park A	105	6194
W. Walpole A	102	6285

2023 Needs Assessment 115 kV Critical Load Level Results

Element	Highest 2023 % LTE Loading	Boston Load Level
Y-151	103	6223
G-133	111	5965
391-508	120	5847
533-508	160	5048
211-514	207	3738
282-520 / 521	208	3569
329-510 / 511	144	4739
329-512 / 513	127	5062
385-510 / 511	173	4102
250-516 / 517	150	4395

Element	Highest 2023 % LTE Loading	Boston Load Level
110-510/511	149	4486
329-530 / 531	134	5562
496-528 / 529	111	6021
W23	212	3091
E-157	135	5314
W23W	265	1414
X-24W	184	3235
433-507	134	5399
282-507	110	6010
240-508	100	6288

2023 Needs Assessment 115 kV Critical Load Level Results

Element	Highest 2023 % LTE Loading	Boston Load Level
274-509	104	6157
455-507	137	5247
447-508 / 509	125	5964
146-502	140	5093
148-522XY	110	5999
F-158N	146	5067

Element	Highest 2023 % LTE Loading	Boston Load Level
F-158S	127	5703
Q-169	115	5899
T-146E	125	6184
T-146	109	6010
M-139	126	5438
N-140	113	5874
K-137E	105	6084

Minimum Load Results

- N-1 testing demonstrated no high voltages in the Greater Boston area
- N-1-1 testing demonstrated high voltages on the downtown Boston cable systems:

- Highest voltage was at K Street at 1.078 p.u.
- Ten 345 kV voltage violations
- Twenty-four 115 kV voltage violations

Short-Circuit Results

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Bulk Power System (Stability) Results

- Results indicate there are 17 stations that need to be upgraded to BPS
 - Fourteen stations in the Greater Boston Area
 - One each in Southeast Mass, Western Mass and Rhode Island
- BPS classification is due to system separation between Maine and the rest of New England
- The Solutions Study is considering
 - Reducing clearing times
 - Rebuilding the stations to BPS standards
 - Adding a dynamic VAR device to improve overall system performance

SOLUTIONS STUDY UPDATE



Primary Objective of the Solutions Study

- The primary objective of the Greater Boston Working Group is to resolve the needs identified in the 2023 Needs Assessment
- A complete Greater Boston AC preferred solution was presented to PAC in March 2012
 - Agreed to examine a hybrid HVDC / AC alternative (SeaLink) proposal made by New Hampshire Transmission, LLC (NHT)
- SeaLink is a hybrid solution consisting of a subset of the AC plan components and an HVDC submarine cable extending from Seabrook to Boston
 - SeaLink would primarily displace the new 345 kV AC transmission lines north of Boston

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Includes subset of AC plan components in the south, west and downtown areas

Study Progress Since March 2012 PAC

- Substantial progress evaluating both the AC and the HVDC SeaLink plans has been made
- The peak load steady state portion of the assessment for both plans is complete
 - AC Plan
 - Determined that not all the AC components presented in March 2012 PAC are needed due to assumption changes in 2023 Needs Assessment
 - Considered several AC component alternatives
 - HVDC SeaLink
 - Uses several components from the AC plan

Study Progress Since March 2012 PAC, cont.

- Currently conducting for both plans
 - BPS screening
 - Short-circuit assessment
 - Minimum load assessment
- Started a comparative assessment of both plans that may include
 - Costs
 - Operational performance
 - Impact on relevant interfaces
 - Robustness through retirement scenarios
 - Other assessments as needed congestion during construction or other implementation issues
- Expect to complete the assessment in Q4 this year

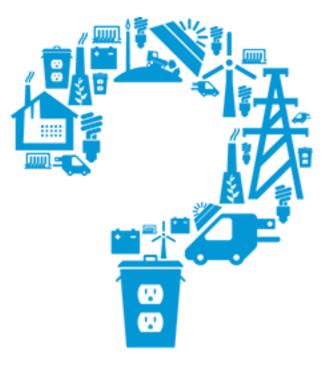




Next Steps

- Post draft Greater Boston 2023 Needs Assessment report in Q3 2013 for stakeholder review
- Complete the testing on the AC and SeaLink HVDC plans
- Compare the AC and the SeaLink HVDC plans
- Choose between the AC and SeaLink HVDC plans for Greater Boston
- Present the Greater Boston solutions at PAC and post the draft Solutions Study for stakeholder review in Q4 2013

Questions





APPENDIX A

Links to Past Presentations



Study History

- 1. Needs Assessment scope presented to PAC in May 2008
 - <u>http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2008/may202008/index.html</u>
- 2. Initial needs presented to PAC in January 2009
 - <u>http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2009/jan212009/index.html</u>
- 3. Detailed preliminary needs and Notification of Solution Study discussed at PAC in July 2009
 - <u>http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2009/jul162009/index.html</u>
- 4. Needs Assessment Status Update in December 2009
 - <u>http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2009/dec162009/index.html</u>

- 5. Greater Boston Study Needs Assessment/Solution Study Status Update presented at PAC in December 2010
 - Grouped transmission solution alternatives into three areas
 - North of Boston
 - South of Boston
 - Central Area
 - Identified the preliminary preferred solutions for both the north and south areas
 - <u>http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2010/dec162010/index.html</u>

- 6. Greater Boston Study Needs Assessment/Solution Study Status Update presented at PAC in June 2011
 - Completed the "Needs Assessment" phase by presenting short-circuit assessment and critical load level assessment for the Boston Area

- Discussed the impact of Salem Harbor Non-Price Retirement
- <u>http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2011/jun302011/index.html</u>

- 7. Greater Boston Study Needs Assessment/Solution Study Status Update presented at PAC in January 2012
 - Grouped transmission solution alternatives for the Central Area into the Western Suburbs and Downtown Boston sub-Areas
 - Western Suburbs
 - Presented competing transmission alternatives
 - Provided feasibility, cost, and technical assessment
 - Identified the preliminary preferred solutions
 - Downtown Boston
 - Presented competing transmission alternatives
 - <u>http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2012/jan182012/index.html</u>

- 8. Greater Boston Study Needs Assessment / Solution Study Status Update in March 2012
 - Downtown Boston
 - Presented competing transmission alternatives
 - Provided feasibility, cost, and technical assessment
 - Identified the preliminary preferred solutions
 - Presented the complete Greater Boston Solution
 - Agreed to consider an HVDC alternative from Seabrook into Boston
 - <u>http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2012/mar142012/index.html</u>
- 9. Greater Boston Solution Study Update in February 2013
 - Presented the impact of assumption changes
 - Presented a preliminary transfer assessment based on the set of AC upgrades described in the March 2012 PAC presentation
 - http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2013/feb122013/index.html

10. NSTAR Underground Cable Rating Update

http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2013/apr242013/index.html



APPENDIX B

Critical Load Level Detailed Results

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