APPENDICES

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APPENDIX 1-1 EXPANDED ENVIRONMENTAL NOTIFICATION FORM (PROVIDED UNDER SEPARATE COVER)

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APPENDIX 1-2 MEPA CERTIFICATE

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November 29, 2021

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS ON THE EXPANDED ENVIRONMENTAL NOTIFICATION FORM

PROJECT NAME	: N12/M13 Double Circuit Tower Separation Project
PROJECT MUNICIPALITY	: Fall River & Somerset
PROJECT WATERSHED	: Taunton River Basin & Mount Hope Bay
EEA NUMBER	: 16467
PROJECT PROPONENT	: New England Power Company
DATE NOTICED IN MONITOR	: October 22, 2021

The Proponent submitted an Expanded Environmental Notification Form (EENF) with a request that I allow a Single EIR to be submitted in lieu of the usual two-stage Draft and Final EIR process pursuant to Section 11.06(8) of the MEPA regulations. The Proponent should submit a Single EIR in accordance with the Scope included in this Certificate.

<u>Project Description</u>

As described in the Environmental Notification Form (EENF), the project consists of the alteration of the existing N12/M13 Double Circuit Tower (DCT) configuration carrying the N12 and M13 115 kilovolt (kV) transmission lines from the Pottersville Switching Station (formerly the Somerset Substation) in the Town of Somerset (Town), over the Taunton River, to the Sykes Road Substation in the City of Fall River (City); a total distance of approximately 1.85 miles. Currently, the lines are supported via a series of smaller transmission structures and two large transmission towers that carry the lines over the Taunton River. The N12 and M13 transmission lines will be separated to improve resiliency, and one line (M13) will be relocated to a new set of transmission structures/towers proposed to be constructed primarily within the existing electric transmission line right-of-way (ROW). Much of the existing transmission infrastructure will also be replaced. As described in the EENF, due to siting constraints on the banks of the Taunton

River, one of the proposed steel transmission towers for the M13 line (which will support the aerial span over the river) will be constructed within the Federal Emergency Management Agency (FEMA) Velocity Zone (VE) in Land Subject to Coastal Storm Flowage (LSCSF) located on the east (Fall River) side of the Taunton River. This new M13 tower is proposed to be located immediately south of the existing N12 tower located on the east side of the Taunton River, which is also in FEMA VE Zone/LSCSF, and is proposed to remain.

The project is proposed to address reliability risk associated with the existing configuration by placing the transmission lines on separate supporting infrastructure, whereas currently the two lines are located on the same series of transmission structures/towers. As described in the EENF, the existing configuration contributes significantly to the potential for widespread voltage collapse and loss of load as any impact to a single structure/tower could cause an outage to both lines. The project was identified as a priority in the New England Independent System Operator (ISO-NE) Southeastern Massachusetts and Rhode Island (SEMI-RI) Area 2026 Solutions Study (released March 2017). The need for the project was reaffirmed in the SEMA-RI Area 2029 Needs Assessment Update (released October 2020). Specifically, the project proposes the installation of 14 new transmission structures and two new river-crossing towers ("Y-Frame" steel monopoles) for the M13 Line and the replacement of seven (7) transmission structures and installation of four (4) new intermediate structures for the N12 Line. The two existing 300-foot high N12 steel lattice towers at the Taunton River crossing will be retained. The EENF states the project has no appreciable effect on generation or other energy facilities as the new towers are being constructed to address existing system capacity shortages. The transmission upgrades will improve reliability and provide more robust transmission facilities to allow for future interconnections from renewable energy projects. According to the EENF, the establishment of the M13N Line will require approval from the Massachusetts Department of Public Utilities (DPU). The M13 Line will cross the Taunton River, a Massachusetts Department of Transportation (MassDOT) rail corridor, and Route 24.

Project Site

The 85-acre project site consists primarily of existing ROW and/or easements owned by the Proponent between the Pottersville Switching Station in Somerset and the Sykes Road Substation in Fall River. Additional permanent and temporary easements will be required to facilitate construction and create access to the proposed M13 structures; the Proponent is currently pursuing these easements. The existing ROW is routinely managed by the Proponent consistent with vegetation management standards for overhead transmission lines. Surrounding land use is primarily residential and commercial. The EENFs states one (1) Environmental Justice (EJ) community is located within the project corridor and two additional communities are located within 1-mile of the project corridor. The EENF indicates the project is not likely to negatively affect these populations, as further described below. The MassDOT rail corridor is part of the South Coast Rail project (EEA #14346), which will provide commuter rail service between Boston and Southeastern Massachusetts. Within the project site, construction associated with the South Coast Rail project includes a new train layover facility (Weavers Cove) in Fall River. A portion of the project site, referred to as the Shell Oil, New Street Release Site is regulated under the Massachusetts Contingency Plan (MCP; 310 CMR 40.0000) and assigned

Release Tracking Number (RTN) 4-0000749 and secondary RTNs 4-0000930, 4-00225522, and 4-0023361.

The transmission lines cross the Taunton River, which is a federally listed Wild and Scenic River; the river is also classified as an impaired water body. In addition to Riverfront Area and LSCSF, the project site contains Bordering Vegetated Wetlands (BVW), Isolated Vegetated Wetlands (IVW), Land Under the Ocean (LUO), Inland Bank, Coastal Bank, Coastal Beach, and Salt Marsh. Portions of the project site are mapped as Flood Zone VE (a coastal area inundated during a 100-year storm with additional hazard associated with storm waves) with a Base Flood Elevation (BFE) of elevation (el.) 17 ft NAVD88, and Flood Zone AE (an area inundated during a 100-year storm) with a BFE of el. 15 ft NAVD88, as delineated on FEMA map 25005C0332G (effective date July 16, 2014). The project site does not contain *Estimated and Priority Habitat of Rare Species* as delineated by the Natural Heritage and Endangered Species Program (NHESP) in the 14th Edition of the Massachusetts Natural Heritage Atlas or an Area of Critical Environmental Concern (ACEC). The site contains several historic and archaeological sites previously recorded in the Massachusetts Historical Commission's (MHC) Inventory of Historic and Archaeological Assets of the Commonwealth; the EENF indicates the project is not anticipated to have any adverse effects on these historic resources.

Environmental Impacts and Mitigation

Potential environmental impacts associated with the project include the alteration of approximately 11.54 acres of land, 11 acres of which is described as temporary impact associated with clearing and/or grading to create temporary work areas. Potential impacts to wetland/coastal resource areas include the alteration of 172,379 square feet (sf) (approximately 3.96 acres) of LSCSF; 6,850 square feet (sf) of Salt Marsh; 1,397 sf of LUO; 133,546 sf (3.07 acres) of BVW; 208 linear feet (lf) of Inland Bank; and approximately 78,384 sf (1.80 acres) of Riverfront Area (0.41 acres of which is coincident with LSCSF or BVW). The project will also alter approximately 91,675 sf (2.10 acres) of Designated Port Area (DPA).

Measures to avoid, minimize, and mitigate project impacts include the use of dust mitigation measures during construction, restoration of temporarily impacted wetland and coastal resources to pre-construction conditions, the creation of wetland replication areas, and the use of erosion and sedimentation controls during construction.

Jurisdiction and Permitting

The project is undergoing MEPA review and is subject to a mandatory EIR pursuant to 301 CMR 11.03(3)(a)(1)(a) of the MEPA regulations because it requires Agency Actions and will result in the alteration of one or more acres of Salt Marsh or Bordering Vegetated Wetlands (in this case, BVW). Additionally, the project exceeds the ENF thresholds at 11.03(3)(b)(1)(c), 11.03(3)(b)(1)(d), 11.03(3)(b)(1)(e), and 11.03(3)(b)(1)(f): the alteration of 1,000 or more sf of salt marsh; the alteration of 5,000 or more sf of bordering or isolated vegetated wetlands; New fill or structure or Expansion of existing fill or structure, except a pile-supported structure, in a velocity zone or regulatory floodway; and the alteration of one half or more acres of any other wetlands (LSCSF), respectively.[1]

The project requires a 401 Water Quality Certification (WQC) from the Massachusetts Department of Environmental Protection (MassDEP), approval pursuant to G.L. c. 164 § 72 (Section 72 approval) from DPU, Federal Consistency Review from the Massachusetts Office of Coastal Zone Management (CZM), and a State and Interstate Highway Right-of-Way Encroachment Permit and Crossing Permit from MassDOT. The EENF indicates the project may potentially require a Chapter 91 (c.91) Waterways License and/or Superseding Order of Conditions from MassDEP as well.

The project requires Orders of Conditions from the Fall River Conservation Commission and Somerset Conservation Commission (or in the case of an appeal of either, a Superseding Order of Conditions from MassDEP). The project requires a Section 404 Permit and Section 10 Permit Modification from the U.S. Army Corps of Engineers (USACE) as well as a National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP) from the United States Environmental Protection Agency (EPA). The project will require review by MHC acting as the State Historic Preservation Officer (SHPO) pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800).

The project is not receiving Financial Assistance from the Commonwealth. Therefore, MEPA jurisdiction for any future reviews would be limited to those aspects of the project that are within the subject matter of any required or potentially required Agency Actions and that may cause Damage to the Environment, as defined in the MEPA regulations. Because the scope of the DPU Section 72 approval extends to all aspects of the project, and the project may require a MassDEP c. 91 license, these Agency Actions confer the functional equivalent of full-scope jurisdiction under MEPA.

Request for Single EIR

The MEPA regulations indicate a Single EIR may be allowed provided I find that the EENF:

a) describes and analyzes all aspects of the project and all feasible alternatives, regardless of any jurisdictional or other limitation that may apply to the Scope;
b) provides a detailed baseline in relation to which potential environmental impacts and mitigation measures can be assessed; and,
c) demonstrates that the planning and design of the project use all feasible means to avoid potential environmental impacts.

Consistent with this request, the EENF was subject to an extended comment period under 301 CMR 11.05(7).

[1] The EENF did not note the exceedance of the MEPA threshold at 301 CMR 11.03(3)(b)(1)(f); however, based on the information provided in the EENF, the project will alter more than one half acre of any other wetlands (LSCSF). The exceedance of this threshold was noted during the remote consultation session held on November 3, 2021.

Review of the EENF

The EENF provided a description of existing and proposed conditions; preliminary project plans; invasive species control plan; correspondence with the Massachusetts Division of Fisheries and Wildlife (MassWildlife), the U.S. Fish and Wildlife Service, and MHC; a spill management plan; wetlands and stream report; wildlife habitat evaluation; and a discussion of the project's compliance with the MEPA Greenhouse Gas (GHG) Policy. The EENF identified measures to avoid, minimize and mitigate environmental impacts. Supplemental information was distributed by the Proponent on November 9, 2021 that included additional site plans, a description of public outreach that has been conducted to-date, details regarding construction work in wetland resource areas, a contingency plan for potential coastal storms, area of tree clearing, MCP site work, and coordination conducted to-date with the Massachusetts Bay Transportation Authority (MBTA). For purposes of clarity, all supplemental materials are referred to herein as the "EENF" unless otherwise referenced. Comments from State Agencies are supportive of granting the Single EIR.

Alternatives Analysis

The EENF included an alternatives analysis which described a No Action Alternative and three potential transmission alternatives identified by ISO-NE in the Solution Study and Needs Assessment Update described above. The No Action Alternative would leave the site in its existing state. While this would not result in additional environmental impacts to the project site, it would not address the project goal of addressing reliability, and the system would remain at risk for failure. As such, the No Action Alternative was not considered viable.

Alternative 2 would involve the installation of a new underground cable extending approximately five miles from the Bristol 51 Substation in Bristol, Rhode Island to a new proposed switching station (Old Boyd's Lane Switching Station) in Portsmouth, Rhode Island. Locating transmission lines underground improves reliability in wind and winter weather events, reduces vegetation management requirements, reduces vulnerability to vehicle collisions, and can reduce outages (among other benefits); however, they are more costly to construct, are susceptible to storm surges and flooding, and can be more difficult and costly to maintain and repair due to access limitations.[2] According to the EENF, as there is currently no transmission circuit in this area, Alternative 2 would require the construction of a new switching station on currently undeveloped land that would have to be acquired, as well as a complex marine crossing of Mount Hope Bay. This alternative also would be considerably more expensive to build than any of the other alternatives; therefore, it was rejected.

Alternative 3B is a variation of the Preferred Alternative (identified in the EENF as Alternative 3A), which would involve the new upland portion of the M13 line consisting of a hybrid configuration of overhead and underground construction (whereas the new line is

[2] From the 2014 *Feasibility Study for Undergrounding Electric Distribution Lines in Massachusetts*, prepared by the Massachusetts Department of Energy Resources (DOER): https://www.mass.gov/doc/feasibility-study-for-undergrounding-electric-distribution-lines-in-massachusetts/download

proposed to be entirely overheard in the Preferred Alternative). As noted above, locating transmission lines underground can have added resiliency benefits. As described in the EENF, Alternative 3B would have similar environmental impacts to the Preferred Alternative, but introduces numerous physical constraints such as dense utility congestion within local roadways. The EENF states there is no feasible option for a trenchless crossing of State Route 24, and therefore this Alternative was rejected.

Alternative 4 would involve the installation of a third new 115 kV line extending approximately 3.5 miles. According to the EENF, Alternative 4 was dismissed because it would require the reconfiguration and rebuilding of the N12 and M13 lines in their entirety (increasing costs and environmental impacts as compared to the Preferred Alternative) and would require additional easements for either an overhead route option or underground route option. The EENF states that the Preferred Alternative (described herein) will best address the identified need and will improve transmission system reliability, and is the preferred solution identified by ISO-NE. The EENF further states that the Preferred Alternative is the best solution when balancing considerations of system reliability, costs to customers, potential environmental impacts, and engineering and construction feasibility.

Environmental Justice

One (1) Environmental Justice (EJ) community is located within the project corridor and two additional communities are located within 1-mile of the project corridor, characterized by Minority or Minority and Income. The EENF states that, as part of the stakeholder outreach plan, the Proponent will promote public involvement by EJ communities through the use and dissemination of multi-lingual project fact sheets, website content, meeting invitations and translation services for future presentations in English, Spanish, and Portuguese (both in writing and in-person). To date, outreach has included door-to-door visits with direct landowners and abutters, distribution of door hangers and fact sheets to notify the immediate abutters of the pending project, and an active 24-hour call-in number and email address so that community members can contact project staff directly. The Proponent is also developing a website that is anticipated to be available to the public by the end of 2021 that contains information in English and translated to Spanish and Portuguese to promote participation. The Proponent will also be scheduling an open house to support the Section 72 Petition to be filed with the DPU in the spring of 2022. Translation services will be available and accessible for those participants whose primary language is not English.

According to the EENF, the project is not reasonably likely to negatively affect EJ communities. The EENF states the project does not exceed MEPA thresholds for Air (301 CMR 11.03(8)) and meets the greenhouse gas de minimis exemption (further discussed below). There are no facilities proposed that would result in long-term air emissions. The Project does not exceed MEPA thresholds for Water (301 CMR 11.03(4)) and there are no long-term water withdrawals or discharges proposed. There will be no reduction in or conversion of public open space. The project will improve the reliability of electricity to the area. As discussed below, however, the project is proposing to locate new structures within a FEMA flood zone and coastal wetlands, which could jeopardize resiliency for surrounding communities, including EJ populations that could be more vulnerable to the effects of climate change. The Single EIR should provide more analysis of climate change scenarios applicable during the useful life of the project, and provide a clear justification for the siting and design choices made by the project. The Single EIR should confirm that, with issuance of a WQC, no water quality degradation is anticipated that would impact the public health of neighboring communities.

Land Alteration

The project will result in the alteration of 11.54 acres of land, including approximately 2.18 acres of tree removal and the conversion of 12,162 sf of forested wetland to scrub-shrub wetland. A significant portion (2 acres) of the proposed tree clearing is associated with the construction of the new M13N6 lattice tower, which will support the aerial span over the river. The remainder of the proposed tree clearing is associated with vegetation management within the existing ROW. The EENF states existing gravel and/or crushed stone upland access roads and paved roads will be used to gain access to the transmission structures. The installation of concrete caisson structure foundations necessary to upgrade and/or refurbish existing public electric utility will result in negligible increases in impervious surfaces. No new direct stormwater discharges (outfalls) are proposed as part of this project. The EENF discussed how the project aligns generally with regional planning documents, including those created by the Southeastern Regional Planning and Economic Development District (SRPEDD). In addition, the EENF states the Preferred Alternative uses substantial portions of existing ROW, thereby minimizing alteration of new land resources to construct the project.

Wetland and Coastal Resources

Approximately 76,055 sf of Riverfront Area; 120,996 sf of BVW; 208 lf of Bank; 1,397 sf of LUO; 90,657 square feet of DPA, 6,850 sf of Salt Marsh, and 119,313 sf of LSCSF will be temporarily altered from the placement of construction mats and pull pads, temporary grading to create level work areas, temporary crossings using low ground pressure equipment for pulling lead lines and the installation overhead conductors and wires. Approximately, 12,550 sf of BVW, 2,329 sf of Riverfront Area, 1,018 sf of DPA, and 53,066 sf of LSCSF will be permanently altered from the addition of fill and the installation of the transmission tower foundations, permanent access routes, and permanent work pads. The majority of the existing N12 and M13 rights of way is already cleared of trees; however, selective tree clearing is proposed within BVW for the installation and operation of the M13/N12 line. The Somerset and Fall River Conservation Commissions will review the project for its consistency with the Wetlands Protections Act (WPA), the Wetland Regulations (310 CMR 10.00), and associated performance standards. The EENF included a discussion of how the project met these performance standards. Wetland replications areas will be required for permanently impacted BVW; however, the location of the areas was not determined at the time the EENF was filed.

The project requires a 401 WQC from MassDEP pursuant to 314 CMR 9.04(1) as it will result in the alteration of over 5,000 sf of BVW. The project may also require a c.91 License; should this be required, MassDEP will also review the project for its consistency with the Waterways regulations 310 CMR 9.00. The EENF states that there are two existing c.91 Permits for the site: License Plan No. 4353 (dated May 1960) and License Plan No. 4781 (dated March 1964). Comments from MassDEP state that the installation of the overhead wires at the Taunton River and Steep Brook and any intermittent stream crossing in an area that is navigable will require a Waterways License in accordance with 310 CMR 9.05. MassDEP further states the

Department will work with the Proponent to determine which waterbodies are jurisdictional. According to MassDEP, the project use has been determined to be Water-Dependent-Industrial in accordance with 310 CMR 9.12(2)(b) 10. As noted above, the project also requires Federal Consistency Review from CZM. Comments from CZM recognize the overall goals of the proposed project, particularly the project's goal to increase electrical reliability and resilience to the community, and are supportive of the Proponent's request for the submission of a Single EIR. However, comments from CZM, MassDEP, and the Massachusetts Division of Marine Fisheries (DMF) note concerns with the proposed work in Salt Marsh and identify additional information that should be included in the SEIR (further discussed below).

Climate Change

Governor Baker's Executive Order 569: Establishing an Integrated Climate Change Strategy for the Commonwealth was issued on September 16, 2016. The Order recognizes the serious threat presented by climate change and direct Executive Branch agencies to develop and implement an integrated strategy that leverages state resources to combat climate change and prepare for its impacts. The urgent need to address climate change was again recognized by Governor Baker and the Massachusetts Legislature with the recent passage of St. 2021, c. 8, An Act Creating a Next Generation Roadmap for Massachusetts Climate Policy, which sets a goal of Net Zero emissions by 2050. I note that the MEPA statute directs all Agencies to consider reasonably foreseeable climate change impacts, including additional greenhouse gas emissions, and effects, such as predicted sea level rise, when issuing permits, licenses and other administrative approvals and decisions. M.G.L. c. 30, § 61.

Additionally, the Town and City are both participants in the Commonwealth's Municipal Vulnerability Preparedness (MVP) program. The MVP program is a community-driven process to define natural and climate-related hazards, identify existing and future vulnerabilities and strengths of infrastructure, environmental resources, and vulnerable populations, and develop, prioritize and implement specific actions the Town/City can take to reduce risk and build resilience. Through the MVP program, the Town and City independently received funding to conduct a planning process for climate change resiliency and implementing priority projects. For the City of Fall River, the results of the initial community-driven process were presented in the "Community Resiliency Building Workshop - Summary of Findings" (the Fall River Report), dated June 2019.[3] The Fall River Report identified flooding, hurricanes or severe storms, earthquakes, and sea level rise as the top natural hazards that will be impacted by climate change in the City. For the Town of Somerset, the results of the initial community-driven process were presented in the "Community Resiliency Building Workshop - Summary of Findings" (the Somerset Report), dated January 2020.[4] The Somerset Report identified hurricanes, nor'easters, flooding (including from storm surge), and heavy precipitation rain events as top climate hazards in the Town.

[3] The Fall River Report is available at: https://www.mass.gov/doc/fall-river-report/download
[4] The Somerset Report is available at: https://www.mass.gov/doc/somerset-report/download

Adaptation and Resiliency

As noted above, portions of the project site are mapped as Flood Zone VE with a BFE of el. 17 ft NAVD88, and Flood Zone AE with a BFE of el. 15 ft NAVD88. The existing N12-6 tower and new M13-N6 tower will be located in both Flood Zone VE and LSCSF. According to the ENF, it is infeasible to locate the tower further inland due to limitations with land availability and existing/planned development in the area. The proposed tower will be located above the existing 10-year storm level. The EENF states that the project will result in a more climate-ready and resilient transmission system that can: withstand more extreme weather events; address existing system capacity shortages and increased demand; and support future interconnections from renewable energy projects and offshore wind. According to the EENF, the primary climate change concerns within the energy sector are flooding, extreme weather events, and increased temperature; all of which were considered in designing the project. Measures that have been implemented into project design include reinforced structure foundations, storm protection measures, minimizing impacts to the existing topography/contours, and site stabilization and reestablishment of natural vegetation.

The EENF included the report generated by the RMAT Tool, which described High Exposure to sea level rise (SLR)/storm surge, Moderate Exposure to Extreme Precipitation (urban flooding), and High Exposure to Extreme Precipitation (riverine flooding) and Extreme Heat. The EENF described potential increases in sea level rise (SLR) of up to 4- to 5-feet above the current Mean Higher High Water (MHHW) mark, although the EENF did not specify what year SLR was estimated for. The RMAT tool report indicates that this structure is at high risk to sea level rise and storm surge; it recommends a target planning horizon of 2070 and that the project be designed to withstand the effects of a 200-year storm. While the EENF asserts that most of the project will be located outside of the extent of inundation under a (current) 100-year storm scenario, when factoring in the SLR assumptions included in the EENF, the Proponent acknowledges that two structures (the existing N12-6 tower and the new M13N6 tower) will be subject to inundation within the FEMA VE Zone. These two structures are also mapped within a category 1 hurricane surge inundation area. Two additional structures on the opposite side of the Taunton River, in Somerset (structure N12-5 and M13N-5) are mapped within a category 4 hurricane surge inundation area; however, these are located inland of an existing seawall along the west bank of the Taunton River, which provides some protection from projected SLR and flooding. The RMAT temperature forecasts project a minimum increase in temperature of 3.50 degrees F and a maximum of 3.90 degrees F in the Project area. The EENF states the new transmission line conductors are designed to operate at higher maximum operating temperatures at a higher carrying capacity and under fluctuations in air temperature than existing conductors. As stated in the Scope, the Single EIR should provide a full justification for siting the new structure in the FEMA VE Zone, and explain why alternatives that improve climate resiliency were deemed infeasible.

The EENF also included a description of contingency measures to be taken should there be a significant coastal storm forecast during project construction. As described in the EENF, the Proponent would likely call for a standby where all construction work would be temporarily suspended. All equipment and vehicles located within LSCSF would be removed from the site or secured. Potentially hazardous materials (such as fuel containers) would be relocated outside of

LSCSF and secured. There would be no operation of construction equipment during a coastal storm event nor during an extreme high tidal cycle. If construction mats are installed within the Salt Marsh, the mats would be anchored in-place or removed. The removal and replacement of construction mats would be determined based on considerations of the forecast sea state, wave height, high tide elevation, and wind conditions. If there is a risk of the mats being dislodged or washed away, the mats would be removed from the Salt Marsh and relocated beyond the forecasted elevation of the tide.

Greenhouse Gas (GHG) Emissions

The project is subject to the MEPA GHG Policy because it exceeds thresholds for a mandatory EIR. The GHG Policy includes a de minimus exemption for projects that will produce minimal amounts of GHG emissions. GHG emissions are anticipated during the construction period of the project only and are not expected to be ongoing. As such, this project may fall under the de minimus exemption. As described in the EENF, the project will have little or no greenhouse gas emissions once construction is complete. The project does not propose the additional generation of energy, and the EENF included measures to limit vehicle idling times and to reduce air emissions during construction. The EENF states there are no anticipated long-term impacts on air quality associated with the operation of the transmission line. The transmission upgrades are proposed to address existing system capacity shortages and improve reliability, and will have no appreciable effect on energy generation. The EENF states the project will provide more robust transmission facilities and increase electrical capacity in the SEMI-RI region to allow for future interconnections from renewable energy projects, which will enable a transition to a cleaner electrical grid.

Transportation

The project requires a State and Interstate Highway Right-of-Way Encroachment Permit and Crossing Permit from MassDOT. Comments from MassDOT recommend that no further environmental review be required based on transportation-related issues. The project will cross the railroad associated with the MBTA's South Coast Rail. As described in the EENF, the Proponent has met with representatives of the MBTA on a routine basis to discuss the coordination required for the respective projects. According to the EENF, the MBTA's proposed work for the rail yard in Fall River includes an access road which the Proponent plans to use on a temporary basis to cross the railroad tracks in order to construct the M13N6 tower, and to perform work at the existing N12-6 tower. Should the N12/M13 DCT Separation Project be approved, the Proponent will provide an updated construction schedule to the MBTA and notify the MBTA of the dates required to cross the tracks.

Hazardous Waste

As noted above, the Shell Oil, New Street Release Site, located immediately south of the proposed M13N6 structure. As described in the EENF, known contaminants associated with the MCP site are expected to be encountered during the construction of the transmission tower foundations, given the close proximity to the former Shell Oil Terminal. The EENF states that a Licensed Site Professional (LSP) has been retained to support MCP during construction. The

LSP will assist with regulatory notifications and reporting requirements under the MCP and with planning and proper management and disposal of impacted soil and groundwater.

Construction Period

The EENF states the project will occur in stages over an approximately 12-month work period starting in mid-2023. Generally, the project will commence as follows:

- Removal of vegetation, ROW mowing in advance of construction and removal of hazard and danger trees
- Staking of proposed transmission structures
- Installation of soil erosion and sedimentation controls and construction-related BMPs
- Construction, repair and/or improvement of access routes to existing and proposed structures
- Installation of work pads and staging areas
- Removal and disposal of select transmission line components (to include recycling of used materials and assets)
- Installation of foundation and construction of new and replacement transmission structures
- Installation of conductor, optical ground wire, and shield wire
- Restoration and stabilization of the ROW

During the construction-phase of the project there may be intermittent and localized increases in noise, dust and emissions from construction vehicles and related equipment. The EENF state there will be measures implemented to minimize and mitigate these temporary impacts. Solid waste will be generated during the construction of the Project. The transmission assets to be removed will be recycled. Those components not salvaged and any debris that cannot be recycled will be removed from the ROW to an approved off-site facility.

All construction activities should be managed in accordance with applicable MassDEP's regulations regarding Air Pollution Control (310 CMR 7.01, 7.09-7.10), and Solid Waste Facilities (310 CMR 16.00 and 310 CMR 19.00, including the waste ban provision at 310 CMR 19.017). The project should include measures to reduce construction period impacts (e.g., noise, dust, odor, solid waste management) and emissions of air pollutants from equipment, including anti-idling measures in accordance with the Air Quality regulations (310 CMR 7.11). The EENF states that diesel-powered non-road construction equipment with engine horsepower ratings of 50 and above to be used for 30 or more days over the course of Project construction will either be USEPA Tier 4-compliant or will be retrofitted with USEPA-verified (or equivalent) emission control devices such as oxidation catalysts or other comparable technologies (to the extent that they are commercially available) installed on the exhaust system side of the diesel combustion engine. The use of ultra-low sulfur diesel fuel in its diesel-powered construction equipment and limits idling time to five minutes except when engine power is necessary for the delivery of materials or to operate accessories to the vehicle such as power lifts. The EENF additionally states vehicle idling will be minimized during the construction phase of the project. If oil and/or hazardous materials are found during construction, the Proponent should notify MassDEP in accordance with the Massachusetts Contingency Plan (310 CMR 40.00). All construction activities should be undertaken in compliance with the conditions of all State and local permits.

Conclusion

The EENF includes an alternatives analysis, identifies baseline environmental conditions and potential environmental impacts, and proposes mitigation measures to justify the request for a Single EIR. Based on review of the EENF and consultation with State Agencies, I hereby allow the Proponent to submit a Single EIR in lieu of a Draft and Final EIR. The Proponent should submit a Single EIR that provides updated project information and analyses as specified in the Scope below.

SCOPE

General

The SEIR should follow Section 11.07 of the MEPA regulations for outline and content, as modified by this Scope. Recommendations provided in this Certificate may result in a modified design that would further avoid, minimize, and/or mitigate Damage to the Environment. The SEIR should identify measures the Proponent will include to further reduce the impacts of the project since the filing of the EENF, or, if certain measures are infeasible, the SEIR should discuss why these measures will not be adopted.

Project Description and Permitting

The SEIR should describe the project and identify any changes to the project since the filing of the EENF. It should include updated site plans for existing and post-development conditions. Conceptual plans should be legible and provided at a reasonable scale. Plans should clearly identify: all major project components (existing and proposed buildings, access roads, etc.); public areas; wetland resource areas; impervious areas; ownership of parcels including easements; pedestrian and bicycle accommodations; and stormwater and utility infrastructure. Conceptual plans should be provided for onsite work as well as any proposed off-site work for transportation or utility improvements that will benefit the project.

The SEIR should provide a brief description and analysis of all applicable statutory and regulatory standards and requirements, and describe how the project will meet those standards. It should include a list of required State Permits, Financial Assistance, or other State or local approvals and provide an update on the status of each. The project should clarify whether a c.91 License will be required from MassDEP, if such a determination has been made at the time of filing the SEIR.

Wetlands

Comments from CZM state the wetland resources identified on the plans provided in the EENF appear to be based on MassDEP Wetlands GIS Layers. The Single EIR should include survey transects to determine the extent of the Coastal Bank.[5] The EIR should describe how any work on or adjacent to the coastal bank meets the performance standards for coastal banks. The EIR should also include information on how the proposed grading might change how flood water flows across the site, and an analysis of potential impacts to adjacent areas from increased velocities and volumes of floodwater, under existing and future conditions. Additional detail on the storm bollards and how their size and height were determined should also be provided. The EENF states that wetlands replication area(s) will be provided to mitigate permanent impacts to BVW; however, the details and location of these restoration areas have not been determined. The Single EIR should provide an update on the development of any BVW mitigation, and possible locations of the wetland replication area(s), if a single location has not been identified yet.

The EENF includes an estimated 6,850 sf of temporary impacts to Salt Marsh associated with temporary crossing using a low ground pressure (LGP) vehicle or installation of temporary construction mats. During the remote consultation session (held on November 3, 2021), the potential use of a helicopter to string the conductors across the Taunton River was discussed to avoid impacts to Salt Marsh, and further described in supplemental information. The EENF estimates that, if needed, the mats would be in place for 4-6 weeks on the Salt Marsh. Comments from DMF indicate that covered marsh vegetation can die off completely in a period of 5 to 7 weeks. Comments from CZM state that mats on Salt Marsh during the growing season may cause alterations in growth, distribution, and composition of vegetation. Comments from MassDEP state using the mats during the growing season should be avoided. More detail should be provided in the Single EIR on the specific methods proposed to cross these coastal wetland resource areas, the potential impacts, and strategies to mitigate impacts. The Single EIR should outline proposed pre-and post-construction monitoring plans to determine whether any marsh impacts occur for either of the proposed temporary crossing methods. The temporary construction mat alternative should be further described, including the proposed timing of this part of the project. Comments from MassDEP state the existing elevation of the Salt Marsh shall be maintained, the low ground pressure equipment or matting shall not compact the Salt Marsh vegetation, lead to pooling in the marsh, or cause marsh vegetation dieback. The Single EIR should address how these items will be addressed to demonstrate compliance with wetland performance standards.

Climate Change Adaptation and Resiliency

As noted above, the project area is expected to experience impacts from SLR associated with climate change. Comments from CZM state the current project designs do not factor in the expected SLR and increases in storm frequency and intensity that will be caused by climate change over the expected life span of the proposed tower structures. The proposed design appears to be resilient to the current-day 10-year storm, and not the 200-year storm as recommended by the RMAT tool by the year 2070. The Single EIR should provide a full explanation of what measures have been taken to improve the project's resiliency to climate

[5] Guidance on the information that should be submitted to determine the extent of a coastal bank is available in Chapter 1 of Applying the Massachusetts Coastal Wetlands Regulations: A Practical Manual for Conservation Commissions to Protect the Storm Damage Prevention and Flood Control Functions of Coastal Resource Areas (aka the Coastal Manual).

change, including how siting and elevation choices were made for the project. The Single EIR should specify the useful life of the project, and whether the project is planning for current or future conditions over the useful life of the project; if the former, the project should explain why future conditions are not being considered. The SEIR should identify what year the SLR projections described in the EENF is based on.

As recommended by CZM, the Single EIR should use the results of the Massachusetts Coast Flood Risk Model (MC-FRM) to assess the frequency and depth of flooding, and overall vulnerability of the proposed new towers and reconducted towers within the utility corridor over the entire life span of the project, and discuss the measures proposed to protect the structures from storm damage, debris impacts, and potential erosions around the base of the structures. For instance, the proponent should explain under what conditions (10-year, 50-year, 100-year) the currently proposed structure will be inundated under future climate conditions in 2030, 2050, and 2070. The Single EIR should explain whether further elevation of the new M13 tower or additional resiliency measures were considered, and if dismissed, explain why these options were dismissed. The Single EIR should explain whether and how the other alternatives studied for the project would have increased climate resiliency for the project (for instance, through underground lines or upland siting), and whether any additional alternatives to improve climate resiliency could be considered, either as part of this project or future upgrades. To the extent future climate resiliency planning for this area has been presented to other regulatory agencies, such as the DPU as part of rate-making proceedings, a summary of those planning efforts should be provided in the Single EIR.

The proposed 42.5-foot diameter base of the transmission tower is a concrete pile cap on top of 36 micro-piles. Engineering analysis of the scour likely to occur around the pilings and pile cap should be included as part of the resiliency analysis for this project. In addition, the Single EIR should identify how the wave reflection off the vertical concrete pile cap will affect the stability of the adjacent coastal bank.

Transportation

The Proponent should work with MassDOT to address the details of the permitting process and any traffic and construction management plans that may be required for temporary work within the state highway layout. The Single EIR should provide an update on any coordination with MBTA regarding project described herein and the South Coast Rail project.

Environmental Justice

The Single EIR should provide an update on efforts to conduct outreach and promote public involvement by nearby communities, including EJ populations. It should provide specific details about the public involvement plan, and explain how public involvement efforts will continue throughout subsequent permitting and through the construction period for the project. The Single EIR should survey public health conditions of the surrounding EJ populations using the EJ Tool issued by the Department of Public Health (DPH),[6] including whether they are included within a municipality or census tract identified as demonstrating "vulnerable EJ criteria." The SEIR should utilize the EEA EJ Mapper[7] to identify languages that are spoken by five percent or more of the population within census tracts containing the above EJ populations who self-identified as "do not speak English very well". The project should provide language services in all languages identified in the EEA EJ Mapper based on the five percent census tract threshold. As noted above, the Single EIR should provide more analysis of climate change scenarios applicable during the useful life of the project and provide an analysis of flooding and erosion risks from the project design. The Single EIR should explain whether the level of climate planning and flooding risks pose any increased risks for the surrounding EJ populations. The Single EIR should confirm that, with issuance of a WQC, no water quality degradation is anticipated from the project that would impact the public health of neighboring communities, including EJ populations. Any specific terms of the WQC intended to address risks to public health should be explained.

Mitigation and Section 61 Findings

The SEIR should include a section that summarizes proposed mitigation measures and provides draft Section 61 Findings for each State Agency Action. It should contain clear commitments to implement these mitigation measures, estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and contain a schedule for implementation.

Responses to Comments

The SEIR should contain a copy of this Certificate and a copy of each comment letter received. In order to ensure that the issues raised by commenters are addressed, the SEIR should include direct responses to comments to the extent that they are within MEPA jurisdiction. This directive is not intended, and shall not be construed, to enlarge the scope of the SEIR beyond what has been expressly identified in this certificate.

Circulation

The Proponent should circulate the SEIR to those parties who commented on the EENF, to any State and municipal agencies from which the Proponent will seek permits or approvals, and to any parties specified in section 11.16 of the MEPA regulations. The Proponent may circulate copies of the SEIR to commenters other than State Agencies in a digital format (e.g., CD-ROM, USB drive) or post to an online website. However, the Proponent should make available a reasonable number of hard copies to accommodate those without convenient access to a computer to be distributed upon request on a first come, first served basis. The Proponent should send a letter accompanying the digital copy or identifying the web address of the online

[6] The DPH EJ Tool is available at: https://matracking.ehs.state.ma.us/Environmental-Data/ej-vulnerable-health/environmental-justice.html

[7] The EEA EJ Mapper is available at: https://mass-eoeea.maps.arcgis.com/apps/MapSeries/index.html?appid=535e4419dc0545be980545a0eeaf9b53

version of the SEIR indicating that hard copies are available upon request, noting relevant comment deadlines, and appropriate addresses for submission of comments. The SEIR submitted to the MEPA office should include a digital copy of the complete document. A copy of the SEIR should be made available for review in the local Somerset and Fall River public libraries.

K. Theoharides

November 29, 2021
Date

Kathleen A. Theoharides

Comments received:

11/18/2021	Massachusetts Office of Coastal Zone Management (CZM)
11/19/2021	Massachusetts Department of Environmental Protection (MassDEP), Southeast Regional Office (SERO)
11/22/2021	Massachusetts Division of Marine Fisheries (DMF)
11/23/2021	Massachusetts Department of Transportation (MassDOT)

KAT/ELM/elm

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
OFFICE OF COASTAL ZONE MANAGEMENT
251 Causeway Street, Suite 800, Boston, MA 02114-2136
(617) 626-1200 FAX: (617) 626-1240

MEMORANDUM

TO: Kathleen A. Theoharides, Secretary, EEA
ATTN: Eva Murray, MEPA Office
FROM: Lisa Berry Engler, Director, CZM Lisa Berry Engler
DATE: November 18, 2021
RE: EEA-16467, N12/M13 Double Circuit Tower Separation Project, Expanded Environmental Notification Form; Somerset and Fall River, Massachusetts

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The Massachusetts Office of Coastal Zone Management (CZM) has completed its review of the above-referenced Environmental Notification Form (ENF), noticed in the *Environmental Monitor* dated October 22, 2021; participated in the virtual MEPA consultation on November 3, 2021; and reviewed the supplemental materials supplied on November 10, 2021. The proposed project exceeds the review threshold for wetlands provided in 301 CMR 11.03 requiring the filing of an Environmental Impact Report (EIR) for the alteration of one or more acres of bordering vegetated wetlands. The project proponent is requesting approval for submission of a Single EIR. CZM has the following comments on the proposed project.

Project Description

The New England Power Company (NEP) is proposing to undertake the N12/M13 Double Circuit Tower (DCT) Separation Project (Project) to improve transmission system reliability in the Southeastern Massachusetts and Rhode Island service area. The Project will be located within an existing 115 kilovolt (kV) electric transmission line right-of-way (ROW) that extends from NEP's Pottersville Switching Station in Somerset, Massachusetts to its Sykes Road Substation in Fall River, a distance of approximately 1.85 miles. This ROW is currently occupied by two 115 kV overhead transmission circuits – the N12 and the M13 – supported on double circuit towers; i.e., the two circuits, each consisting of three individual phase conductors, share the same series of towers within the ROW. The main disadvantage of the DCT configuration is reliability; a contingency affecting a single structure could cause an outage to both lines. Placing the N12 and M13 onto separate sets of structures will improve the reliability of the electric transmission system.

The proposed project includes both temporary and permanent impacts to the following coastal resources: Salt Marsh (310 CMR 10.32), Land under the Ocean (310 CMR 10.25), Land Subject to Coastal Storm Flowage (310 CMR 10.04), and Riverfront Area (310 CMR 10.58). The project also proposes work within a Designated Port Area (DPA) and waterways or tidelands that are subject to the Waterways Act, M.G.L.c.91.

Comments

CZM recognizes the overall goals of the proposed project, particularly the project's goal to increase electrical reliability and resilience to the community. CZM is supportive of the proponent's request for the submission of a single EIR and recommends that the following issues be addressed in the EIR's scope.

Proposed new and reconducted tower structures at locations 5 & 6 are located within Land Subject to Coastal Storm Flowage (LSCSF) and FEMA's current Flood Hazard Area (VE Zone 17 ft) and can be expected to experience significant flooding and waves during severe coastal storm events under current sea level rise conditions. The current project designs do not factor in the expected sea-level rise and increases in storm frequency and intensity that will be caused by climate change over the expected life span of the proposed tower structures. Tower structures at location 7 may also be impacted under future storm conditions. This infrastructure is considered critical and should be designed using the best available information regarding the likely future flood zone extents. The RMAT tool report indicates that this structure is at high risk to sea level rise and storm surge and recommends a target planning horizon of 2070 and that the project be designed to withstand the effects of a 200-year storm. NEP should use the results of the Massachusetts Coast Flood Risk Model (MC-FRM) to assess the frequency and depth of flooding, and overall vulnerability of the proposed new towers and reconducted towers within the utility corridor over the entire life span of the project, and discuss the measures proposed to protect the structures from storm damage, debris impacts, and potential erosions around the base of the structures. The proposed 42.5-foot diameter base is a concrete pile cap on top of 36 micro-piles. Engineering analysis of the scour likely to occur around the pilings and pile cap should be included as part of the resiliency analysis for this project. In addition, the EIR should identify how the wave reflection off the vertical concrete pile cap will affect the stability of the adjacent coastal bank.

The project also proposes significant grading changes for an access road to towers located at location 6. The wetland resource area extents on the project plans appear to be based on the Massachusetts Department of Environmental Protection (DEP) Wetlands GIS layers. These layers were developed from interpretation of aerial photos and are only appropriate for general planning purposes. Resource delineations for site specific projects need to be conducted on the site. The access road is within LSCSF and it appears that a portion of the access road may alter a jurisdictional coastal bank per DEP policy 92-1. The EIR should include survey transects to determine the extent of the coastal bank. Guidance on the information that should be submitted to determine the extent of a coastal bank is available in Chapter 1 of Applying the Massachusetts Coastal Wetlands Regulations: A Practical Manual for Conservation Commissions to Protect the Storm Damage Prevention and Flood Control Functions of Coastal Resource Areas (aka the Coastal Manual). The EIR should describe how any work on or adjacent to the coastal bank meets the performance standards for coastal banks. The EIR should also include information on how the proposed grading might change how flood water flows across the site, and an analysis of potential impacts to adjacent areas from increased velocities and volumes of floodwater, under existing and future conditions should be provided. Additional detail on the storm bollards and how their size and height were determined is also requested.

The project includes potential impacts to salt marsh and land under the ocean to facilitate "Temporary crossing with low ground pressure (LGP) equipment to pull the lead line to facilitate wire pulling and installation of the overhead conductors and wires". The supplemental information states that the use of LGP equipment is preferred, and mats may be placed upon the saltmarsh for a period of 4-6 weeks. Mats on the saltmarsh during the growing season may cause alterations in growth, distribution, and composition of salt marsh vegetation. More detail should be provided in the EIR on the specific methods proposed to cross these coastal wetland resource areas, the potential impacts, strategies to mitigate impacts, and if necessary potential restoration of those coastal wetland resources.

Federal Consistency Review

This project may be subject to CZM federal consistency review, which requires that the project be found to be consistent with CZM's enforceable program policies. For further information on this process, please contact Bob Boeri, Project Review Coordinator, at robert.boeri@mass.gov or visit the CZM web site at https://www.mass.gov/federal-consistency-review-program.

LBE/sh/rlb/rh/ts

cc: Fall River Mayor's Office
Fall River Conservation Commission
Somerset Town Administrator
Dan Gilmore, DEP SERO
Cally Harper, MA DEP
Erin Whoriskey, National Grid

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

November 19, 2021

Kathleen A. Theoharides
Secretary of Environment and Energy
Executive Office of Energy and
Environmental Affairs
100 Cambridge Street, Suite 900
ATTN: MEPA Office
Boston, MA 02114

RE: EENF Review. EOEEA 16467.
SOMERSET & FALL RIVER. N12M13
Double Circuit Tower Separation Project at
Right-of-Way located between the Pottersville
Substation (1981 Riverside Avenue) in
Somerset to the Sykes Road Substation in Fall
River (521 Sykes Road)

Dear Secretary Theoharides,

The Southeast Regional Office of the Department of Environmental Protection (MassDEP) has reviewed the Expanded Environmental Notification Form (EENF) for the N12M13 Double Circuit Tower Separation Project at Right-of-Way located between the Pottersville Substation (1981 Riverside Avenue) in Somerset to the Sykes Road Substation in Fall River (521 Sykes Road) and existing overhead transmission rights-of-way in Somerset and Fall River, Somerset and Fall River, Massachusetts (EOEEA # 16467). The Project Proponent provides the following information for the Project:

Construction of the Project will result in limited unavoidable impacts to coastal and inland wetland resource areas. Temporary and permanent impacts to bordering vegetated wetlands are necessary for construction access and staging, installation of structure foundations where vegetated wetland could not be avoided, establishment of new pervious access routes, and limited tree clearing for transmission line clearance. Due to siting and real estate limitations on the banks of the Taunton River, new proposed structure M13N6, which will support the aerial span over the river, will be constructed within Federal Emergency Management Agency (FEMA) Velocity Zone (VE) in Land Subject to Coastal Storm Flowage (LSCSF) located on the east (Fall River) side of the Taunton River. The existing N12-6 tower is located within this same environment and landscape position and will remain.

Bureau of Water Resources Comments

Wetlands. The Project proposes work within inland and coastal resource areas including Bank (310 CMR 10.54), Bordering Vegetated Wetland (BVW, 310 CMR 10.55), Riverfront Area (310 CMR 10.58), Land Under Ocean (310 CMR 10.25), Designated Port Area (310 CMR

10.26), Salt Marsh (310 CMR 10.32), and Land Subject to Coastal Storm Flowage (LSCSF, 310 CMR 10.04).

The Project will result in temporary and permanent alterations to the above-referenced Resource Areas. Approximately 76,055 square feet of Riverfront Area, 120,996 square feet of BVW, 208 linear feet of Bank, 1,397 square feet of Land Under Ocean, 90,657 square feet of Designated Port Area, 6,850 square feet of Salt Marsh, and 119,313 square feet of LSCSF will be temporarily altered from the placement of construction mats and pull pads, temporary grading to create level work areas, temporary crossings using low ground pressure equipment for pulling lead lines and the installation overhead conductors and wires.

Approximately, 12,550 square feet of BVW, 2,329 square feet of Riverfront Area, 1,018 square feet of Designated Port Area, and 53,066 square feet of LSCSF will be permanently altered from the addition of fill and the installation of structure foundation, permanent access routes, and permanent work pads. The majority of the existing N12 and M13 right of way has been cleared of trees and selective tree clearing is proposed within BVW for the installation and operation of the M13/N12 line. The tree removal will result in the conversion of some forested wetlands to either scrub-shrub wetland or emergent BVW.

The Project is not within or adjacent to an Area of Critical Environmental Concern or on or within a half mile radius of an Outstanding Resource Water. The Project is not located within Priority Habitat of State-Listed Rare Species and Estimated Habitat of Rare Wildlife. DEP-SERO Wetlands program notes that the Proponent intends to submit Notices of Intent with the city of Fall River and town of Somerset under the Limited Project provisions of 310 CMR 10.24(7)(b) and 310 CMR 10.53(3)(d); and a Water Quality Certification in accordance with 314 CMR 9.04(1), respectively. The Notices of Intent shall include the information necessary to determine the Project's compliance with the performance standards to each of the resource areas affected. The Department will address the Project's compliance with the applicable performance standards during NOI review.

DEP SERO notes that the Proponent identified several methods for crossing the salt marsh. The Proponent's preferred method is to use low ground pressure equipment approximately 8 feet wide with ground pressure less than or equal to 3 pounds per square inch. The second alternative is to place construction mats in the salt marsh for 4-6 weeks during the mobilization, wire stringing and demobilization of the wire stringing equipment phase of the Project. The temporary alteration to the salt marsh may be avoided altogether if the Project utilizes a helicopter for the wire stinging operations. The use of a helicopter was discussed at the MEPA Consultation on November 3, 2021 and included in the supplementary filing dated November 9, 2021.

The Department notes that a proposed Project shall maintain the existing elevation of the salt marsh, the low ground pressure equipment or matting shall not compact the salt marsh vegetation, lead to pooling in the marsh or cause marsh vegetation dieback. Furthermore, the Project should be performed during the non-growing season of the marsh grasses.

Waterways. After performing a review of its data-base, the Department concurs that authorizations identified by the Proponent, for properties at these sites, include but are not limited to License No. 4357 (1960) and 4781 (1964).

Installation of the overhead wires at the Taunton River and Steep Brook and any intermittent stream crossing in an area that is navigable will require a Waterways License in accordance with 310 CMR 9.05.

The Department will work with the Proponent to determine which waterbodies are jurisdictional.

This Project use has been determined to be Water-Dependent-Industrial in accordance with 310 CMR 9.12(2)(b) 10. Any additional concerns will be addressed during the permitting process.

Stormwater Management/National Pollutants Discharge Elimination System (NPDES) Permit. The Proponent has acknowledged the need to file a Notice of Intent for coverage under this permit.

The Proponent is advised to consult with Sania Kamran at Kamran.Sania@epa.gov, 617-918-1522 for any of its questions regarding EPA's NPDES stormwater permitting requirements.

Bureau of Waste Site Cleanup Comments
The Project involves installation of new foundations for an existing transmission line. The former Shell Terminal, 1 New Street, Fall River, Release Tracking Number 4-749, is immediately south of the proposed Project along the eastern bank of the Taunton River, but the transmission line is not part of the site where MCP response actions are occurring. There are no other listed MCP disposal sites located at or in the vicinity of the Project that would appear to impact the proposed Project area. Interested parties may view a map showing the location of BWSC disposal sites using the MassGIS data viewer (Oliver) at: http://maps.massgis.state.ma.us/map_ol/oliver.php. Under "Available Data Layers" select "Regulated Areas", and then "DEP Tier Classified 21E Sites". MCP reports and the compliance status of specific disposal sites may be viewed using the BWSC Waste Sites/Reportable Release Lookup at: https://eeaonline.eea.state.ma.us/portal#!/search/wastesite

The Project Proponent is advised that if oil and/or hazardous material are identified during the implementation of this Project, notification pursuant to the Massachusetts Contingency Plan (310 CMR 40.0000) must be made to MassDEP, if necessary. A Licensed Site Professional (LSP) should be retained to determine if notification is required and, if need be, to render appropriate opinions. The LSP may evaluate whether risk reduction measures are necessary if contamination is present. The BWSC may be contacted for guidance if questions arise regarding cleanup.

Bureau of Air and Waste (BAW) Comments
Air Quality. The Proponent reports: "During the construction-phase of the Project there may be intermittent and localized increases in noise, dust and emissions from construction vehicles and related equipment."

The Proponent is reminded that construction and operation activities shall not cause or contribute to a condition of air pollution due to dust, odor, or noise. To determine the appropriate requirements please refer to:

310 CMR 7.09 Dust, Odor, Construction, and Demolition
310 CMR 7.10 Noise

Construction-Related Measures
The Proponent reports: "Diesel-powered non-road construction equipment with engine horsepower ratings of 50 and above to be used for 30 or more days over the course of Project construction will either be USEPA Tier 4-compliant or will be retrofitted with USEPA-verified (or equivalent) emission control devices such as oxidation catalysts or other comparable technologies (to the extent that they are commercially available) installed on the exhaust system side of the diesel combustion engine.

The use of ultra-low sulfur diesel fuel in its diesel-powered construction equipment and limits idling time to five minutes except when engine power is necessary for the delivery of materials or to operate accessories to the vehicle such as power lifts."

MassDEP reminds the Proponent if a piece of equipment is not available in the Tier 4 configuration, the Proponent should then use construction equipment that has been retrofitted with appropriate emissions reduction equipment. Emission reduction equipment includes EPA-verified, CARB-verified, or MassDEP-approved diesel oxidation catalysts (DOCs) or Diesel Particulate Filters (DPFs). The Proponent should maintain a list of the engines, their emission tiers, and, if applicable, the best available control technology installed on each piece of equipment on file for Departmental review.

Massachusetts Air Quality and Idling Regulation
The Project Proponent reports: "Vehicle idling is to be minimized during the construction phase of the Project, in compliance with the Massachusetts Anti-idling Law, G.L. c. 90 § 16A, c. 111 §§ 142A – 142M, and 310 CMR 7.11. In addition, NEP contractors will adhere to NEP's Environmental Guidance (EG-802MA) Vehicle Idling."

MassDEP reminds the Proponent, regarding construction period activity, typical methods of reducing idling include driver training, periodic inspections by site supervisors, and posting signage. In addition, to ensure compliance with this regulation once the Project is underway, MassDEP recommends that the Proponent install signs limiting idling to five minutes or less on-site.

Spills Prevention. A spills contingency plan addressing prevention and management of potential releases of oil and/or hazardous materials from pre- and post-construction activities should be presented to workers at the site and enforced. The contingency plan should include but not be limited to, refueling of machinery, storage of fuels, and potential on-site activity releases.

Solid Waste Management. As a reminder, the Project Proponent is advised of the following requirements:

1. *Compliance with Waste Ban Regulations*: Waste materials discovered during construction that are determined to be solid waste (e.g., construction and demolition waste) and/or recyclable material (e.g., metal, asphalt, brick, and concrete) shall be disposed, recycled, and/or otherwise handled in accordance with the Solid Waste Regulations including *310 CMR 19.017: Waste Bans*. Waste Ban regulations prohibit the disposal, transfer for disposal, or contracting for disposal of certain hazardous, recyclable, or compostable items at solid waste facilities in Massachusetts, including, but not limited to, metal, wood, asphalt pavement, brick, concrete, and clean gypsum wallboard. The goals of the waste bans are to: promote reuse, waste reduction, or recycling; reduce the adverse impacts of solid waste management on the environment; conserve capacity at existing solid waste disposal facilities; minimize the need for construction of new solid waste disposal facilities; and support the recycling industry by ensuring that large volumes of material are available on a consistent basis. Further guidance can be found at: https://www.mass.gov/guides/massdep-waste-disposal-bans.

   MassDEP recommends the Proponent consider source separation or separating different recyclable materials at the job site. Source separation may lead to higher recycling rates and lower recycling costs. Further guidance can be found at: https://recyclingworksma.com/construction-demolition-materials-guidance/

   For more information on how to prevent banned materials from entering the waste stream the Proponent should contact the RecyclingWorks in Massachusetts program at (888) 254-5525 or via email at info@recyclingworksma.com. RecyclingWorks in Massachusetts also provides a website that includes a searchable database of recycling service providers, available at http://www.recyclingworksma.com.

2. *Tree removal/land clearing:* As defined in 310 CMR 16.02, clean wood means "discarded material consisting of trees, stumps and brush, including but limited to sawdust, chips, shavings, bark, and new or used lumber" …etc. Clean wood does not include wood from commingled construction and demolition waste, engineered wood products, and wood containing or likely to contain asbestos, chemical preservatives, or paints, stains or other coatings, or adhesives. The Proponent should be aware that wood is not allowed to be buried or disposed of at the Site pursuant to 310 CMR 16.00 & 310 CMR 19.000 unless otherwise approved by MassDEP. Clean wood may be handled in accordance with 310 CMR 16.03(2)(c)7 which allows for the on-site processing (i.e., chipping) of wood for use at the Site (i.e., use as landscaping material) and/or the wood to be transported to a permitted facility (i.e., wood waste reclamation facility) or other facility that is permitted to accept and process wood.

If you have any questions regarding the Solid Waste Management Program comments above, please contact Mark Dakers at (508) 946-2847 for solid waste comments.

Proposed s.61 Findings

The "Certificate of the Secretary of Energy and Environmental Affairs on the EENF may indicate that this Project requires further MEPA review and the preparation of an Environmental Impact Report. Pursuant to MEPA Regulations 301 CMR 11.12(5)(d), the Proponent will prepare Proposed Section 61 Findings to be included in the EIR in a separate chapter updating and summarizing proposed mitigation measures. In accordance with 301 CMR 11.07(6)(k), this chapter should also include separate updated draft Section 61 Findings for each State agency that will issue permits for the Project. The draft Section 61 Findings should contain clear commitments to implement mitigation measures, estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and contain a schedule for implementation.

Other Comments/Guidance
The MassDEP Southeast Regional Office appreciates the opportunity to comment on this EENF. If you have any questions regarding these comments, please contact George Zoto at (508) 946-2820.

Very truly yours,

Jonathan E. Hobill,
Regional Engineer,
Bureau of Water Resources

JH/GZ

Cc: DEP/SERO

ATTN: Millie Garcia-Serrano, Regional Director
Gerard Martin, Acting Deputy Regional Director, BWR
John Handrahan, Acting Deputy Regional Director, BWSC
Seth Pickering, Deputy Regional Director, BAW
Jennifer Viveiros, Deputy Regional Director, ADMIN
Daniel Gilmore, Chief, Wetlands and Waterways, BWR
Cally Harper, Wetlands, BWR
Brendan Mullaney, Waterways, BWR
Carlos Fragata, Waterways, BWR
Mark Dakers, Chief, Solid Waste, BAW
Elza Bystrom, Solid Waste, BAW
Allen Hemberger, Site Management, BWSC

The Commonwealth of Massachusetts
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CHARLES D. BAKER
Governor

KARYN E. POLITO
Lt. Governor

KATHLEEN A. THEOHARIDES
Secretary

RONALD S. AMIDON
Commissioner

DANIEL J. MCKIERNAN
Director

November 18, 2021

Secretary Kathleen Theoharides
Executive Office of Energy and Environmental Affairs (EEA)
Attn: MEPA Office
Eva Murray, EEA No. 16467
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear Secretary Theoharides:

The Division of Marine Fisheries (MA DMF) has reviewed the Expanded Environmental Notification Form (ENF) for the proposed N12/M13 Double Circuit Tower (DCT) Separation Project in the City of Fall River and Town of Somerset. The project involves separation of the two circuits onto separate transmission structures to eliminate the existing configuration and associated risks of widespread voltage collapse. The project site spans from the Pottersville Switching Station in the Town of Somerset to the Sykes Road Substation in the City of Fall River. Existing marine fisheries resources and habitat and potential project impacts to those resources are outlined in the following paragraphs.

A section of the proposed work includes salt marsh habitat. Salt marsh provides a variety of ecosystem services, including habitat and energy sources for many fish and invertebrate species [1–3].

MA DMF offers the following comments for your consideration:

- The EENF includes an estimated 6,850 square feet of temporary impacts to salt marsh associated with temporary crossing using a low ground pressure (LGP) vehicle or installation of temporary construction mats (EENF Tables 1-2 and 5-4). An LGP vehicle is identified as the preferred approach but mats are also included in the event that LGP use is not feasible. The EENF supplemental information estimates that, if needed, the mats would be in place for 4-6 weeks. Experimental results demonstrated that marsh vegetation covered by wrack (plant debris) completely died off after five (*Spartina patens*) to seven (*S. alterniflora*) weeks [4]. A similar degree of loss would be anticipated if mat cover occurred during the growing season. The EIR developed for this project should outline proposed pre-and post-construction monitoring plans to determine whether any marsh impacts occur for either of the proposed temporary crossing methods. The temporary construction mat alternative should be further described as well, particularly proposed timing of this part of the project. Work on the marsh platform outside of the growing season would help to minimize potential impacts to this important habitat.

Questions regarding this review may be directed to John Logan in our New Bedford office at john.logan@mass.gov.

Sincerely,

Daniel J McKiernan

Daniel J. McKiernan

Director

cc: Somerset Conservation Commission
Fall River Conservation Commission
Jamie Durand, POWER Engineers Consulting, PC
Sabrina Pereira, NMFS
Robert Boeri, CZM
Ed Reiner, EPA
Tori LaBate, DFG
Simi Harrison, Emma Gallagher, Keri Goncalves, DMF

References

1. Boesch DF, Turner RE. Dependence of fishery species on salt marshes: the role of food and refuge. Estuaries. 1984;7: 460–468.
2. Deegan LA, Garritt RH. Evidence for spatial variability in estuarine food webs. Mar Ecol Prog Ser. 1997;147: 31–47.
3. Deegan LA, Hughes JE, Rountree RA. Salt marsh ecosystem support of marine transient species. In: Weinstein MP, Kreeger DA, editors. Concepts and Controversies in Tidal Marsh Ecology. Kluwer Academic Publisher, The Netherlands; 2000. pp. 333–365.
4. Bertness MD, Ellison AM. Determinants of pattern in a New England salt marsh plant community. Ecol Monogr. 1987;57: 129–147.

DM/JL/sd

Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Jamey Tesler, Secretary & CEO

Massachusetts Department of Transportation

November 22, 2021

Kathleen Theoharides, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114-2150

RE: Somerset/Fall River: N12/M13 Double Circuit Tower Separation Project
ENF - (EEA #16467)

ATTN: MEPA Unit
Eva Murray

Dear Secretary Theoharides:

On behalf of the Massachusetts Department of Transportation, I am submitting comments regarding the Expanded Environmental Notification Form for the N12/M13 Double Circuit Tower Separation Project in Somerset and Fall River prepared by the Office of Transportation Planning. If you have any questions regarding these comments, please contact J. Lionel Lucien, P.E., Manager of the Public/Private Development Unit, at (857) 368-8862.

Sincerely,

David J. Mohler
Executive Director
Office of Transportation Planning

DJM/jll

cc: Jonathan Gulliver, Administrator, Highway Division
Carrie Lavallee, P.E., Acting Chief Engineer, Highway Division
Mary Joe Perry, District 5 Highway Director
Neil Boudreau, Assistant Administrator of Traffic and Highway Safety
Southeastern Regional Planning and Economic Development District
Planning Board, Town of Somerset
Planning Department, City of Fall River

Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Jamey Tesler, Secretary & CEO

massDOT
Massachusetts Department of Transportation

MEMORANDUM

TO: David J. Mohler, Executive Director
Office of Transportation Planning

FROM: J. Lionel Lucien, P.E, Manager
Public/Private Development Unit

DATE: November 22, 2021

RE: Somerset/Fall River: N12/M13 Double Circuit Tower Separation Project – ENF
(EEA #16467)

The Public/Private Development Unit (PPDU) has reviewed the Expanded Environmental Notification Form for the N12/M13 Double Circuit Tower Separation Project submitted by the New England Power (NEP) Company ("the Proponent") in Somerset and Fall River. The Proponent proposes to eliminate the existing N12/M13 Double Circuit Tower (DCT) configuration carrying the N12 and M13 115 kilovolt (kV) transmission lines from the Somerset Substation (now Pottersville Switching Station) in Somerset, MA, over the Taunton River, to the Sykes Road Substation in Fall River, MA. The N12 and M13 transmission lines will be separated, and one line (M13) relocated to separate sets of transmission structures located within the existing electric transmission line right-of-way (ROW). Much of the existing transmission structures will also be replaced.

The project will result in the alteration of 3.96 acres of Land Subject to Coastal Storm Flowage (LSCSF); 6,850 square feet (sf) of Salt Marsh; 1,397 sf of Land Under the Ocean; 3.07 acres of Bordering Vegetated Wetlands (BVW); 208 linear feet (lf) of Inland Bank; and approximately 1.80 acres of Riverfront Area (0.41 acres of which is coincident with LSCSF or BVW). Approximately 11.54 acres of land is proposed to be altered, 11 acres of which is described as temporary impact associated to create temporary work areas.

The project requires the submission of an ENF and Mandatory EIR because it requires it will result alteration of one or more acres of salt marsh or bordering vegetating wetlands. The Proponent has submitted an EENF requesting a Waiver of a Mandatory EIR. The project requires a State and Interstate Highway Right-of-Way Encroachment Permit and Crossing Permit from the Massachusetts Department of Transportation (MassDOT).

MassDOT recommends that no further environmental review be required based on transportation-related issues. The Proponent should work with MassDOT to address the details of the permitting process and any traffic and construction management plans that may be required for temporary work within the state highway layout. If you have any questions regarding these comments, please contact me at *Lionel.Lucien@state.ma.us.*

APPENDIX 2-1 INDEPENDENT SYSTEM OPERATOR OF NEW ENGLAND (ISO NEW ENGLAND) SOUTHEASTERN MASSACHUSETTS AND RHODE ISLAND AREA 2026 SOLUTION STUDY, REVISION 1

This document has been reviewed for Critical Energy Infrastructure Information (CEII) July 2022.

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Southeastern Massachusetts and Rhode Island Area 2026 Solutions Study, Revision 1

Transmission Planning

MARCH 2017

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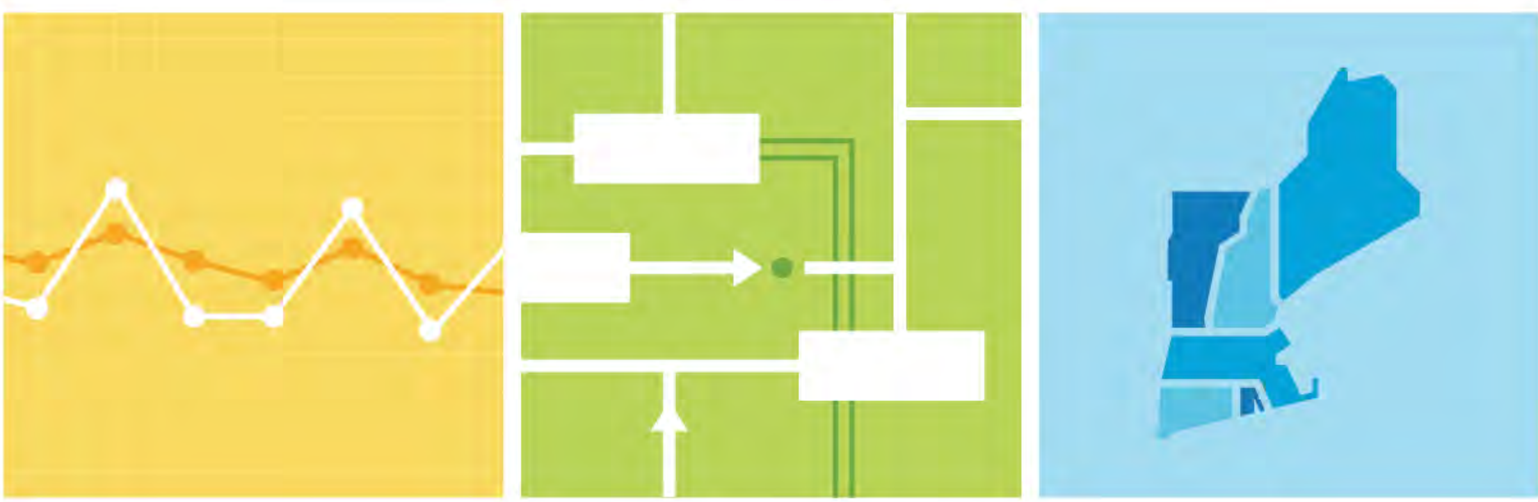

Contents

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Figures

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Tables

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Section 1
Executive Summary

1.1 Needs Assessment Results and Problem Statement

The objective of Southeastern Massachusetts and Rhode Island (SEMA-RI) Needs Assessment study was to evaluate the reliability performance and identify reliability-based transmission needs in the SEMA-RI study area for the year 2026 while considering the following:

- Future load growth
- Reliability over a range of generation patterns and transfer levels
- Limited short circuit margin in the SEMA-RI area
- Coordination with plans in Boston, Northeastern Massachusetts and Eastern Connecticut
- Existing and Forward Capacity Market-cleared supply resources
- All applicable North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Corporation (NPCC) and ISO New England (ISO-NE) transmission planning reliability standards

The 2026 Needs Assessment[1] was a follow-up to the 2022 Needs Assessment for this study area. The 2022 Needs Assessment PAC presentation[2] identified a number of criteria violations in the SEMA-RI area.

The 2026 Needs Assessment used the following study assumptions:

- 2026 summer peak 90/10 peak load based on the 2015 CELT report: 35,310 for New England
- All future transmission projects with Proposed Plan Application (PPA) approval as of the May 2015 Regional System Plan (RSP) Project Listing
- The Aquidneck Island Reliability Projects (RSP ID: 1669, 1670, and 1671) were included because they are located in the SEMA-RI study area and could eliminate potential needs
- All future generation projects with a Capacity Supply Obligation (CSO) as of Forward Capacity Auction #9 (FCA #9)
- Two significant new resources in the study area that received obligations in FCA #10, QP 449 and QP 489
- All Demand Resources (DR) cleared in FCA #9. In addition, any accepted Non-Price Retirement (NPR) requests or DR and any DR terminations in SEMA-RI for FCA #10 were also taken into account
- Forecasted energy efficiency (EE) through 2026 based on the 2015 CELT forecast
- Transfer levels
    - High East-West with High North-South
    - High West-East with Low North-South
    - High West-East with Medium North-South
- Generation dispatch scenarios included one or two relevant generation units out-of-service

[1] https://smd.iso-ne.com/operations-services/ceii/pac/2016/05/final_sema_ri_needs_assessment_report.pdf

[2] https://smd.iso-ne.com/planning/ceii/reports/2010s/archive/sema_ri_area_needs_assessment_critical_load_level_analysis.pdf

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(OOS) combined with different New York – New England transfer stresses.

Results of the N-0 testing identified there was one thermal criteria violation and no voltage criteria violations.

Results of the N-1 testing identified one 345/115 kV element and twenty-nine 115 kV elements that were found to be overloaded under N-1 outage conditions. Additionally there were nine 115 kV buses that were found to have voltage violations under N-1 outage conditions.

Results of the N-1-1 testing identified a substantial number of thermal and voltage violations in the study area, including the subareas of Farnum, West Medway/West Walpole, South Shore, Industrial Park, Somerset/Newport, Cape Cod and Boston Area. The majority of N-1-1 violations could not be addressed by operational adjustments including existing Special Protection Systems (SPSs) or generation re-dispatch.

The critical load level for the majority of criteria violations in the 2026 Needs Assessment are prior to the 2016 summer peak.

Transmission needs identified have been deemed time-sensitive if they have a year of need within three years of the completion of this Needs Assessment and met the requirements of Section 4.1(j) of the Tariff.[3] Since the publishing date of this Needs Assessment occurred before June 1, 2016, the threshold for determining time-sensitive needs has been determined to be any issues that occur before the 2019 summer peak. See Section 9, Appendix A for a listing of time-sensitive and non-time-sensitive needs.

Short circuit results from the Needs Assessment indicate there were no over-duty circuit breakers in the study area. Overall results of short circuit testing indicated that there were a total of thirteen 345 kV circuit breakers and five 115 kV circuit breakers that could see fault current levels over 95% of their interrupting capability.

1.2 Recommended Solution

The preferred solution alternatives are comprised of several solution components as shown in Table 1-1. A more detailed description of each component can be found in Section 5.3.1 and the station one line diagrams of the preferred solution components can be found in Section 16, Appendix H.

Table 1-1: SEMA-RI Solution Components

ID	Solution Components
1	Grand Army 115 kV GIS switching station and loop the existing E-183E, F-184, X3 and W4 lines into the station
2	Upgrades at Brayton Point (new 115 kV breaker, new 345/115 kV transformer and upgrades to E-183E, F-184 station equipment)
3	Increase clearances on E-183E & F-184 lines between Brayton Point & Grand Army (~1.5 miles each)
4	Separate X3/W4 DCT and reconductor X3, W4 lines between Somerset and Grand Army (~2.7 miles each).

[3] https://www.iso-ne.com/static-assets/documents/regulatory/tariff/sect_2/oatt/sect_ii.pdf - pages 361-362

[redacted]

ID	Solution Components
5	Robinson Ave 115 kV circuit breaker addition and re-terminate Q10 line at the station
6	Install 45.0 MVAR capacitor bank at Berry Street
7	Separate N12/M13 DCT & reconductor N12 & M13 lines between Somerset and Bell Rock (~3.5 miles)
8	Install new breaker in series with the N12/D21 tie breaker and upgrade the D21 Line switch at Bell Rock
9	Install a third breaker in a bay to terminate Line 114 at Bell Rock
10	Extend Line 114 – Eversource/NGRID border to Bell Rock (~4.2 miles)
11	Extend Line 114 – Industrial Park Tap to Eversource/NGrid border (~7.9 miles)
12	Install capacitors at Bell Rock (37.5 MVAR), High Hill (35.3 MVAR) and Wing Lane (35.3 MVAR)
13	Reconfigure Bell Rock to breaker and a half station and split M13 line at Bell Rock
14	Reconductor the 108-4 line from Bourne to the Horse Pond Tap (1.9 miles)
15	Reconductor the M13 and L14 lines from Bell Rock to Bates St Tap (8.3 miles)
16	Reconductor the 112 line from Tremont to the Industrial Park Tap (10.3 miles)
17	Replace wave trap on 114 line at Tremont
18	Replace Kent County T3 345/115 kV transformer
19	Loop 201-502 line into the Medway station to form the 201-502N and 201-502S lines
20	Rerate the Eversource portion of the 323 line from Millbury #3 to West Medway by replacing the West Medway substation disconnect switches 107A, 107B, 108A and 108B with 3000A disconnects
21	Install new line from Carver to Kingston (approximately 8.0 miles)
22	Install a bay position at Kingston for new line from Carver
23	Rebuild the Middleborough Gas and Electric Department (MGED) portion of E-1 line from Bridgewater to Middleboro (2.5 miles)
24	Install a new line from Bourne to West Barnstable (approximately 13.0 miles) which requires terminal work at West Barnstable and Bourne
25	Separate the 122/135 line DCT
26	Retire the Barnstable SPS
27	Separate the 325/344 DCT from West Medway to West Walpole (approximately 50 structures)

The total estimated cost of the preferred solution is $305.8M.

1.3 NERC Compliance Statement

In accordance with North American Electric Reliability Corporation (NERC) Transmission Planning (TPL) Standard, this assessment provides:

- A written summary of plans to address the time-sensitive system performance issues described in the "*Southeastern Massachusetts and Rhode Island Area 2026 Needs Assessment*", dated May, 2016[4], and the "*Addendum Analysis Report to the Southeastern Massachusetts and Rhode Island Area 2026 Needs* Assessment", dated October 2016[5]
- A schedule for implementation as shown in Section 8.3
- A discussion of expected required in-service dates of facilities and associated load level when required as shown in Section 8.3
- A discussion of lead times necessary to implement plans in Section 8.3

[4] https://smd.iso-ne.com/operations-services/ceii/pac/2016/05/final_sema_ri_needs_assessment_report.pdf
[5] https://smd.iso-ne.com/operations-services/ceii/pac/2016/10/sema_ri_needs_assessment_addendum_v3.pdf

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Section 2
Needs Assessment Results Summary

2.1 Introduction

The Southeastern Massachusetts and Rhode Island Needs Assessment ("SEMA-RI Need Assessment") was conducted for the SEMA-RI study area to evaluate transmission system performance against transmission reliability standards for the projected 2026 system conditions. This assessment, detailed in the report "*Southeastern Massachusetts and Rhode Island Area 2026 Needs Assessment"*, dated May, 2016[6], and the "*Addendum Analysis Report to the Southeastern Massachusetts and Rhode Island Area 2026 Needs* Assessment", dated October 2016[7] indicated that there are a significant number of thermal overloads and unacceptable voltages across a number of subareas within the SEMA-RI study area.

The study area focused on the portion of the system within the SEMA-RI Interface shown by the black line in Figure 2-1. The SEMA-RI Interface encompasses the areas within Massachusetts located south of Boston as well as the entire state of Rhode Island. This study also coordinated with other surrounding area Needs Assessment and Solutions Studies, such as those conducted for Eastern Connecticut (ECT) and Greater Boston (GB).

The SEMA-RI study area transmission performance was tested for steady state performance with all lines in-service, as well as under N-1 and N-1-1 contingency conditions, under a number of possible operating conditions. Thermal overloads were observed for a number of N-0, N-1, and N-1-1 contingency conditions. Additionally, unacceptable voltages were observed for a number of N-1-1 contingency conditions. Short circuit testing revealed that there were no over-dutied circuit breakers in the study area.

2.2 Needs Assessment Review

An overview of the results of the testing was organized by sub-areas within the study area. The set of the defined sub-areas were developed based on a review of the thermal and voltage reliability performance that was specific to particular areas within the SEMA-RI study area. The SEMA-RI study area results were grouped into six sub-areas as shown in Figure 2-1 and as follows:

[6] https://smd.iso-ne.com/operations-services/ceii/pac/2016/05/final_sema_ri_needs_assessment_report.pdf

[7] https://smd.iso-ne.com/operations-services/ceii/pac/2016/10/a7_sema_ri_2026_needs_assessment_update.pdf

[redacted]

1) **Farnum Subarea** – This is an area that runs along the northern section of SEMA-RI across northern Rhode Island.
2) **West Medway/West Walpole Subarea** – This is the area running across northern SEMA-RI from the Rhode Island boarder to the Walpole area.
3) **South Shore Subarea** – This is an area that runs along the northern section of SEMA-RI from the area south of Boston to the Massachusetts southern shore line.
4) **Industrial Park Subarea** – This is an area running across southern SEMA-RI from the New Bedford area through to the Cape Cod Canal.
5) **Somerset/Newport Subarea** – This is an area that runs along the lower part of SEMA-RI from lower Rhode Island through to lower southeastern Massachusetts.
6) **Cape Cod Subarea** – This area includes Cape Cod and the islands of Martha's Vineyard and Nantucket.

The SEMA-RI study area borders the Boston Import Interface to the north and the Connecticut Import Interface to the West.

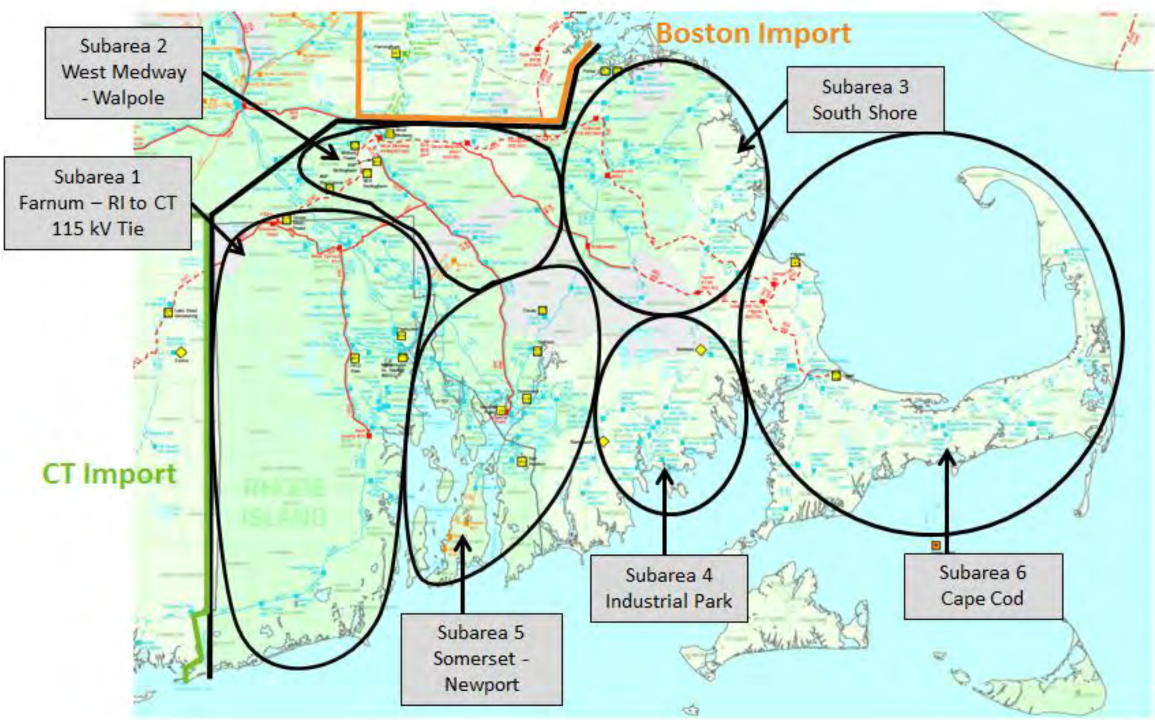

Figure 2-1: SEMA-RI Area Map

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2.1.1 **Steady State Testing Results**

The results of the analysis for all of the study work completed indicated that there were a number of thermal overloads and voltage violations for N-1 and N-1-1 conditions. One thermal overload was observed for N-0 conditions.

2.1.2 **Review of N-0 Testing**

N-0 (also known as "all-lines-in") conditions were reviewed for the cases modeled. The results indicated that under all tested dispatch and transfer level conditions there was one 115 kV element N-0 thermal overload observed. Additionally, there were no N-0 voltage criteria violations observed.

2.1.3 **Review of N-1 Testing**

N-1 testing was performed for all the system conditions described in Section 1.1. Overall, by 2026, N-1 contingency overloads were observed for elements within the SEMA-RI study area across the 115 kV and 345 kV transmission facilities.

There were a total of one 345/115 kV element and twenty-nine 115 kV elements that were found to be overloaded under N-1 outage conditions. Additionally there were nine 115 kV buses that were found to have voltage violations under N-1 outage conditions.

Table 2-1: Number of N-1 Criteria Violations

Subarea	2026 Study Year	
	LTE Overloaded Elements	Voltage Violations
Farnum	10	0
West Medway/West Walpole	0	0
South Shore	2	0
Industrial Park	5	4
Somerset/Newport	13	5
Cape Cod	0	0
Boston Area	0	0
Total	**30**	**9**

2.1.4 **Review of N-1-1 Testing**

Initial element-out-of-service (N-1-1) testing included all 115 kV and 345 kV transmission lines as well as 345 kV autotransformers in the SEMA-RI study area and along the border of the eastern Connecticut and the Greater Boston study areas that are considered Bulk Electric System (BES) elements. These element-out-of-service conditions were tested against the full set of contingencies used in the N-1 tests, with noted exceptions made for the treatment of no-fault contingencies as described in Appendix H of the Transmission Planning Technical Guide.[8]

[8] https://www.iso-ne.com/static-assets/documents/2016/08/transmission_planning_technical_guide_8_12_2016.pdf

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Table 2-2 provides a summary of the total number of elements by subarea that had thermal or voltage criteria violations under N-1-1 contingency conditions, as well as the critical load level range (in terms of projected net New England load) and earliest reported year of need. No N-1-1 high voltage violations were observed. The values shown include all 115 kV, and 345 kV elements in the study area.

Table 2-2: Number of N-1-1 Criteria Violations

Subarea	2026 Study Year			
	LTE Overloaded Elements	Voltage Violations	Critical Load Level Range (MW)	Earliest Year of Need
Farnum	21	9	19,527 – 29,750	Prior to 2016
West Medway/West Walpole	8	5	26,501 – 29,346	Prior to 2016
South Shore	9	12	27,162 – 30,228	Prior to 2016
Industrial Park	6	5	10,063 – 28,198	Prior to 2016
Somerset/Newport	25	13	12,216 – 30,000	Prior to 2016
Cape Cod	2	4	28,108 – 30,307	2016
Boston Area	13	0	21,917 – 29,346	Prior to 2016
Total	**84**	**48**		

In addition to the noted N-1-1 criteria violations, a number of non-convergent cases were observed for various contingency combinations associated with 115 kV line outages into the Cape area along with loss of 345 kV support into the area from West Barnstable.

See Section 9, Appendix A for Critical Load Level and Year of Need results.

2.1.5 **Review of Minimum Load Testing**

The minimum load analysis for the SEMA-RI study area is being conducted under a separate effort. At the time of this report, the minimum load analysis is in the Needs Assessment phase. Once the minimum load needs have been identified, solutions will be identified that will solve the identified time-sensitive needs and work in concert with the Preferred Solutions which will be selected by the result of this Solutions Study.

2.1.6 **Short Circuit Testing**

A short circuit assessment was also conducted for this study. The results indicated that no stations had any breakers that would be over-dutied for modeled system conditions. Overall results of short circuit testing indicated that there were a total of thirteen 345 kV circuit breakers and five 115 kV circuit breakers that could see fault current levels over 95% but under 100% of their interrupting capability.

2.3 Year of Need/Critical Load Level Analysis

The critical load level for the majority of criteria violations in the study area are prior to the 2016 summer peak. In today's system, these violations are prevented in operations by such steps as

[redacted]

restricting transfers, running generation out-of-merit, and posturing the system for these critical contingencies.

Transmission needs identified in the Needs Assessment study have been deemed time-sensitive if they have a year of need within three years of the completion of this Needs Assessment. Since the publishing date of the Needs Assessment report occurred before June 1, 2016, the threshold for determining time-sensitive needs has been determined to be any issues that occur before the 2019 summer peak.

Table 9-1, Table 9-2, and Table 9-3 in Section 9 list the needs in the SEMA-RI study area that have been determined to be time-sensitive as part of this Needs Assessment. To address these needs, ISO-NE utilized the Solutions Study process described in Section 4.2 of Attachment K and developed solutions to address them in cooperation with Eversource Energy, National Grid, and Middleborough Gas and Electric Department (MGED).

Table 9-4 and Table 9-5 in Section 9 list the needs in the SEMA-RI study area that have been determined to be not time-sensitive as part of this Needs Assessment. These needs occur only for projected system conditions in the 2019 study year and beyond. During the Solutions Study phase, specific transmission solutions were not developed to address these needs. However, due to the nature of transmission solutions, it is quite likely that many of the needs determined to be non-time sensitive will be resolved. Once the solution to address the time-sensitive needs in the SEMA-RI study area has been fully developed, any of these needs that remain will be re-evaluated pursuant to the requirements of Attachment K, Section 4.1(j).

Section 3
Study Assumptions

3.1 Analysis Description

The purpose of the Solutions Study was to investigate system reinforcement options to determine feasible long-term transmission alternative plans to remedy the time-sensitive SEMA-RI study area criteria violations. Long-term transmission plans were not developed for any non-time-sensitive criteria violations. The study was based on 2026 system conditions that included planned system upgrades expected to be in-service. The study analyses included a steady-state thermal and voltage study and a short circuit study. The Solutions Study was conducted in accordance with applicable NERC, NPCC and ISO-NE standards and criteria.

The transmission needs in the SEMA-RI study area required the evaluation of numerous transmission alternative solutions. In many cases there were two or more competing alternatives that could potentially meet the needs of each SEMA-RI subarea. The multiple competing alternatives for each of the subareas resulted in a large number of competing solutions. To manage the evaluation of the competing solutions, the SEMA-RI working group evaluated the competing solutions in sequential phases. As the solutions were developed, some of the solution alternatives solve needs across the subarea designations that were created during the Needs Assessment phase. Due to this finding, the SEMA-RI study area was partitioned into new groups for the Solutions Study as shown in Figure 3-1.

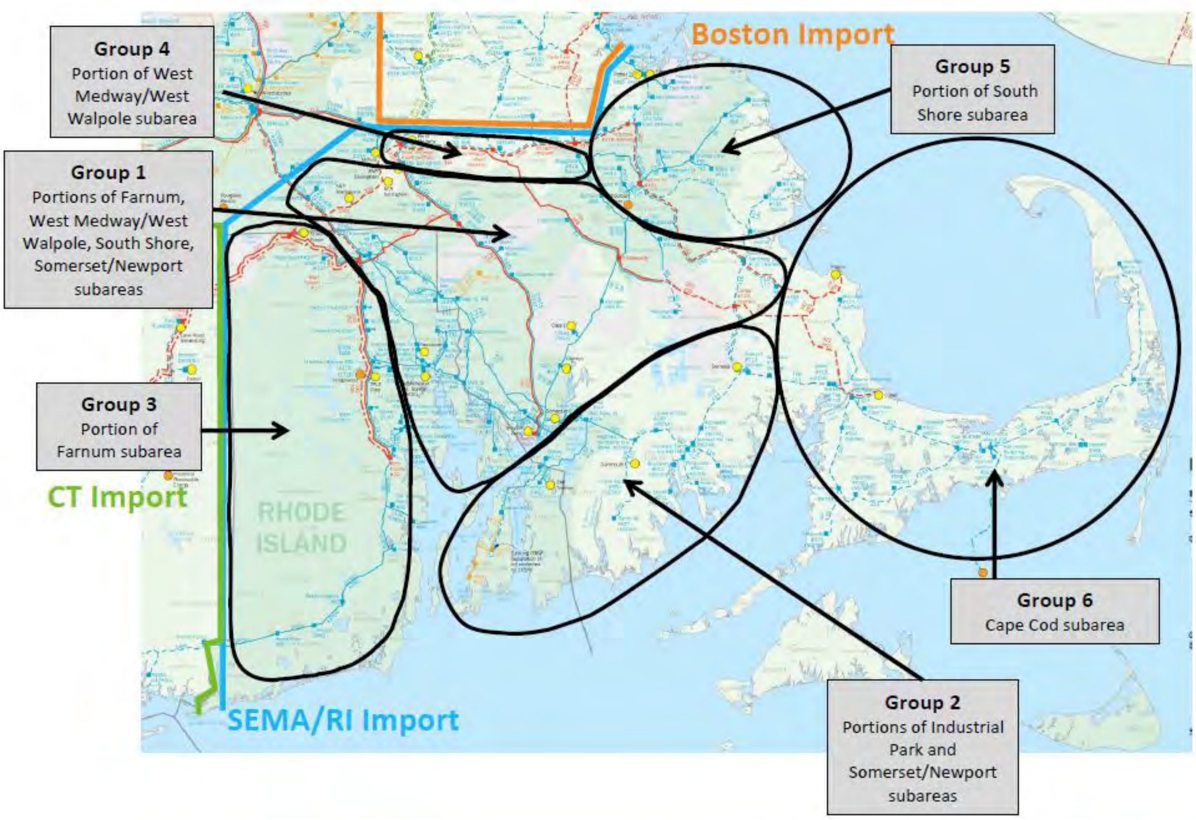

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Figure 3-1: SEMA-RI Solutions Study Groups Map

Several software modeling tools were used for the evaluations. These include:

- Transmission Adequacy and Reliability Assessment (TARA) version 8.50[9] was used to conduct all steady state contingency analysis presented in this report. This application allowed for interactive adjustment of phase shifter settings to capture operational responses, re-dispatch of generation to minimize overloads, processing of multiple base cases against a large number of contingencies and reporting of results in an effective manner.
- PSS/E version 32.2.3 was used to set up the system topologies for steady-state contingency analysis
- ASPEN version 14 was used to conduct the short circuit analysis

3.2 Steady State Model Assumptions

3.2.1 Study Assumptions

The regional steady-state model was developed to be representative of the 10-year projection of the 90/10 summer peak system demand levels to assess reliability performance under stressed system conditions. The assumptions include consideration of area generation unit unavailability conditions as well as variations in surrounding area regional interface transfer levels. These study assumptions are consistent with ISO-NE Planning Procedure No. 3 (PP-3), "Reliability Standards for the New England Area Bulk Power Supply System".

3.2.2 Source of Power Flow Models

The power flow study cases used in this study were obtained from the ISO Model on Demand (MOD) system with selected upgrades to reflect the system conditions in 2026. A detailed description of the system upgrades included is described in later sections of this report.

3.2.3 Transmission Topology Changes

Transmission projects with Proposed Plan Application (PPA) approval in accordance with Section I.3.9 of the Tariff, as of the May 2015 RSP Project Listing, have been included in the study base case. In addition, any projects in the listing that were considered "Proposed" and determined to have an effect on the SEMA-RI study area were included. The Aquidneck Island Reliability Projects (RSP ID: 1669, 1670, and 1671) were also included in the base case because they are located in the SEMA-RI study area and could eliminate potential needs. A listing of the major future projects in Massachusetts, Rhode Island, and Connecticut is included below:

Massachusetts

- Greater Boston Upgrades (RSP ID: 965, 1199, 1212, 1213, 1220, 1260, 1327, 1329, 1330, 1335-1339, 1352-1357, 1363-1365, 1516, 1518-1522, 1527, 1528, 1549-1554, 1558, 1636, 1637, 1640, 1645-1647)
- Central/Western Massachusetts Upgrades (RSP ID: 937, 945, 946, 949-951, 953-955)

[9] TARA (Transmission Adequacy and Reliability Assessment) is a load flow software tool for identifying and analyzing transmission bottlenecks, DC (linear) & AC (non-linear) contingency analysis, Security Constrained Economic Dispatch (SCED), and Security Constrained Reliability Dispatch (SCRD).

[redacted]

- NEEWS – Interstate Reliability Project (RSP ID: 190, 1094, 1293)
- Pittsfield/Greenfield Project (RSP ID: 1208-1210, 1221-1226)

Rhode Island

- NEEWS – Interstate Reliability Project (RSP ID: 794, 1233, 1252, 1298)
- Chase Hill (Crandall Street) Substation (RSP ID: 1253)
- Aquidneck Island Reliability Projects (RSP ID: 1669, 1670, 1671)
- Brayton Point Non-Price Retirement Short-Term Reliability Upgrades (RSP ID: 1623)[10]

Connecticut

- NEEWS – Interstate Reliability Project (RSP ID: 191, 802, 1245)
- Southwestern Connecticut (SWCT) Transmission Solutions (RSP ID: 1380, 1381, 1383-1386, 1389, 1399, 1400, 1559-1579, 1620-1622)
- Greater Hartford/Central Connecticut (GHCC) Transmissions Solutions (RSP ID: 1580-1605, 1659)

3.2.4 Generation Assumptions (Additions & Retirements)

All generation projects in New England with a Forward Capacity Market (FCM) Capacity Supply Obligation (CSO) as of Forward Capacity Auction 9 (FCA #9) were included in the study base case. In addition, two generators that received CSOs in the most recent Forward Capacity Auction (FCA # 10) in the SEMA-RI area were also included. A listing of the major new future projects cleared in FCA #1 through FCA #10 and not yet in service in the SEMA-RI study area is included below:

- QP 444 – Medway Peakers (195 MW - FCA #9)
- QP 449 – Canal #3 (333 MW - FCA #10)
- QP 489 – Burrillville Energy Center (485 MW - FCA #10)

A summary of major Non-Price Retirement (NPR) requests in southern New England is provided in Table 3-1.

Table 3-1: Summary of Non-Price Retirement Requests

Resource Name	Summer Qualified Capacity (MW)	NPR Request Date	NPR Determination Date
AES Thames	182.653	9/18/2012	11/19/2012
Bridgeport Harbor 2	0.000	9/20/2013	10/16/2013
Brayton Point 1	228.205	10/6/2013	12/20/2013
Brayton Point 2	225.750	10/6/2013	12/20/2013
Brayton Point 3	610.000	10/6/2013	12/20/2013
Brayton Point 4	422.000	10/6/2013	12/20/2013
John Street 3	2.000	9/26/2013	10/16/2013

[10] The West Farnum 175T and Kent County 3X 345/115 kV autotransformer rating increases also proposed as part of this set of upgrades were not listed in the RSP Project Listing. These rating increases have been included in the study base cases.

[redacted]

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Resource Name	Summer Qualified Capacity (MW)	NPR Request Date	NPR Determination Date
John Street 4	2.000	9/26/2013	10/16/2013
John Street 5	1.900	9/26/2013	10/16/2013
Norwalk Harbor 1	162.000	9/30/2013	12/20/2013
Norwalk Harbor 2	168.000	9/30/2013	12/20/2013
Norwalk Harbor 10	11.925	9/30/2013	12/20/2013
Pilgrim Nuclear Power Station	677.284	10/12/2015	12/18/2015

Due to the NPR request submitted for the Pilgrim Nuclear Power Station for FCA #10, the unit was modeled as OOS in all study base cases. No other significant NPR requests were submitted for FCA #10 that would have an effect on the SEMA-RI study area; therefore, these NPRs were not reflected in the study. All other NPR requests across New England through FCA #9 were modeled as OOS in the study base case. An 11.8 MW Active DR partial NPR was also submitted in SEMA-RI, but the acceptance of this NPR has a negligible effect on the study area and was not included in the study. While other generator retirements may occur between the issuance of this report and 2026, consistent with Attachment K of the OATT, the ISO has not modeled generators other than those noted above as retired.

Real-Time Emergency Generation (RTEG) are distributed generation which have air permit restrictions that limit their operations to ISO Operating Procedure 4 (OP-4), Action 6 – an emergency action which also implements voltage reductions of five percent (5%) of normal operating voltage that require more than 10 minutes to implement. RTEG cleared in the FCM was not included in the reliability analyses because in general, long-term analyses should not be performed such that the system must be in an emergency state as required for the implementation of OP-4, Action 6. It should be noted that in 2017, the ISO Tariff is being revised to eliminate the RTEG resource type.

3.2.5 Explanation of Future Changes Not Included

The following projects were not included in the study base cases:

- Transmission projects that have not been fully developed and were not classified as “Proposed” as of the May 2015 RSP Project Listing. These projects were not modeled in the study base case due to the uncertainty concerning their final development or lack of an impact on the SEMA-RI study area.
- With the exception of the Greater Boston projects, transmission projects outside of the SEMA-RI area that have received PPA approval since the May 2015 RSP Project Listing was published. These projects were not modeled due to the lack of an impact on the SEMA-RI study area.

[redacted]

3.2.6 **Forecasted Load**

A ten-year planning horizon was used for this study based on the most recently available Capacity, Energy, Loads, and Transmission (CELT) Report issued in May 2015. This study was based on the forecasted 2026 peak demand load levels for the ten-year horizon[11].

The 2026 summer peak 90/10 demand forecast for New England is 35,310 MW.

The CELT load forecast includes both system load and losses (transmission & distribution) from the power system. Since power flow modeling programs calculate losses on the system, the actual system load modeled in the case was reduced to account for system losses which are explicitly calculated in the system model.

Demand Resources (DR) are treated as capacity resources in the Forward Capacity Auctions (FCA). DR is split into two major categories, Passive and Active DR. Passive DR is largely comprised of energy efficiency and is expected to lower the system demand during designated peak hours in the summer and winter. Active DR is commonly known as Demand Side Management (DSM) and can be dispatched on a zonal basis if a forecasted or real-time capacity shortage occurs on the system. Starting in 2012, forecasting passive DR has become part of the annual load forecasting process. This forecast takes into account additional electrical efficiency (EE) savings beyond FCM results across the ten-year planning horizon. This forecast is primarily based on forecasted financial investment in state-sponsored EE programs and its correlation with historical data on reduction in peak demand per dollar spent. This EE forecast was published in the annual CELT Report beginning in spring 2012.

Active DR are modeled in the base case at the levels of the FCA #9, multiplied by a Performance Factor of 75% based on historical performance of similar resources. Passive DR are modeled at 2026 levels based on the passive DR cleared through FCA #9 (2010-2019) and the aforementioned EE forecast for the years until 2026 (2020-2026).

Since Demand Resources are modeled at the low side of the distribution bus in the power flow model, all DR values were increased by 5.5% to account for the reduction in losses on the local distribution network. Passive DR is modeled by load zone and Active DR is modeled by dispatch zone. The amounts modeled in the cases are listed in Table 3-2 and Table 3-3 and detailed reports can be seen in Section 10.

Table 3-2: 2026 Passive DR through FCA #9 and EE Forecast

Load Zone	Passive DR (FCA #1-9) DRV[12] (MW)	EE Forecast (2020-2026) DRV[12] (MW)	Total Passive DR DRV[12] (MW)
Maine	168	104	227
New Hampshire	95	64	159
Vermont	117	102	219
Northeast Massachusetts &	527	363	890

[11] The 2015 CELT forecast only has projected peak demands for the years 2015-2024. To determine the 2026 peak demand forecasted load, the growth rate from years 2023-2024 was applied to the 2024 forecast twice.

[12] DRV = Demand Reduction Value = the actual amount of load reduced measured at the customer meter; these totals are forecasted values for the commitment period beginning June 1, 2025. These values exclude transmission and distribution losses.

[redacted]

Boston			
Southeast Massachusetts	284	192	476
West Central Massachusetts	331	225	556
Rhode Island	189	132	321
Connecticut	425	324	749
New England Total[13]	**2,135**	**1,506**	**3,641**

Table 3-3: Active DR Values through FCA #9

Dispatch Zone	Active DR (FCA #1-9) DRV[12] (MW)
Bangor Hydro	27
Maine	97
Portland, ME	17
New Hampshire	13
New Hampshire Seacoast	2
Northwest Vermont	24
Vermont	5
Boston, MA	50
North Shore Massachusetts	18
Central Massachusetts	32
Springfield, MA	8
Western Massachusetts	15
Lower Southeast Massachusetts	7
Southeast Massachusetts	41
Rhode Island	56
Eastern Connecticut	8
Northern Connecticut	28
Norwalk-Stamford, Connecticut	3
Western Connecticut	32
New England Total[13]	**484**

3.2.7 Forecasted Photovoltaic (PV) Generation

In addition to the resources that cleared the FCM, the PV generation forecast was used to model PV generation in the study base cases. The 2015 CELT PV generation forecast includes the PV generation that has been installed as of the end of 2014 and provides a forecast by state of the total PV (by AC Nameplate) that is expected to be in service by the end of each forecast year for the next 10 years. As an example, the 2015 PV forecast provides data on the PV that is in service as of the end of 2014 as well as an annual forecast for the PV that will be in service for end of 2015, end of 2016 and so on until the end of 2024. For years beyond 2024, the rate of PV generation growth from 2023-2024 was used to extrapolate the PV generation forecast.

An availability factor of 26% was applied to the values from the PV generation forecast. Table 3-4 summarizes the PV generation modeled for the initial study files for New England.

[13] The sum of individual values may not equal the total value due to rounding.

[redacted]

Table 3-4: Forecasted PV Generation Modeled in New England Modeled in Study Base Cases

Load Zone		2026 Peak
New England	A - PV generation (nameplate) in New England	1,937
	B - 5.5% Reduction in Distribution Losses	107
	C - Unavailable PV generation (A+B)*(1-26%)	1,512
	PV Generation Modeled in Case as Negative Load (A+B)-C	**531**

3.2.8 **Load Levels Studied**

Consistent with ISO-NE planning practices, transmission planning studies utilize the ISO extreme weather 90/10 forecast assumptions for modeling summer peak load profiles in New England. A breakdown of the load modeled in the 2026 cases, taking into account transmission and distribution losses, is shown in Table 3-5. A more detailed report of the loads modeled and how the numbers were derived from the CELT values can be seen in Section 10.

Table 3-5: Load Levels Studied

State	2026 CELT 90/10 Load[14] (MW)
Maine[15]	2,525
New Hampshire	3,350
Vermont	1,265
Massachusetts	16,545
Rhode Island	2,550
Connecticut	9,075
New England Total	**35,310**

After taking into account the aforementioned transmission losses, the contributions of demand resources and forecasted EE, and the addition of non-CELT and station service loads, the actual load level modeled in the base cases for this study was approximately 31,103 MW.

3.2.9 **Load Power Factor Assumptions**

Load power factors consistent with the local transmission owner's planning practices were applied uniformly at each substation. Eversource Energy's load power factor was modeled as 0.983 in SEMA. National Grid's load power factor was modeled as 0.995 in SEMA and 0.996 in RI. Demand resource power factors were set to match the power factor of the load at that bus in the model. A list of overall power factors by company territory can be found in the detailed load report in Section 10, Appendix B.

3.2.10 **Transfer Levels**

In accordance with the reliability criteria of the NERC, NPCC and the ISO, the regional transmission power grid must be designed for reliable operation during stressed system conditions. A detailed list of all transfer levels can be found in the study base summaries in Section 12. The following external transfers were utilized for the study.

---

[14] These values exclude transmission and distribution losses.

[15] The value does not include 365 MW of paper mill load where the mills have on site generation located behind their meter.

[redacted]

Table 3-6: Interface Levels Tested

Case	Interface Level Condition	North-South Transfers	East-West Transfers	West to East Transfers	Boston Import	CT Import
A	High East to West with High North-South	High	High	Low	Low	High
B	High West to East with Low North-South	Low	Low	High	Low	Low
C	High West-East with Medium North-South	Medium	Low	High	Medium	Low

Case A: This case represents a scenario with high East-West flows. In this case, the stress is from East-to-West with SEMA-RI transfer levels being dictated by the load in the area and unit unavailability. All units in the Boston area were assumed in-service for this scenario. Imports from Hydro-Quebec over the HVDC circuits and on the New-Brunswick to New England (NB-NE) ties were adjusted accordingly to achieve a high East-to-West bias. Flows over the New-York tie lines were allowed to adjust within acceptable limits to meet New England load.

Case B: This case represents a scenario with high West-East flows. In this case, the North-South interface was held at a low value with SEMA-RI zone being stressed from the West. In this scenario, all units in the Boston area were assumed in service. The flows on the HVDC tie from Quebec and NB-NE were adjusted as needed to maintain a high West-to-East interface flow. Flows over the New-York tie lines were allowed to adjust within acceptable limits to meet New England load.

Case C: This case represents a scenario with high West-East flows. In this scenario, one unit in the Boston area was assumed out-of-service. Imports from Hydro-Quebec over the HVDC circuits and on the New-Brunswick to New England (NB-NE) ties were adjusted accordingly to achieve a high West-East interface flow. Imports/Exports over New-York tie lines were allowed to adjust within acceptable limits to meet New England load.

Generation Dispatch ScenariosTable 3-7 shows a list of the generating units in the study area and their modeled generation capacities.

Table 3-7: Modeled Generating Capacities of Study Area Units

Generating Unit	Modeled Capacity (MW)	Fast-Start Unit[16]
NEA Bellingham	277.621	No
Edgar / Fore River	700.000	No
ANP Blackstone 1	239.634	No
ANP Blackstone 2	245.314	No

[16] "Fast-start" generators are those units that can go from being off-line to their full Seasonal Claimed Capability in 10 minutes. These units do not need to participate in the 10-minute reserve market to be considered a fast-start unit in planning studies.

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Generating Unit	Modeled Capacity (MW)	Fast-Start Unit[16]
SEMASS 1	46.955	No
SEMASS 2	22.174	No
Canal 1	547.059	No
Canal 2	545.125	No
Canal 3 (FCA #10)	333.000	No[17]
Dartmouth Power	62.156	No
Potter	73.927	No
Milford Power	149.000	No
ANP Bellingham 1	237.102	No
ANP Bellingham 2	243.587	No
Cleary 8	24.825	No
Cleary 9/9A	104.931	No
Dighton Power	160.539	No
Ocean State Power G1/G2/S1	270.901	No
Ocean State Power G3/G4/S2	270.180	No
Manchester / Franklin Square 9/9A	149.000	No
Manchester / Franklin Square 10/10A	149.000	No
Manchester / Franklin Square 11/11A	149.000	No
Pawtucket Power	59.810	No
Tiverton Power	244.086	No
RISE	543.455	No
Ridgewood Landfill	26.000	No
Burrillville Energy Center (FCA #10)	485.000	No[17]
Lake Road 1[18]	245.792	No
Lake Road 2[18]	251.213	No
Lake Road 3[18]	255.000	No
West Medway Jet 1[19]	42.000	Yes
West Medway Jet 2[19]	40.835	Yes
West Medway Jet 3[19]	35.441	Yes
West Tisbury	5.568	Yes
Oak Bluffs	8.120	Yes
Thomas A. Watson	105.200	Yes

[17] Since this unit's ramping capability has not yet been tested and verified, this study has assumed that it is not a fast-start unit.

[18] While these units are located outside of the SEMA-RI area, they do have a significant influence on the performance of the study area and are therefore listed.

[redacted]

At all locations in the study area where a single fast-start unit is available, that unit was assumed out of service (OOS) for each dispatch. For subareas where there are multiple fast-start units, one of the fast-start units was taken out of service and the rest were assumed online and available in that subarea.

Of all the fast-start units available in SEMA-RI study area, approximately 20% of them were considered OOS for each dispatch. The rest of the fast-start units were assumed available for dispatch. For all cases except Edgar or Edgar and Potter out-of-service, West Medway Jet 2 and Oak Bluffs are considered the best helpers[19], and were assumed OOS. For Edgar or Edgar and Potter OOS, Thomas A. Watson 1 is considered the best helper, and was assumed OOS. In all cases, approximately 80% of the fast-starts were assumed in-service.

Generating units in the rest of the New England system outside of the SEMA-RI study area were dispatched to create the stress conditions shown in Table 3-6.

The most up-to-date voltage schedules obtained from ISO-NE Operating Procedure 12 (OP-12) were utilized in this study. The fast-start dispatch assumptions detailed above were turned on in the base case and no adjustments were made to these fast-start units post-first contingency. Canal 3 and Burrillville Energy Center are in service in all cases.

Table 3-8 and Table 3-9 show the dispatch scenarios and the list of units that were assumed unavailable in each of the base cases. These scenarios have been set up to stress different parts of SEMA-RI study area.

New one-unit-out and two-units-out generation dispatches were not required for the Canal 3 and Burrillville Energy Center due to their interconnection points which are shared with other units or are within the same proximity. Canal 3 will be connected with the other Canal units at the Canal substation and the Burrillville Energy Center will be connected into the Sherman Road 345 kV substation, similar to the Ocean State Power generation units. The existing two-units-out generation dispatches serve as the worst case scenario. Canal 3 and Burrillville Energy Center are in service in all cases.

[19] In this case, a "helper" unit is the fast-start unit that would be most beneficial, for the given situation, to turn on in order to help offset the loss of a certain base generation unit.

[redacted]

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Table 3-8: One-Unit-Out Generation Dispatches

Unit OOS	Modeled Capacity (MW)	One Unit OOS Dispatch Number																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Canal 2	545.1	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Edgar	688.3	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Potter	74.2	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Tiverton	244.6	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Dighton	160.3	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Cleary / Taunton	130.8	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
RISE	548	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Manchester/ Franklin Square 11	149	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON
NEA Bellingham	277.6	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON
ANP Bellingham 1	236.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON
Ocean State Power C1, C2, S1	270.9	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON
ANP Blackstone 1	221.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON
Lake Road 1	245.8	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON
SEMASS	69.2	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON
Dartmouth Power	83.1	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON
Milford Power	149	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON
Pawtucket Power	61.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF

[redacted]

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Table 3-9: Two-Units-Out Generation Dispatches

Unit OOS	Modeled Capacity (MW)	Two Units OOS Dispatch Number														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Canal 1	549.9	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Canal 2	545.1	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Edgar	688.3	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Potter	74.2	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Tiverton	244.6	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	OFF
Dighton	160.3	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Cleary/Taunton	130.8	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF
RISE	548	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Manchester / Franklin Square 11	149	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	OFF	ON	ON
Manchester / Franklin Square 10	149	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON
NEA Bellingham	277.6	ON	ON	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	ON
ANP Bellingham 1	236.4	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON
ANP Blackstone 1	221.4	ON	ON	ON	ON	ON	ON	ON	OFF	ON	OFF	ON	ON	ON	ON	ON
Ocean State Power G3, G4, S2	270.2	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON
Ocean State Power G1, G2, S1	270.9	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON
Lake Road 2	251.2	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON
Lake Road 1	245.8	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON
Dartmouth Power	83.1	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	OFF	ON
Pawtucket Power	61.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON
SEMASS	69.2	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON

[redacted]

3.2.11 Reactive Resource and Dispatch Assumptions

All area shunt reactive resources were assumed available and dispatched when required. Reactive output of generating units was modeled to reflect defined limits. A summary of the reactive output of units and shunt devices connected to the transmission system that played a significant role in the study area can be found in the power flow case summaries included in Section 12.

3.2.12 Demand Resources

As stated in Section 3.2.6, Passive DR as forecasted for the year 2026 and Active DR that cleared as of FCA #9 in 2015 were modeled for this study. Passive DR was assumed to perform to 100% of their qualified amount. The passive DR included the forecasted EE which were assumed to perform to 100% of the forecasted amount. Active DR was assumed to perform to 75% of their qualified amount. A summary of assumed DR performance is shown in Table 3-10. Real Time Emergency Generation (RTEG) was not modeled, consistent with all needs and solutions planning analyses.

Table 3-10: New England Demand Resource Performance Assumptions

Region	Passive DR	Active DR	Forecasted EE	RTEGs
New England	100%	75%	100%	0%

3.2.13 Protection and Control System Devices Included in the Study Area

There are five Special Protection Systems that are in operation in the SEMA-RI study area:

1. Barnstable SPS – NPCC Type III
2. Bellingham Plant #2 (BEL2) SPS – NPCC Type III
3. Edgar Station SPS – NPCC Type III
4. L14/M13 Tiverton SPS – NPCC Type III
5. Stoughton Station SPS – NPCC Type III

The Barnstable SPS is a flow-based SPS which will initiate load shedding on the Cape based on [redacted].

The Bellingham Plant #2 (BEL2) SPS will trip the Bellingham Unit #2 generator breaker following [redacted].

[redacted]

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The Edgar SPS trips specific Edgar station generation (EDG1, EDST) if [redacted].

The L14/M13 Tiverton SPS is a flow-based SPS that reduces the output of [redacted].[20]

The Stoughton SPS trips certain lines in the Boston area for N-1-1 conditions. The operation of this SPS is needed to avoid [redacted].

Contingencies affected by the operation of these SPSs were tested both with the SPS operating and out-of-service.

3.2.14 Explanation of operating Procedures and Other Modeling Assumptions

The SEMA-RI area transmission power flows are managed on a daily basis through the use of generation dispatch. For the purposes of the contingency testing conducted as part of this study generation adjustments were modeled in the analysis to reflect system adjustments that could occur between outages under N-1-1 contingency conditions. These adjustments were primarily limited to unit back-downs in the SEMA-RI study area and HVDC terminal adjustments. The reductions in resource output were limited to a total of 1,200 MW across the New England system to reflect consistency with operating reserve constraints.

Additionally, the SEMA-RI area has an operating guide for the operation of the Canal 1 and 2 generating units when certain facilities are out of service or following the loss of certain facilities. This procedure serves to limit the output of the Canal units to avoid potential loss of generation due to instability following specific contingency events. Modeling of this operating procedure was captured through base case dispatch conditions and/or through system adjustments performed between contingency events.

[20] https://www.iso-ne.com/static-assets/documents/2016/06/tiverton_generator_uprate_i_3_9.pdf and https://smd.iso-ne.com/operations-services/ceii/rc/2016/06/a3_3_tiverton_generator_uprate_lvl3_sps_retirement_ppa.pdf

[redacted]

3.3 Stability Modeling Assumptions

Not applicable for this study.

3.4 Short Circuit Model Assumptions

3.4.1 **Study Assumptions**

The short circuit study evaluated the available fault current levels around the SEMA-RI area. It also included the effects of area reliability project upgrades as well as proposed generation interconnection projects as outlined in Sections 3.2.3 and 3.2.4.

3.4.2 **Short Circuit Model**

The ASPEN Circuit Breaker Rating Module software was used to calculate all circuit breaker duties. The case for the short circuit study was obtained from the 2015 short circuit base case library and all "Proposed", "Planned", and "Under Construction" projects from the May 2015 RSP Project Listing, as discussed in Section 3.2.3 of this scope document, were added to that model. In addition, the Aquidneck Island Reliability Projects (RSP ID: 1669, 1670, and 1671) were also included in the case.

3.4.3 **Contributing Generation Assumptions (Additions & Retirements)**

The model included proposed generation interconnection projects that have PPA approval as well as those generator projects that have FCA Capacity Supply Obligations (CSOs).

The following relevant proposed generation projects were modeled in the Needs Assessment study and were included in this study:

- QP 444 – Medway Peakers (195 MW - FCA #9)
- QP 449 – Canal #3 (333 MW - FCA #10)
- QP 489 – Burrillville Energy Center (485 MW - FCA #10)

In addition, if new generation resources which could impact the SEMA-RI study area entered into the Feasibility Study (FS) or System Impact Study (SIS) phase, those resources were also modeled in this short circuit testing. The additional new generation resources included in this short circuit testing but not included in the Needs Assessment short circuit testing are:

- QP 588 – 50 MW
- QP 596 – 1120 MW
- QP 598 – 575 MW

The Non-Price Retirements listed in Table 3-1 were reflected in the short circuit base cases.

3.4.4 **Generation and Transmission System Configurations**

NPCC Regional Reliability Reference Directory #1, "Design and Operation of the Bulk Power System" and PP-3 required short circuit testing to be conducted with all transmission and generation facilities in-service for all potential operating conditions.

[redacted]

3.4.5 **Boundaries**

This study included testing of all 115 kV and 345 kV substations and breakers in the SEMA-RI study area as well as select substations and breakers in neighboring portions of the Greater Boston and Eastern Connecticut study areas.

3.4.6 **Other Relevant Modeling Assumptions**

Not applicable for this study.

[redacted]

Section 4
Analysis Methodology

4.1 Planning Standards and Criteria

The applicable NERC, NPCC and ISO-NE standards and criteria were tested as part of this evaluation. Descriptions of each of the NERC, NPCC and ISO-NE standard tests that were used to assess system performance are discussed later in this section.

4.2 Performance Criteria

4.2.1 **Steady State Criteria**

The Solutions Study was performed in accordance with NERC TPL-001-4 Transmission Planning System Standards, NPCC "Regional Reliability Reference Directory #1, Design and Operation of the Bulk Power System", dated 09/30/15, and ISO-NE Planning Procedure No. 3, "Reliability Standards for the New England Area Bulk Power Supply System", dated 03/01/13. The contingency analysis steady-state voltage and loading criteria, solution parameters and contingency specifications that were used in this analysis are consistent with these documents.

NERC Reliability Standards require that the system thermal and voltage levels remain within applicable limits after the events as described in "Table I – Steady State & Stability Performance Planning Events" of the NERC Reliability Standard TPL-001-4.

In this study report, only criteria violations on Pool Transmission Facility (PTF) transmission elements and substations were reported. Information on non-PTF violations can be found in Section 14, but was not considered in transmission solution development.

4.2.1.1 *Steady State Thermal and Voltage Limits*

Loadings were monitored on all transmission facilities rated at 115 kV and above in the SEMA-RI study area and in the Greater Boston and Eastern Connecticut study areas, which are in close proximity to the SEMA-RI study area. The thermal violation screening criteria defined in Table 4-1 was applied.

Table 4-1: Steady State Thermal Criteria

System Condition	Maximum Allowable Facility Loading
Pre-Contingency (All Lines In)	Normal Rating
Post-Contingency	Long Time Emergency (LTE) Rating

Voltages were monitored at all buses with voltages 115 kV and above in the study area and in the Greater Boston and Eastern Connecticut study area which is in close proximity to the SEMA-RI study area. System bus voltages outside of limits identified in Table 4-2 were identified for all normal (pre-contingency) and post-contingency conditions.

[redacted]

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Table 4-2: Steady State Voltage Criteria

Transmission Owner	Voltage Level	Bus Voltage Limits (Per-Unit)	
		Normal Conditions (Pre-Contingency)	Emergency Conditions (Post-Contingency)
National Grid	230 kV and above	0.98 to 1.05	0.95 to 1.05
	115 kV and below	0.95 to 1.05	0.90[21] to 1.05
Eversource Energy	69 kV & above	0.95 to 1.05	0.95 to 1.05
Eversource Energy (NSTAR)	230 kV and above	0.95 to 1.05	0.95 to 1.05
	115 kV and below	0.95 to 1.05	0.95 to 1.05
Millstone / Seabrook[22]	345 kV	1.00 to 1.05	1.00 to 1.05
Pilgrim[22]	345 kV	0.995 to 1.05	0.99 to 1.05
Vermont Yankee[22]	115 kV	1.00 to 1.05	1.00 to 1.05

4.2.1.2 *Steady State Solution Parameters*

The steady-state analysis was performed with pre-contingency solution parameters that allowed for adjustment of load tap-changing transformers (LTCs), static VAR devices (SVDs, including automatically-switched capacitors), and phase angle regulators (PARs). Table 4-3 summarizes the solution parameters used in the study.

Table 4-3: Study Solution Parameters

Case	Area Interchange Control	Tap Adjustments	Adjust Phase Shift	Switched Shunt Adjustments
Base	Tie Lines and Loads Enabled	Stepping	Enabled	Enabled
Contingency	Disabled	Stepping	Disabled	Disabled

[21] This minimum voltage criterion only applies to [redacted] designated substations. [redacted] stations must be >0.95 post contingency.

[22] This is in compliance with NUC-001-2, *"Nuclear Plant Interface Coordination Reliability Standard,"* adopted August 5, 2009.

4.2.2 **Stability Performance Criteria**

Not applicable for this study.

4.2.3 **Short Circuit Performance Criteria**

This study was performed in accordance with appropriate IEEE C37 standards and specific design parameters of the circuit breakers. This includes specific considerations for total-current rated and symmetrical-current rated breakers as appropriate.

The circuit breakers were evaluated for short circuit adequacy based on the following criteria:

- *Acceptable-duty*: Circuit breaker fault interrupting duty less than 100% of the available fault current. No action required.
- *Over-duty Condition*: Circuit Breaker Fault Interrupting Duty greater than 100%. This is considered an unacceptable operating condition requiring a solution to be developed to eliminate the over-duty condition.

4.2.4 **Other Performance Criteria**

Not applicable for this study.

Section 5
Development of Alternative Solutions

The 2026 Needs Assessment identified numerous system weaknesses on the existing 115 kV network in SEMA-RI. Most involved large pockets of load being served from a few weak connections to the high voltage network. When a combination of these connections along with the critical units that were removed during N-1-1 analysis, the remaining lines in-service were unable to handle the increased loading and resulted in thermal overloads and low voltage to potential voltage collapse in the load pocket. For example, [redacted] caused load loss over 300 MW.

Other violations occurred due to lack of sufficient transmission capacity to serve load under multiple line and critical unit outage scenarios. For example, outage of one [redacted] traversing the SEMA-RI study area and results in overloads of facilities in the Boston area.

The alternative solutions were developed to find ways to strengthen these connections to the load pockets and the 345 kV facilities by: adding new sources into the load pocket, improving the remaining elements after N-1-1 contingency events to adequately handle the additional loading, or eliminating the contingency condition causing the violations. A description of all the alternative solutions is in Section 5.3. All of the alternative solutions were first evaluated to ensure that the solution components resolve all the identified time-sensitive criteria violations identified in the Needs Assessment. These evaluations are described in Section 6. The next step was to compare the alternative solution components in terms of cost, constructability, environmental concerns, and several other criteria. These comparisons are described in Section 7.

At the October 2016 PAC meeting, the ISO presented the addition of the [redacted][23] contingency to the Needs Assessment analysis. The [redacted] share two structures together at the entrance to the Taunton station. The worst N-1-1 contingency results in a loading of 108.93% LTE seen on the U6 line between Bridgewater and Raynham [redacted]. NPCC Directory 1 allows for the automatic exclusion of a DCT contingency if the DCT is used only for station entrance and exit and it doesn't exceed five towers at each station. The ISO has reviewed the low likelihood of the DCT contingency in the context of the proposed changes to PP-3 and has concluded that the DCT will be exempted as part of the solutions in the study area.

[23] [redacted]

[redacted]

5.1 Preliminary Screen of Alternative Solutions

Only time-sensitive needs, as identified in the Needs Assessment, were evaluated for a regulated transmission solution. The working group disregarded non-time-sensitive needs during solution alternative development. It should be noted that a solution alternative which solves a time-sensitive need may also resolve a non-time-sensitive need; however, the working group did not develop transmission solutions with the expressed intent of solving non-time-sensitive needs.

During the conceptual phase of the Solutions Study, several solutions were proposed to address the identified needs. The addition of new 115 kV lines or new 345/115 kV autotransformers were discussed as possible solutions to serve the load pockets. At the onset it was determined that any additional 345 kV lines in the area would be far more costly than 115 kV projects and would have many challenges in the densely populated region of SEMA-RI. Therefore, 345 kV line alternatives were eliminated from consideration when developing solution alternatives for the area.

5.2 Coordination of Alternative Solutions with Other Entities

The working group included representatives from Eversource, National Grid, MGED and ISO-NE. This working group helped ensure that the study of alternatives included other planned transmission system changes outside of the SEMA-RI study area as well as the impact that the alternative solution had on facilities outside of the study area. Coordination with other ongoing working groups adjacent to SEMA-RI was also done throughout the process. In particular, a joint Eastern Connecticut and SEMA-RI working group was created to address violations on the border of Connecticut and Rhode Island. The working group also coordinated efforts with the ongoing generator system impact studies in the SEMA-RI area to ensure all proposed projects would work together and not cause each other adverse impacts.

5.3 Description of Alternative Solutions

From the Needs Assessment report, the needs were categorized into six subareas which were selected based on the transmission topology as well as geographic orientation of facilities. For the development of solution alternatives, the SEMA-RI working group partitioned the study area into new geographic groups shown below.[24] Within each new group are needs that are interrelated and driven by common system conditions (dispatch and contingencies). The needs in each new group are relatively independent of needs in other groups. Therefore it made sense to develop solution alternatives for each of these new groups sequentially by addressing the needs in each group. The new groups are:

1) **Group 1 –**Portions of Farnum, West Medway/West Walpole, South Shore, and Somerset/Newport subareas
2) **Group 2** – Portions of Industrial Park and Somerset/Newport subareas
3) **Group 3** – Portion of Farnum subarea
4) **Group 4** – Portion of West Medway/West Walpole subarea
5) **Group 5** – Portion of South Shore subarea
6) **Group 6** – Cape Cod subarea

[24] To observe the relationship between the Subareas developed in the Needs Assessment and the Groups formed in this Solutions Study, refer to Section 9, Appendix A.

The geographic locations on the defined subareas listed above are shown in Figure 5-1.

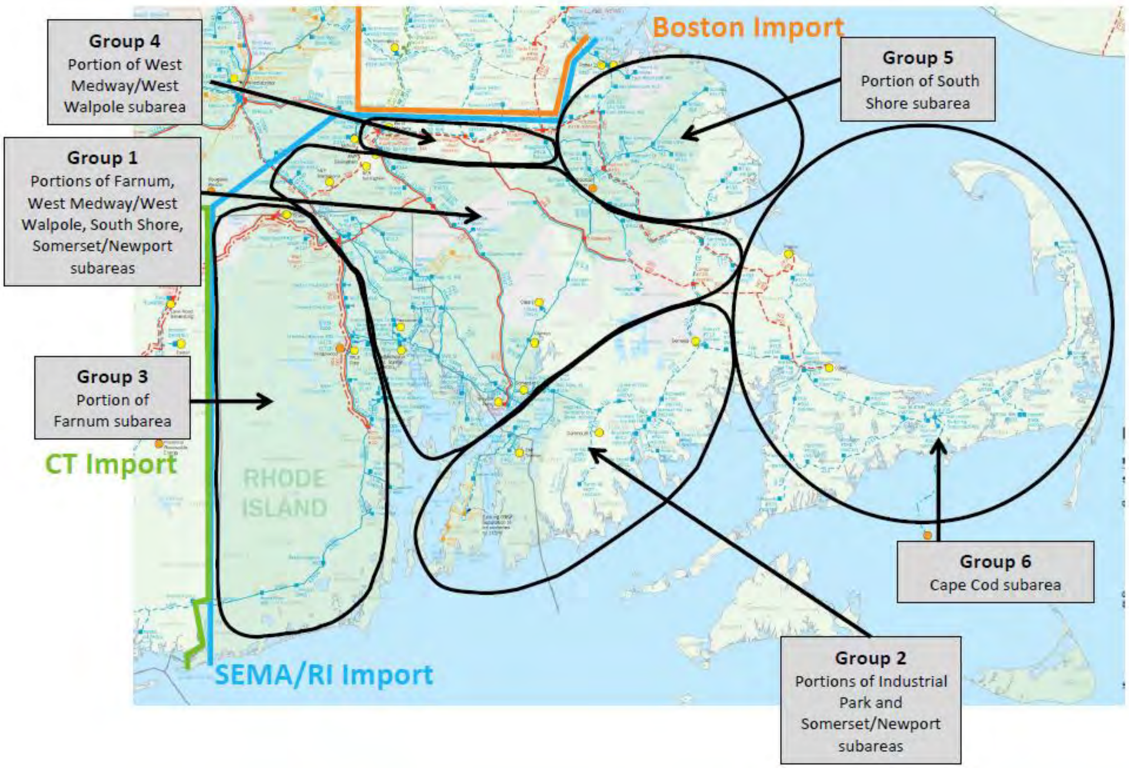

Figure 5-1: SEMA-RI Solutions Study Groups Map

5.3.1 Group 1 – Portions of Farnum, West Medway/West Walpole, South Shore, and Somerset/Newport Subareas

Needs in the Group 1 boundary are driven by generation unavailability in the [redacted]. Insufficient injection at Somerset station causes the majority of the overloads. The nearest 345 to 115 kV sources to the Somerset area are Bridgewater, West Farnum, and Carver. Brayton Point is a 345 kV to 115 kV source but is only connected to the Somerset area via 115 kV lines through northern Rhode Island. Under various stress scenarios and N-1-1 conditions, power flows on the 115 kV system from Brayton Point to northern RI to the Somerset area, from West Farnum to the Somerset area or from Bridgewater to the Somerset area.[25] Under these conditions, the 115 kV lines overload in northern Rhode Island (H17, V-148S, R9, J16S, P11, and Q10) and in the Somerset area (K15, U6, V5, S8, and W4). This event was the catalyst for the new Group 1 boundary. Three alternative solutions were developed to solve Group 1 needs.

Alternative #1 was developed after the Group 1 boundary was established. Solution Alternative #1 simply solved each thermal and voltage overload individually. Taking this approach required the

[25] Any needs that appear from power flowing from the Carver 345 to 115 kV source to the Somerset area will be addressed in Group 2.

[redacted]

reconductoring of fourteen 115 kV lines for approximately 117 miles and installing numerous reactive devices to solve voltage violations.

For Alternative #2 National Grid offered a solution alternative which would tie Brayton Point to Somerset by utilizing existing transmission lines. This can be accomplished by building a new GIS switching station to tie the 115 kV X3, W4, E-183E and F-184 lines in a breaker and a half station on land owned by National Grid between existing New England Power (NEP) and EUA ROW in Somerset, MA. See Figure 5-2.

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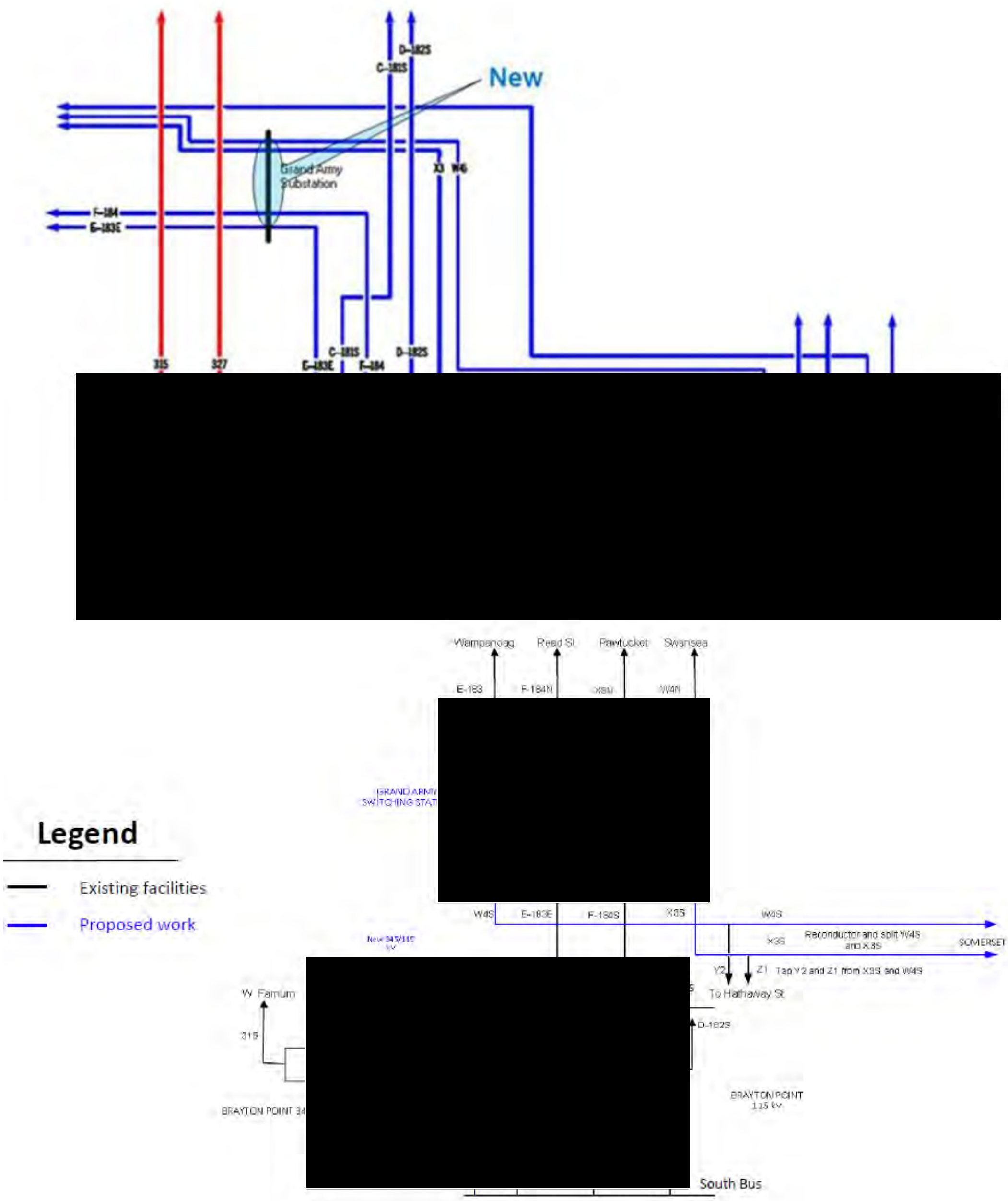

Figure 5-2: Solution Alternative #2 – New Grand Army Station

By utilizing the existing 115 kV lines and constructing a new station in close proximity to Brayton Point and Somerset, the system performance achieved by this Solution Alternative #2 is equivalent to Solution Alternative #3. The solution components which make up the Solution Alternative #2 are shown Table 5-1.

Table 5-1: Solution Alternative #2 Solution Components

Solution Components
Grand Army 115 kV GIS switching station and loop the E-183E, F-184, X3 and W4 lines
Upgrades at Brayton Point (new 115 kV breaker, new 345/115 kV transformer and upgrades to E183E, F184 station equipment)
Increase clearances on E-183E & F-184 lines between Brayton Point & Grand Army (~1.5 miles each)
Separate X3/W4 DCT and reconductor X3, W4 lines between Somerset and Grand Army (~2.7 miles each). [26]

Alternative #3 was created to introduce a new supply into the Somerset/Fall River/Aquidneck Island/ New Bedford/Industrial load pocket. The nearest 345 kV source for the load pocket is Brayton Point. The distance between Brayton Point and Somerset stations is less than four miles. The idea to construct a direct tie between the stations is not a new one based on a component of the Greater Rhode Island (GRI) Transmission Projects which received Proposed Plan Application (PPA) approval in 2008.[27] Under GRI, a new 115 kV line would be constructed from Brayton Point to Somerset. Due to the advent of the NERC Bulk Electric System (BES) designation[28], an additional line was added from Brayton Point to Somerset to meet the new contingency criteria. By connecting the existing stations, the working group found that the proposed solution of two new 115 kV lines between Brayton Point and Somerset solved many of the time-sensitive needs across numerous subareas originally defined in the SEMA-RI 2026 Needs Assessment.[29] See Figure 5-3.

[26] The separation of the X3/W4 DCT was not required to solve the needs however based on the lowest cost construction plan to solve the needs, the X3 and W4 lines will be separated. The reconductoring of the W4 line will be accomplished by moving the W4 line to the double circuit towers that currently support the Y2 and Z1 lines, installing new conductors on the double circuit towers and bussing the phases together to make a higher capacity W4 line. The X3 line will be reconductored by installing new conductors on the existing X3/W4 double circuit towers and bussing the phases together to make a higher capacity X3 line. The Y2 and Z1 lines will then be tapped off the X3 and W4 lines. This proposed work makes use of most of the existing towers and provides increased rating at the lowest cost. A by-product of this arrangement is the separation of X3 and W4 DCT.

[27] National Grid withdrew the GRI PPAs on May 13, 2015. https://smd.iso-ne.com/operations-services/ceii/rc/2015/05/a3_7_greater_ri_ppa_withdrawal_letter.pdf

[28] NERC defined BES facilities using a bright line of 100 kV and above with some inclusions and exceptions.

[29] This proposed solution alternative became Solution Alternative #3 in Group 1.

[redacted]

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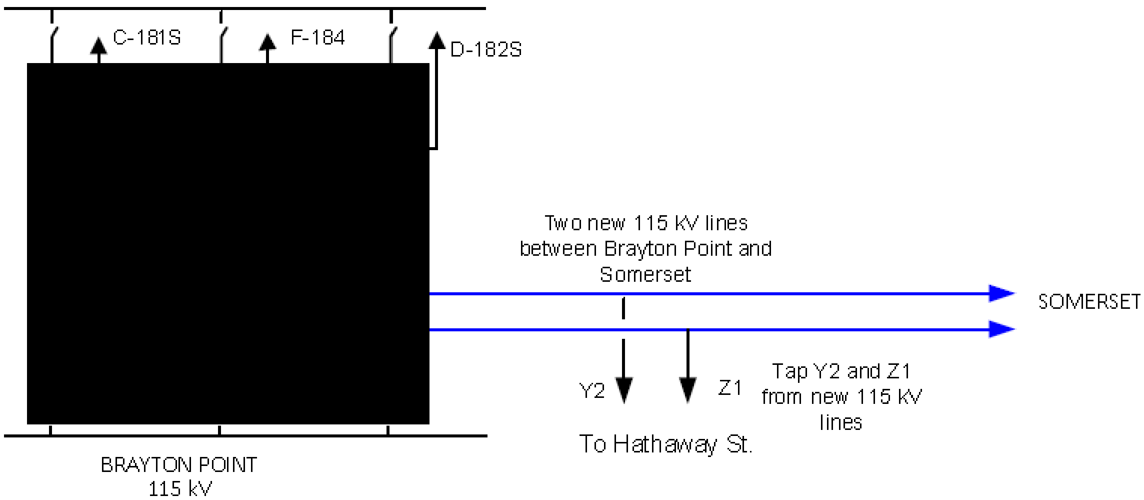

Figure 5-3: Group 1 Solution Alternative #3

The solution components which make up the Solution Alternative #3 are shown Table 5-1.

Table 5-2: Solution Alternative #3 Solution Components

Solution Components
Install 2 new OH 115 kV lines between Brayton Point and Somerset (~3.7 miles each). Relocate F-184, E-183E and D-182S to make space in ROW for new lines
Upgrades at Brayton Point substation (new 345/115 kV XFMR, new 115 kV breaker and station work to accommodate two new lines)
Upgrades at Somerset substation to accommodate two new lines

Common Upgrades:

Alternative #2 or #3 does not solve the needs driven by the [redacted]. In addition, the [redacted] takes the whole Robinson Ave substation out of service since these two lines are not terminated adjacent to each other in the four breaker ring. ([redacted].) By installing a new 115 kV breaker and re-terminating the Q10 line at Robinson Ave, all of the remaining needs in Group 1 are resolved.[30] The installation of a new 115 kV breaker and the re-termination of the Q10 line at Robison Ave are considered common solutions for Alternative #2 and #3.

With the new configuration of the system in the Brayton Point and Somerset area, National Grid performed a [redacted] to determine if stations in the area would

[30] The 115 kV H17-2 (Farnum Tap to Riverside) and R9 (Riverside to Valley) lines were shown as time-sensitive needs in the Needs Assessment but are not solved by this study because the needs will be solved by the QP 489 – Burrillville Energy Center project.

[redacted]

become [redacted] following implementation of the transmission solution. Their preliminary testing showed [redacted] would [redacted] stations. National Grid's minimum requirements for post contingency voltages are 0.95 p.u. for 230 and 345 kV buses. Also, National Grid buses that are part of the Bulk Power System, and other buses deemed critical by operations, are also required to meet the criteria for 345 kV and 230 kV buses. For all other National Grid buses, the minimum voltage requirement is 0.9 p.u. If Berry Street [redacted], then a 45.0 MVAR capacitor would be needed to correct the voltage to the 0.95 p.u. voltage criterion. It should be noted that the [redacted] at this time and results can change when the PPA study is conducted in the future. The PPA study will identify the continued need for the capacitor at Berry Street and other upgrades needed if [redacted]. At this time, the installation of a 45.0 MVAR capacitor at Berry Street is considered a common solution to Alternative #2 and #3.

In the July PAC presentation[33] a common project to Alternatives #2 and #3 was listed to reconductor the H17-2 line from Farnum Tap to Riverside (3.4 miles). The addition of this project was an error because the upgrade of this line is currently part of Burrillville Energy Center generator interconnection system upgrades.

5.3.2 Group 2 – Portions of Industrial Park and Somerset/Newport Subareas

The Group 2 load pocket could be subjected to events which violated the consequential load loss threshold of 300 MW or voltage collapse concerns on the 115 kV system. The loss of [redacted] disconnects approximately 450 MW of load in the load pocket. See Figure 5-4.

[31] Under the latest [redacted] Berry Street 115 kV is [redacted] however it would be [redacted] once the Brayton Point resources retire.

[32] Somerset will be rebuilt due to asset condition and the new construction will insure [redacted].

[33] https://smd.iso-ne.com/operations-services/ceii/pac/2016/07/a3_sema_ri_2026_solution_study_update.pdf

[redacted]

[redacted]

Figure 5-4: Consequential Load Loss Event

[redacted] Under these conditions, the load pocket is [redacted]. Voltage collapse is expected to spread beyond this load pocket affecting approximately 600 MW of load in the entire area. See Figure 5-5.

[redacted]

[redacted]

Figure 5-5: Voltage Collapse Event

To solve the consequential load loss and voltage collapse issues, the working group developed solution components to create new transmission supplies to serve the load pocket. In the case of the voltage collapse issue, two new transmission feeds are needed. [redacted] if only one new transmission feed was created, the loss of the new transmission feed and [redacted] would result in the same existing system configuration that leads to voltage collapse. The working group developed four new solution alternatives to serve the load pocket:

- Alternative #1
    - Install a new undersea line from Bristol substation to a new switching station named Boyd's Lane in Portsmouth, RI (approximately 5.0 miles)
    - Reconductor F-184 115 kV line from Merriman Junction to Warren to Bristol (5.1 miles)
- Alternative #2
    - Separate the M13/N12 DCT from Somerset to Sykes Road
    - Reconductor M13 and N12 from Somerset to Bell Rock (3.5 miles)
    - Loop the M13 line into Bell Rock
    - Reconfigure Bell Rock to a breaker and a half configuration
- Alternative #3

[redacted]

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- Install a new line from Somerset to Bell Rock
- Loop the M13 line into Bell Rock
- Reconfigure Bell Rock to a breaker and a half configuration

- Alternative #4
  - Extend the 114 line from the Industrial Park Tap to either High Hill or Bell Rock
    - High Hill (6.6 miles) and rebuild High Hill substation or
    - Bell Rock (approximately 12.0 miles) and convert Bell Rock to a breaker and a half configuration
  - Resolve M13/N12 thermal violations by reconductoring or bussing the lines together
  - Install reactive devices to address voltage violations
    - 37.5 MVAR capacitor at Bell Rock
    - 35.3 MVAR capacitor at High Hill
    - 35.3 MVAR capacitor at Wing Lane
  - Install a new breaker in series with the N12/D21 tie breaker at Bell Rock

Solution alternatives to solve the consequential load loss and voltage collapse issues would require two of the four solution alternatives listed above. Selecting two of the four solution components would result in a total of six solution alternatives. However, the total of combinations is reduced to five because solution Alternatives #2 and #3 cannot be combined together due to space constraints within the right of way between Somerset and Bell Rock. In addition, Alternative #2 and #3 are unique alternatives when combined with Alternative #1, however, Alternatives #2 and #3 propose work in the same right of way from Somerset toward Bell Rock and, when combined with Alternative #4, are essentially the same from an electrical performance and cost standpoint. See Figure 5-6. Therefore, the combination of Alternative #2 and Alternative #4 is the same as the combination of Alternative #3 and Alternative #4. This combination will be referred to as Alternative #2/#3 and Alternative #4.

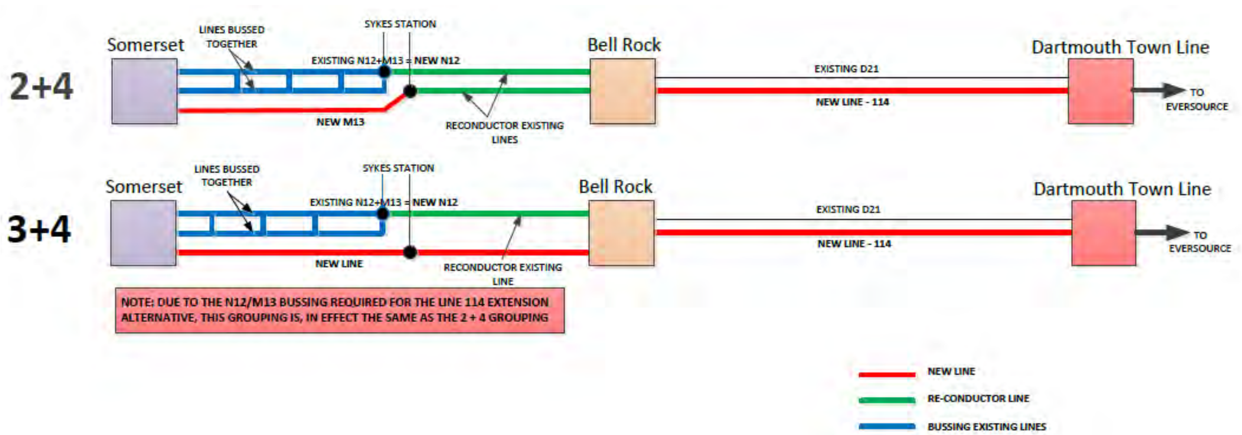

Figure 5-6: Comparison between Alternative #2 and #4 and Alternative #3 and #4

Alternative #4 proposed an extension of the 114 Line from the Industrial Tap to either High Hill (6.6 miles) or Bell Rock (12.0 miles) with station work required at both High Hill and Bell Rock. Even though the proposed line extension to Bell Rock is longer in distance, the amount of station

[redacted]

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work required at High Hill was more costly and therefore the line extension to High Hill was dropped from consideration

The remaining four combinations are shown in Table 5-3 below.

Table 5-3: Group 2 Solution Alternative Combinations

ID	Solution Components	Alt #1 & Alt #2	Alt #1 & Alt #3	Alt #1 & Alt #4	Alt #2/#3 & Alt #4
1	Install a new line from Bristol substation to a new switching station named Boyd's Lane in Portsmouth, RI (approximately 5.0 miles). Includes cost for Horizontal Directional Drilling (HDD) submarine cable across Mt. Hope Bay	X	X	X	
2	Bristol station upgrades and add new 115 kV breaker	X	X	X	
3	Install new 115 kV station with a 5 breaker ring at Boyd's Lane in Portsmouth, RI. Terminate new 115 kV line & loop L14/M13 in/out of the station	X	X	X	
4	Reconductor F-184 115 kV line from Merriman Junction to Warren to Bristol (5.1 miles)	X	X	X	
5	Separate N12/M13 DCT & reconductor N12 & M13 between Somerset and Bell Rock (~3.5 miles)	X			X
6	Install new 115 kV line (UG-1.7 mi and OH-1.8 mi) between Somerset and Bell Rock (~3.5 miles). Add circuit breaker at Somerset for new line		X		
7	Install new breaker in series with the N12/D21 tie breaker and upgrade the D21 Line switch upgrade at Bell Rock				X
8	Reconductor N12 & M13 (No DCT Split) between Somerset and Bell Rock (~3.5 miles)			X	
9	Install a third breaker in a bay to terminate Line 114 at Bell Rock			X	X
10	Extend Line 114 – Eversource/NGRID border to Bell Rock (~4.2 miles)			X	X
11	Extend Line 114 – Industrial Park Tap to Eversource/NGrid border (~7.9 miles)			X	X

[redacted]

12	Install capacitors at Bell Rock, High Hill and Wing Lane	X	X

In addition to the four solution alternatives, there are a number of common projects to solve the remaining time-sensitive needs in Group 2. See Table 5-4 below.

Table 5-4: Group 2 Common Solution Components

Common Solution Components
Reconfigure Bell Rock to breaker and a half station and split M13 line at Bell Rock
Reconductor the 108-4 line from Bourne to the Horse Pond Tap (1.9 miles)
Reconductor the M13 and L14 line from Bell Rock to the Bates St Tap (8.3 miles)
Reconductor the 112 line from Tremont to the Industrial Park Tap (10.3 miles)
Replace wave trap on 114 line at Tremont

5.3.3 **Group 3 – Portion of Farnum Subarea**

Most of the time-sensitive needs in this Group were located on the 115 kV lines which make up the Connecticut and Rhode Island tie. The Connecticut to Rhode Island tie is comprised of the 1280 line from Montville to Mystic, CT, the 1465 line from Mystic, CT to Shunock, the 1870S line from Shunock to Wood River, the 1870 line from Wood River to Kenyon, the 1870N line from Kenyon to West Kingston and the G185S and L190 lines from West Kingston to Kent County. The current Eastern Connecticut working group is also conducting a Solutions Study to solve time-sensitive needs on the Connecticut side of the Connecticut to Rhode Island tie. Since contingencies in one study area drive time-sensitive needs in the other study area and vice versa, the development of solution alternatives needs to be a coordinated effort between both study groups. Both study working groups have held some preliminary meetings and it is anticipated that preferred solutions will be developed and presented to the PAC in 2017.

Outside of the Connecticut and Rhode Island tie, there was only one remaining time-sensitive need. The preferred solution to solve the time-sensitive need is to replace the Kent County T3 345/115 kV transformer.

5.3.4 **Group 4 – Portion of West Medway/West Walpole Subarea**

In this Group, all of the thermal time-sensitive needs were located on the C-129N line and all of the voltage time-sensitive needs were located at stations served by the C-129N line when [redacted]. Two solution alternatives were developed for this group.

- Alternative #1- See Figure 5-7
  - Loop 201-502 line into the Medway station to form the 201-502N and 201-502S lines.
- Alternative #2 – See Figure 5-8
  - Reconductor/rebuild the C-129N line (11.7 miles) from Millbury to Purchase St Tap
  - Reconductor/rebuild the C-129N line (2.2 miles) from Purchase St Tap to Rocky Hill Tap
  - Install reactive devices to address voltage

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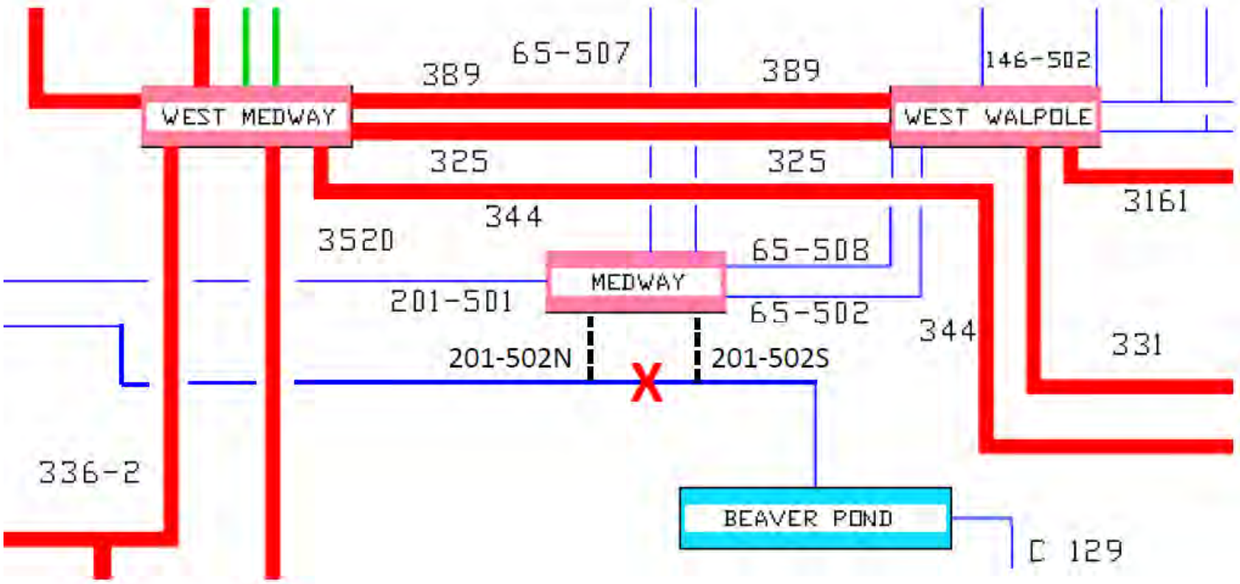

Figure 5-7: Loop 201-502 Line into Medway

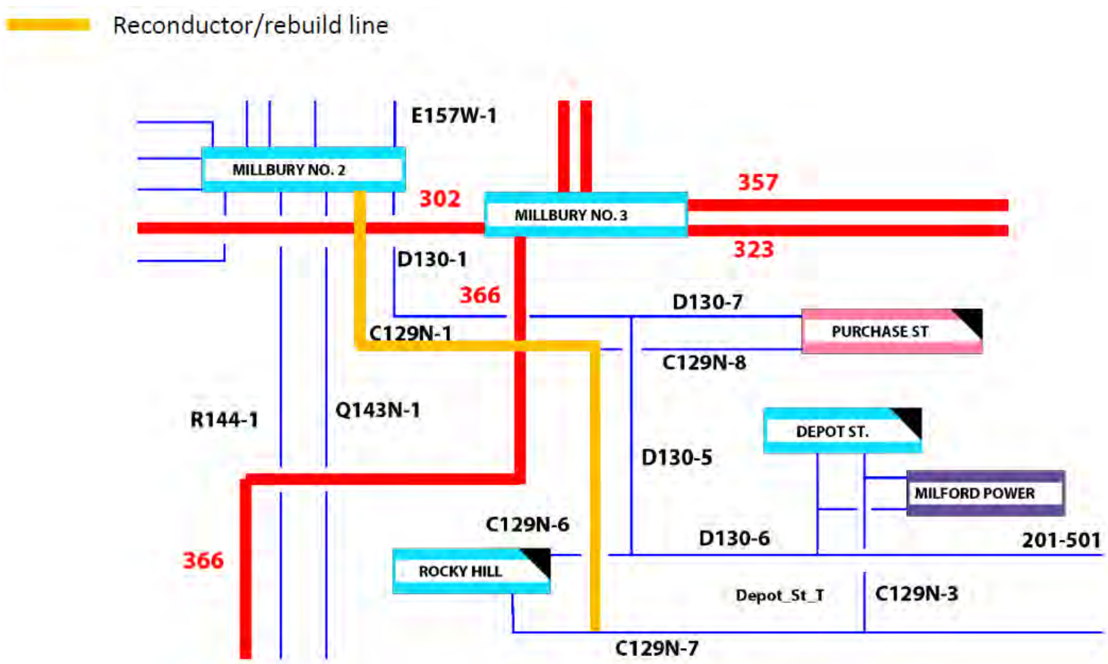

Figure 5-8: Reconductor/rebuild the C-129N line (approximately 14.0 miles) from Millbury to Rocky Hill Tap

In addition to the two solution alternatives in Group 4, additional work which is common to Alternative #1 and #2 is needed to rerate the Eversource portion of the 323 line from Millbury #3

[redacted]

to West Medway by replacing the West Medway substation disconnect switches 107A, 107B, 108A and 108B with 3000A disconnects.

5.3.5 Group 5 – Portion of South Shore Subarea

As part of the solution development for Group 5, Eversource brought forth plans to rebuild the Kingston substation due to asset condition needs. Eversource presented the Kingston Substation #735 Asset Condition Replacement project at the December 2016 PAC meeting.[34] Eversource stated that the Kingston substation replacement project would include:

- the replacement of aged equipment due to asset condition needs,
- the addition of PTF related equipment where the costs would not be regionalized under the Regional Network Service (RNS) rate, and
- work to terminate new lines as a result of solution alternative development to solve time-sensitive needs in the Group 5 area

Since Eversource would have mobilized crews to rebuild the Kingston substation, the cost to incorporate potential solution alternatives from the SEMA-RI study would be reduced due to synergies between the projects. The potential reduced costs for some of the solution components will be discussed and compared in Section 7 of this report.

Group 5 is a load pocket served by the 115 kV 191 line (Auburn to Kingston), 194 line (Auburn to Brook Street) and the 116 line (Carver to Brook Street). The loss of the [redacted] results in a thermal overload of the 191 line (Auburn to Kingston) and in low voltage at the Brook Street and Kingston substations. In addition, the loss of the [redacted] results in an overload of the 117 line (Carver to Brook St).

There are two strategies to solve the time-sensitive needs in Group 5. One strategy is to create a new source into the load pocket. The other strategy is to increase the capacity of the existing lines that serve the load pocket.

The working group developed four new solution alternatives to serve the load pocket:

- Alternative #1– See Figure 5-9
  - Reconductor the 117 line from Brook St to Kingston (3.1 miles)
  - Reconductor the 191 line from Auburn to Kingston (15.3 miles)
  - Replace terminal equipment at Kingston
- Alternative #2– See Figure 5-10
  - Install new line from Carver to Kingston (approximately 8.0 miles)
  - Rebuild Kingston to a breaker and a half configuration
- Alternative #3– See Figure 5-11
  - Install new line from Manomet to Kingston (approximately 6.0 miles new, 9.2 miles existing)
  - Install breakers at Manomet to accommodate new line

[34] https://smd.iso-ne.com/operations-services/ceii/pac/2016/12/a2_kingston_substation_asset_conditions.pdf

[redacted]

- Rebuild Kingston to a breaker and a half configuration

- Alternative #4– See Figure 5-12
  - Install a parallel line from Brook St to Carver (4.9 miles)
  - Reconductor the 117 line from Brook St to Kingston (3.1 miles)
  - Replace terminal equipment at Kingston

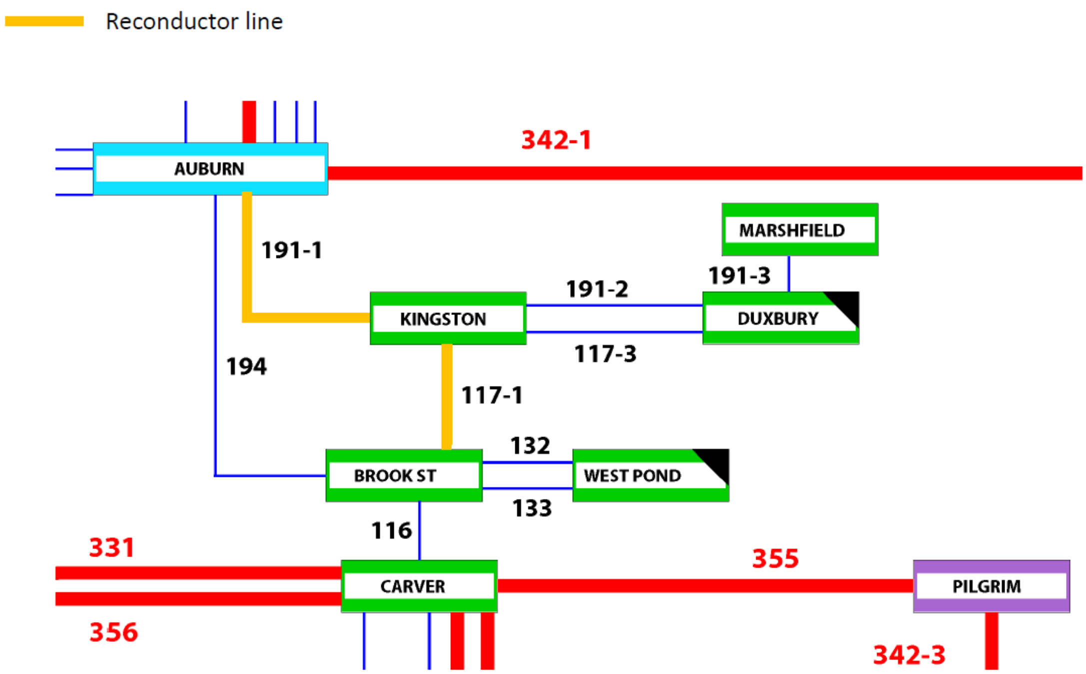

Figure 5-9: Reconductor 117 and 191 Lines

[redacted]

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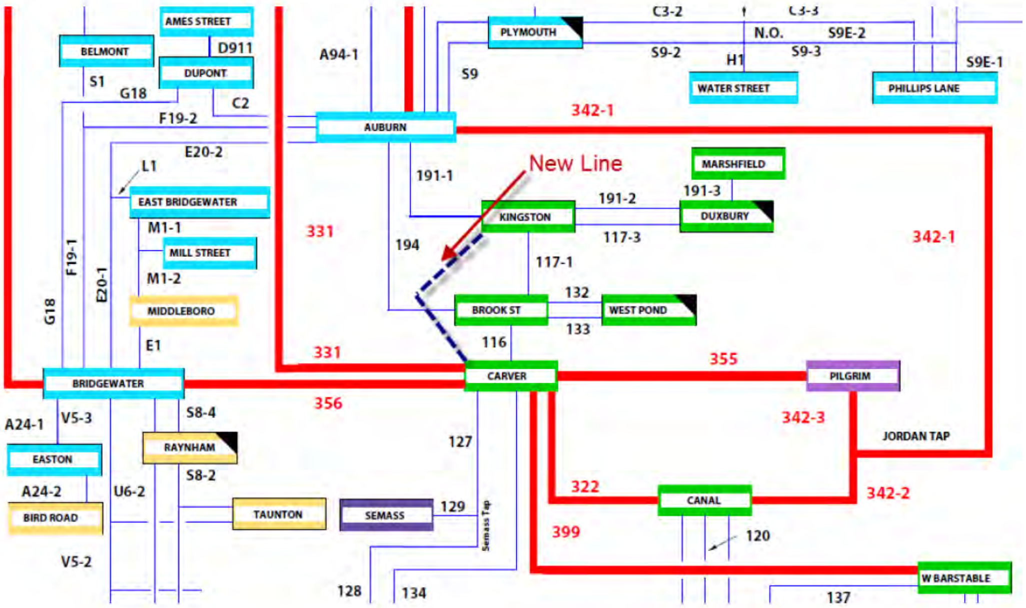

Figure 5-10: Install New Line from Carver to Kingston and Rebuild Kingston

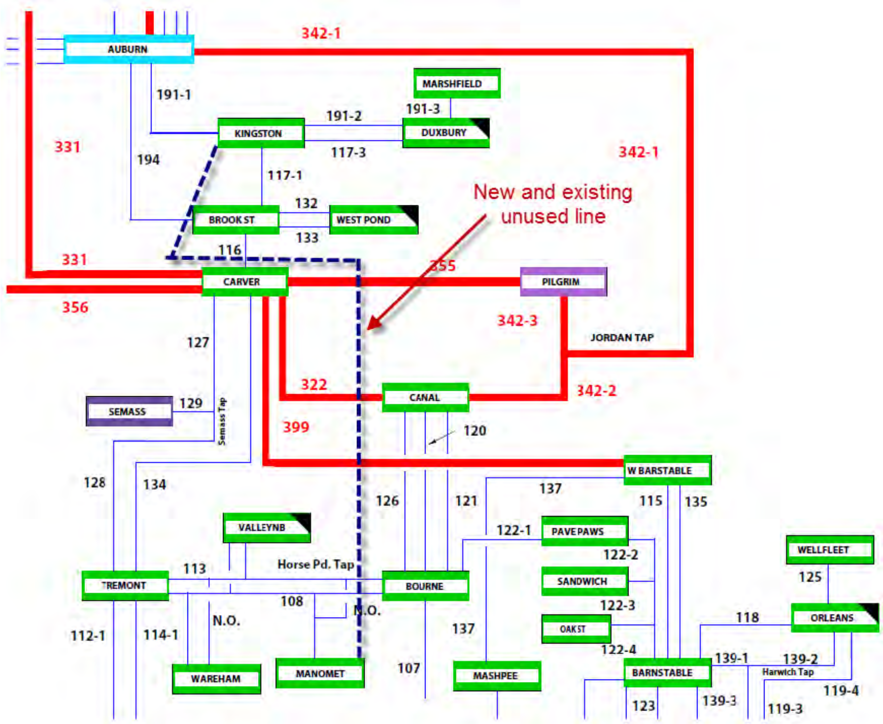

Figure 5-11: Install New Line from Manomet to Kingston and Rebuild Kingston

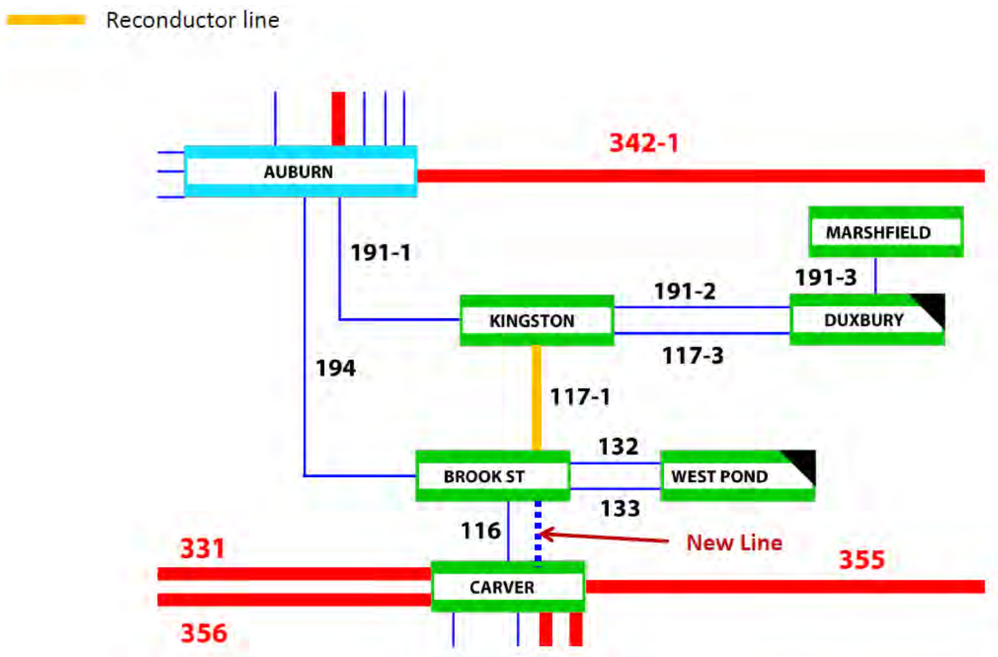

Figure 5-12: Install a New Line from Brook Street to Carver and Reconductor the 117 Line

There was one common solution component for Group 5. It was the rebuild of the MGED portion of E1 line from Bridgewater to Middleboro (2.5 miles).

5.3.6 Group 6 – Cape Cod Subarea

As part of the solution development for Group 6, Eversource brought forth plans to rebuild the Bourne station due to asset condition needs. Eversource presented the Bourne Station #917 Condition Assessment and Solution project at the November 2016 PAC meeting.[35] The Bourne station rebuild would be required due to asset condition regardless of the solution alternatives developed for the SEMA-RI study.

Group 6 or the Cape Cod Subarea is a large load pocket. From the Bourne station the 345 kV 399 line (Carver to West Barnstable), the 115 kV 122 line (Bourne to Barnstable) and the 115 kV 107 line (Bourne to Falmouth Tap) serve all of Cape Cod's load. [redacted] as shown by the numerous non-converged load flow results. The strategy to solve the time-sensitive needs in Group 6 is to add a new source into the load pocket.

The working group developed two new solution alternatives to serve the load pocket:

- Alternative #1– See Figure 5-13
  - Install a new 115 kV line from Bourne to West Barnstable (approximately 13.0 miles)
- Alternative #2– See Figure 5-14

[35] https://smd.iso-ne.com/operations-services/ceii/pac/2016/11/a3_bourne_asset_conditions_preferred_solutions.pdf

- Reconductor/rebuild the 107 line from Bourne to Falmouth Tap (10.0 miles)
- Reconductor/rebuild the 136 line (formerly the 115 line) from Falmouth Tap to West Barnstable (16.5 miles)
- Reconductor/rebuild the 122 line from Bourne to Barnstable (16.6 miles)
- Terminal equipment upgrades at Barnstable and Falmouth Tap

In addition to the two solution alternatives, additional work which is common to Alternative #1 and #2 is needed. The common solution components are:

- The separation of the 122 and 135 lines from West Barnstable to Barnstable (3.3 miles) and
- The retirement of the Barnstable SPS.

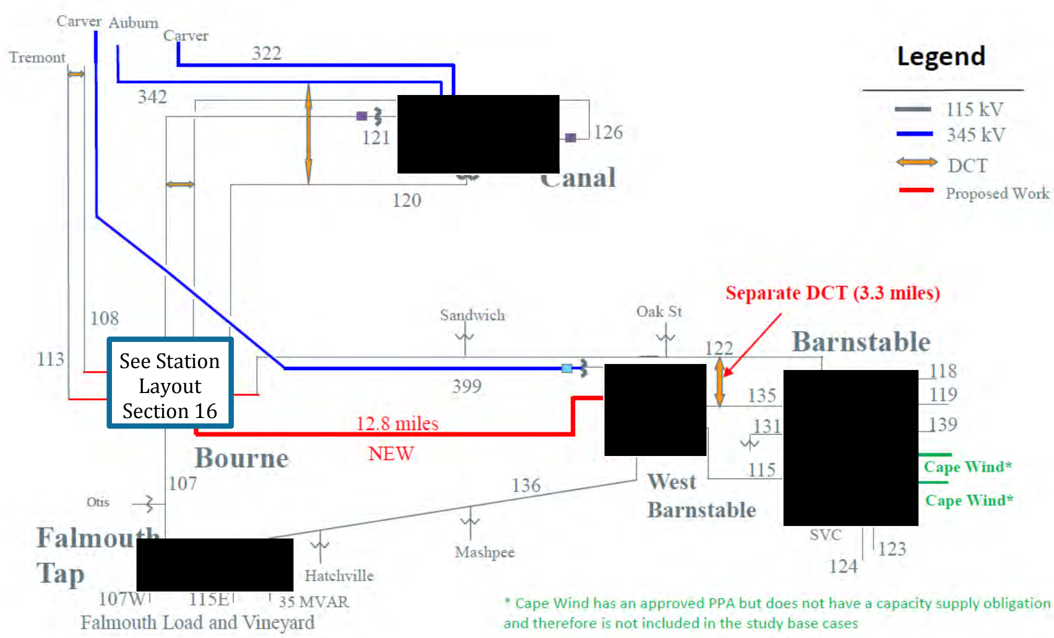

Figure 5-13: Group 6 - Alternative #1

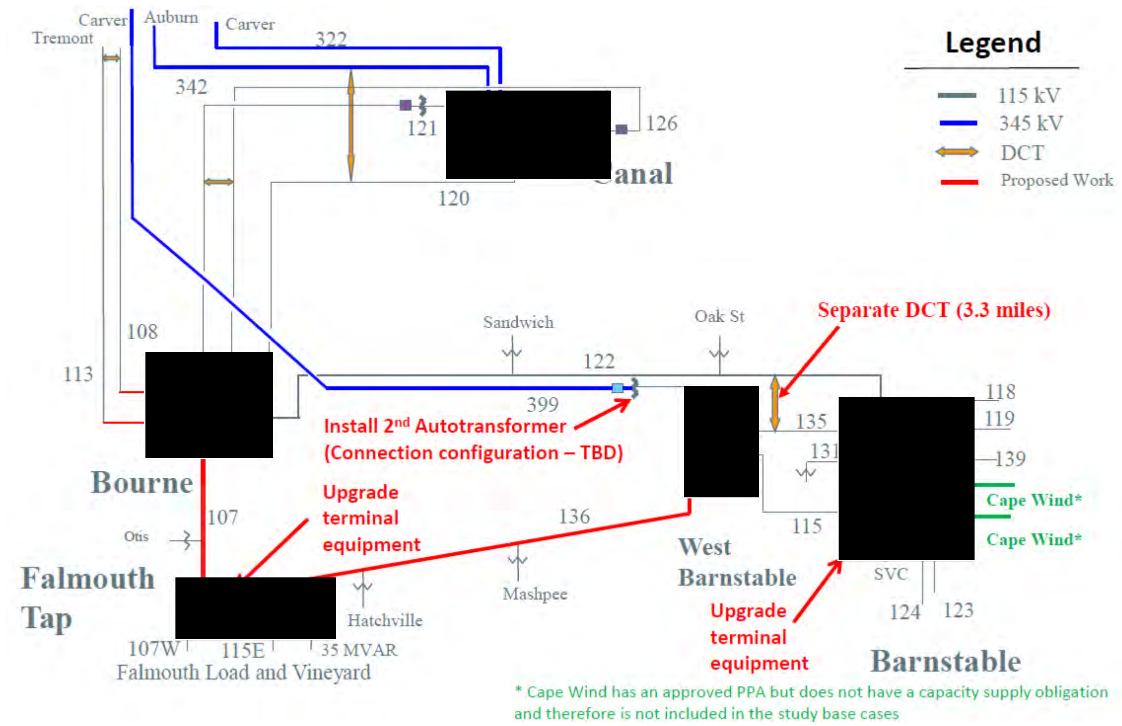

Figure 5-14: Group 6 - Alternative #2

5.3.1 **Boston Area**

A number of time-sensitive needs appeared in the Boston area due to contingencies in the SEMA-RI study area. All of the time-sensitive needs were the result of the loss of the [redacted]. [redacted] and results in overloads of facilities in the Boston area. There are two strategies to solve the time-sensitive needs in the Boston area. One strategy is to eliminate the DCT contingency by splitting the DCT. The other strategy is to increase the capacity of the existing facilities that overload in the Boston area.

The working group developed two new solution alternatives to serve the load pocket.

- Alternative #1– See Figure 5-15
    - Separate the 325 and 344 lines from West Medway to West Walpole (approximately 50 structures)
- Alternative #2– See Figure 5-16
    - Replace the 345A and 345B autotransformers at Kingston
    - Reconductor the 329-531 cable from North Cambridge to Brighton (2.9 miles)
    - Reconductor the 385-512 and 385-513 cables from Kingston to K St (2.3 miles)
    - Reconductor the 385-510 and 385-511 cables from K St to High St to Kingston (2.2 miles)

[redacted]

- Terminal equipment upgrades at Barnstable and Falmouth Tap

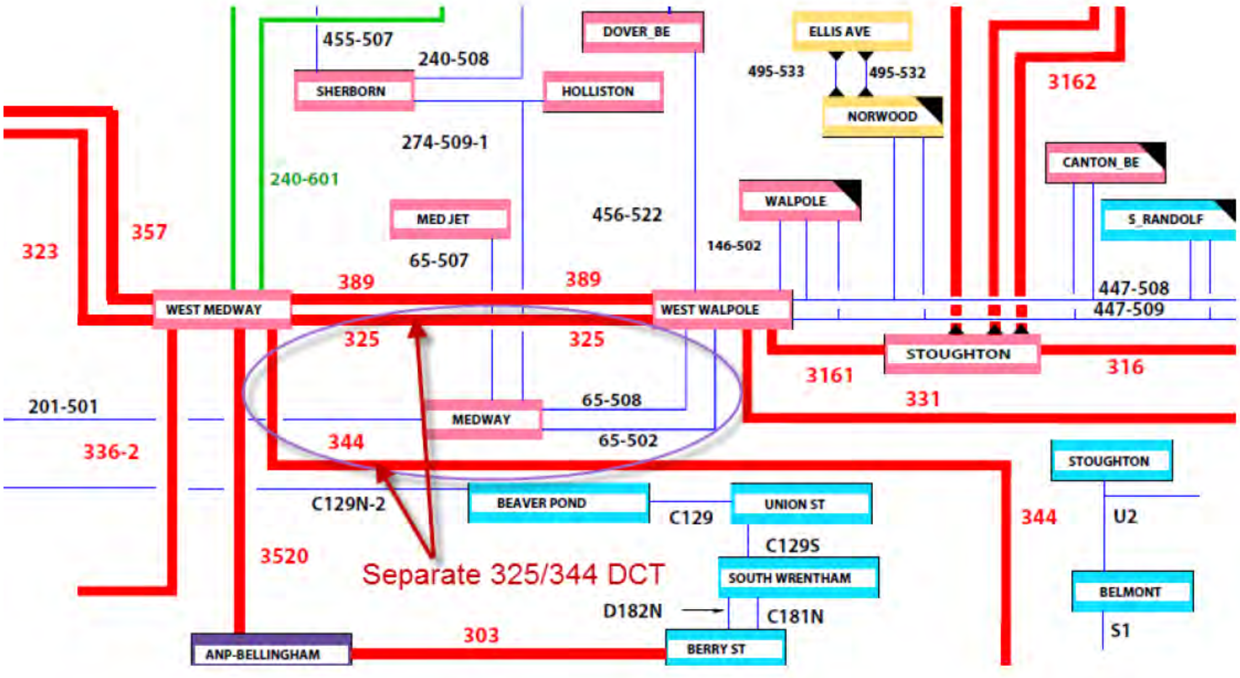

Figure 5-15: Boston Area - Alternative #1

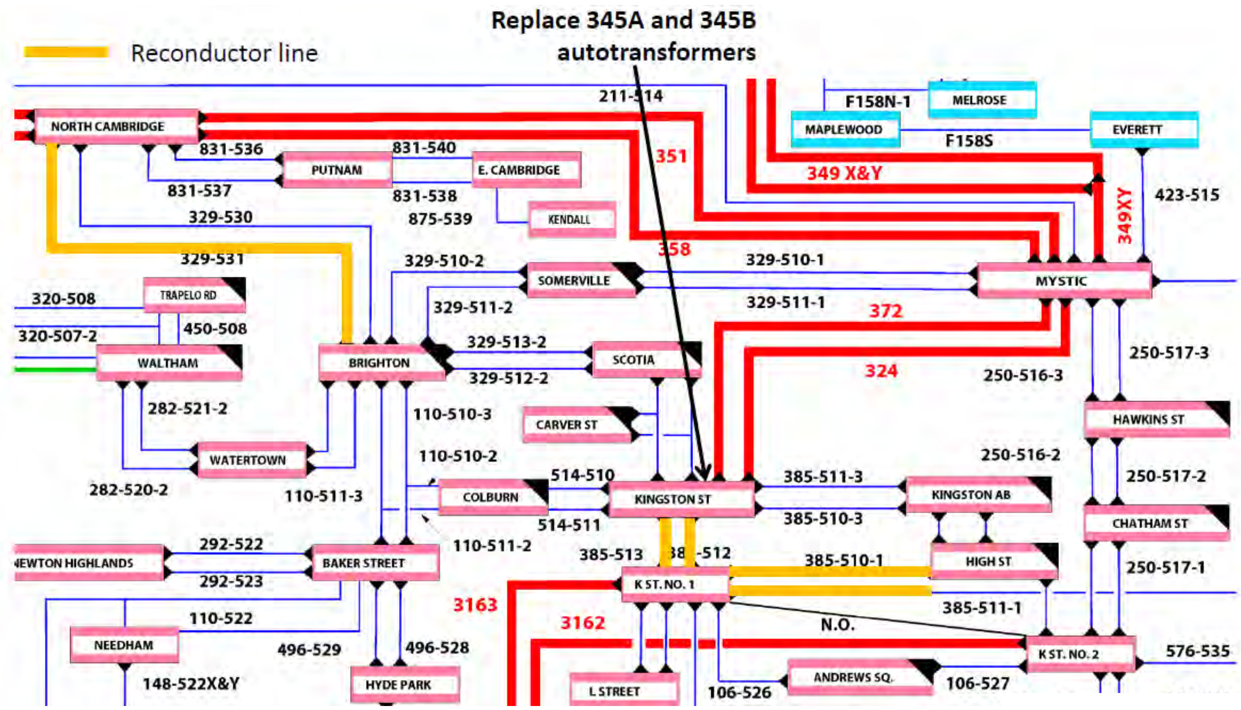

Figure 5-16: Boston Area - Alternative #2

[redacted]

Section 6
Alternative Solution Performance Testing and Results

6.1 Steady State Performance Results

All combinations of solution alternatives resolved the thermal and voltage criteria violations found in the Needs Assessment. A detailed description of the results of the solution alternatives is described in the following sections.

6.1.1 N-0 Thermal and Voltage Performance Summary

There was one time-sensitive N-0 thermal violation identified in the SEMA-RI 2026 Needs Assessment testing. Each transmission solution alternative for each Group was tested against the identified time- sensitive needs, and was augmented until a complete solution package was developed to address the needs identified in the Needs Assessment. As such, the N-0 thermal criterion is fully satisfied with the full combination of each Group's solution alternatives.

6.1.2 N-1 Thermal and Voltage Performance Summary

Each transmission solution alternative for each Group was tested against the identified time-sensitive needs, and was augmented until a complete solution package was developed to address the time-sensitive needs identified in the Needs Assessment. As such, the N-1 thermal and voltage criteria are fully satisfied with the full combination of each Group's solution alternatives.

6.1.3 N-1-1 thermal and Voltage Performance Summary

Each transmission solution alternative for each Group was tested against the identified time-sensitive needs, and was augmented until a complete solution package was developed to address the time-sensitive needs identified in the Needs Assessment. As such, the N-1-1 thermal and voltage criteria are fully satisfied with the full combination of each Group's solution alternatives.

6.2 Stability Performance Results

Not applicable for this study.

6.3 Short Circuit Performance Results

After the solution alternatives were selected, each transmission owner (TO) studied short circuit duties within their service territory. Detailed study reports of the short circuit studies performed by National Grid and Eversource are found in Appendix G: Short Circuit Analysis Results.

6.3.1 Short Circuit Performance Results

All the preferred solution alternatives as shown in Section 7 were used for the short circuit testing and the results are summarized in Table 6-1.

[redacted]

Table 6-1: Preferred Solution Alternatives Short Circuit Study Summary

Station	kV	Over Duty (Above 100%)	High Duty (95.1-100%)	Marginal Duty (90-95.0%)
West Medway	345	--	12 (50 kA)	1 (50 kA)
Medway	115	--	5 (40 kA)	--
Drumrock	115	--	--	5 (40 kA)
Bridgewater	115	--	--	5 (50 kA)

As a result of the short circuit testing, no breakers become over-dutied due to the preferred solution alternatives.

6.4 Other Assessment Performance Results

6.4.1 Special Protection System Screening Test

As described in Section 3.2.13, the study area has several special protection systems (SPS). An assessment was completed on each SPS to ensure if it was still required after the preferred solution was implemented. The same base cases, generator dispatches, and system stresses were tested in the screening study as in the Solutions Study. The results of the test are described for each SPS in the following sections.

6.4.1.1 *Barnstable SPS – NPCC Type III*

The assessment of the Barnstable SPS is shown in Table 6-2.

Table 6-2: Barnstable SPS Evaluation

[redacted]

Based on the results of the analysis, the Barnstable SPS will be retired.

6.4.1.2 *Bellingham Plant #2 (BEL2) SPS – NPCC Type III*

It was determined that preferred solution does not cause a significant change to system topology that would alter the current need for the Bellingham Plant #2 (BEL2) SPS. No change will be made to the current SPS.

6.4.1.3 *Edgar Station SPS – NPCC Type III*

It was determined that preferred solution does not cause a significant change to system topology that would alter the current need for the Edgar Station SPS. No change will be made to the current SPS.

6.4.1.4 *L14/M13 Tiverton SPS – NPCC Type III*

Due to the Tiverton Generator Uprate Project the L14/M13 SPS will be retired.

6.4.1.5 *Stoughton Station SPS – NPCC Type III*

It was determined that preferred solution does not cause a significant change to system topology that would alter the current need for the Stoughton Station SPS. No change will be made to the current SPS.

Section 7
Comparison of Alternative Solutions

7.1 Factors Used to Compare Alternative Solutions

When the estimated cost (+50/-25% accuracy) was similar, the key factors used to compare the solution alternatives included:

- Expected ease of permitting (e.g. environmental, siting, etc.)
- Ease of constructability (during the construction phase)
- Fewer and shorter construction outages (number and length of outages)
- Reduced environmental impact
- Reduced abutter impact
- Overall system performance
- Shorter length of time to construct or earlier expected in-service date (ISD)

The siting issues took into consideration easements along existing rights-of-way (ROW) as well as available space in existing substation. Total cost estimates were used to consider differences between all solution alternatives.

7.2 Cost Estimates and Comparison for Selected Alternative Solutions

All cost estimates were developed consistent with ISO-NE cost estimation procedures as defined in Attachment D of ISO-NE Planning Procedure No. 4.0. All cost estimates in this report were developed with +50/-25% accuracy.

Cost estimates for some proposed solution alternatives were not developed because the scope of work and resulting costs for the solution alternative were determined to be far greater than those of a competing solution alternative. In this case, the solution alternative with the greater scope of work and resulting higher cost was dropped from further consideration.

Cost estimates were developed by the transmission owners (TO) for each solution component and solution components were added together to form solution alternatives for each group. The total cost for each solution alternative was compared against the other solution alternatives in a group. If a solution alternative had a far lower cost than the other solution alternatives, then the lower cost alternative became the preferred solution based on cost. If the cost of the solution alternatives were very close to each other, then the factors shown in Section 7.1 were used to compare the solution alternatives and select the preferred solution. The comparison of non-cost factors is shown in Section 7.3.

7.2.1 Group 1 – Portions of Farnum, West Medway/West Walpole, South Shore, and Somerset/Newport Subareas

Solution Alternative #1 was dropped from consideration because it was cost prohibitive due to the amount of reconductoring and reactive devices required. The remaining solution alternatives for Group 1 are shown below.

Table 7-1: Group 1 Cost Estimates

[redacted]

ID	Solution Components	Solution Alternatives Reported in $M at +50/-25% Accuracy	
		Alt #2	Alt #3
1	Grand Army 115 kV GIS switching station and loop the E-183E, F-184, X3 and W4 lines	43.8	
2	Upgrades at Brayton Point (new 115 kV breaker, new 345/115 kV transformer and upgrades to E183E, F184 station equipment)	13.1	
3	Increase clearances on E-183E & F-184 lines between Brayton Point & Grand Army (~1.5 miles each)	3.4	
4	Separate X3/W4 DCT and reconductor X3, W4 lines between Somerset and Grand Army (~2.7 miles each). Reconfigure Y2 and Z1	14.6	
5	Install 2 new OH 115 kV lines between Brayton Point and Somerset (~3.7 miles each). Relocate F-184, E-183E and D-182S to make space in ROW for new lines		52.6
6	Upgrades at Brayton Point substation (new 345/115 kV XFMR, new 115 kV breaker and station work to accommodate two new lines)		19.9
7	Upgrades at Somerset substation to accommodate two new lines		2.8
8	Robinson Ave 115 kV circuit breaker addition and re-terminate Q10 line	2.0	2.0
9	Install 45.0 MVAR capacitor bank at Berry Street	1.6	1.6
	Group 1 Solution Alternative Total in $M	**78.5**	**78.9**

Since the cost for both solution alternatives are very close to each other, the factors shown in Section 7.1 were used to compare the solution alternatives and select the preferred solution. Further discussion is provided in Section 7.3.1.

7.2.2 Group 2 – Portions of Industrial Park and Somerset/Newport Subareas

As discussed in Section 5.3.2, the combination of Alternative #2 and #3 is not feasible and the combinations of Alternative #2 and #4 and Alternative #3 and #4 are the same from an electrical performance and cost standpoint. These combinations are shown as Alt #2/#3 & Alt #4 in the table below. The remaining solution four alternatives for Group 2 are shown below.

Table 7-2: Group 2 Cost Estimates

ID	Solution Components	Solution Alternatives Reported in $M at +50/-25% Accuracy			
		Alt #1 & Alt #2	Alt #1 & Alt #3	Alt #1 & Alt #4	Alt #2/#3 & Alt #4
1	Install a new line from Bristol substation to a new switching station named Boyd's Lane in Portsmouth, RI (approximately 5.0 miles) Includes cost for Horizontal Directional Drilling (HDD) submarine cable across Mt. Hope Bay	70.4	70.4	70.4	
2	Bristol station upgrades and add new 115 kV breaker	5.5	5.5	5.5	
3	Install new 115 kV station with a 5 breaker ring at Boyd's Lane in Portsmouth, RI. Terminate new 115 kV line & loop L14/M13 in/out of the station	14.4	14.4	14.4	
4	Reconductor F-184 115 kV line from Merriman Junction to Warren to Bristol (5.1 miles)	12.0	12.0	12.0	
5	Separate N12/M13 DCT & reconductor N12 & M13 between Somerset and Bell Rock (~3.5 miles)	39.0			39.0
6	Install new 115 kV line (UG-1.7 mi and OH-1.8 mi) between Somerset and Bell Rock (~3.5 miles). Add circuit breaker at Somerset for new line[36]		47.0		
7	Install new breaker in series with the N12/D21 tie breaker and upgrade the D21 Line switch upgrade at Bell Rock				0.6
8	Reconductor N12 & M13 (No DCT Split) between Somerset and Bell Rock (~3.5 miles)			10.3	
9	Install a third breaker in a bay to terminate Line 114 at Bell Rock			1.0	1.0
10	Extend Line 114 – Eversource/NGRID border to Bell Rock (~4.2 miles)			12.3	12.3
11	Extend Line 114 – Industrial Park Tap to Eversource/NGrid border (~7.9 miles)			16.2	16.2
12	Install capacitors at Bell Rock, High Hill and Wing Lane			4.3	4.3
13	Reconfigure Bell Rock to breaker and a half station and split M13	16.0	16.0	16.0	16.0

[36] Due to space limitations in the right of way, a portion of the new line will need to be constructed underground

	line at Bell Rock				
14	Reconductor the 108-4 line from Bourne to the Horse Pond Tap (1.9 miles)	0.9	0.9	0.9	0.9
15	Reconductor the M13 and L14 line from Bell Rock to the Bates St Tap (8.3 miles)	29.2	29.2	29.2	29.2
16	Reconductor the 112 line from Tremont to the Industrial Park Tap (10.3 miles)	4.8	4.8	4.8	4.8
17	Replace wave trap on 114 line at Tremont	0.2	0.2	0.2	0.2
	Group 2 Solution Alternative Total in $M	**192.4**	**200.4**	**197.5**	**124.5**

When comparing the cost of all four combinations, the Alternative #2/#3 and Alternative #4 cost is $67.9M lower than the next cheapest combination (Alternative #1 and Alternative #2). Due to the large gap in cost between the solution alternatives, Alternative #2/#3 and Alternative #4 is selected as the preferred solution.[37]

7.2.3 Group 3 – Portion of Farnum Subarea

Only one solution component was developed in Group 3 and therefore it becomes the preferred solution for Group 3.

Table 7-3: Group 3 Cost Estimate

ID	Solution Components	Solution Alternatives Reported in $M at +50/-25% Accuracy
1	Replace Kent County T3 345/115 kV transformer	8.1
	Group 3 Preferred Solution Total in $M	**8.1**

7.2.4 Group 4 – Portion of West Medway/West Walpole Subarea

Solution Alternative #2 was dropped from consideration because it was cost prohibitive due to the amount of reconductoring and reactive devices required. The remaining solution alternative for Group 4 is shown below. Since only one solution alternative remains for Group 4, it becomes the preferred solution for Group 4.

[37] National Grid is considering construction of Alternative #1 rather than the preferred solution. https://www.iso-ne.com/static-assets/documents/2016/12/a3_sema_ri_ngrid_presenattion.pdf. The regionalization of the additional costs for construction of Alternative #1 would not be supported by ISO New England. https://smd.iso-ne.com/operations-services/ceii/pac/2016/12/a3_sema_ri_2026_preliminary_preferred_solutions.pdf

[redacted]

Table 7-4: Group 4 Cost Estimates

ID	Solution Components	Solution Alternatives Reported in $M at +50/-25% Accuracy
1	Loop 201-502 line into the Medway station to form the 201-502N and 201-502S lines	7.8
2	Rerate the Eversource portion of the 323 line from Millbury #3 to West Medway by replacing the West Medway substation disconnect switches 107A, 107B, 108A and 108B with 3000A disconnects	0.2
	Group 4 Preferred Solution Total in $M	**8.0**

7.2.5 Group 5 – Portion of South Shore Subarea

All four solution alternatives for Group 5 are shown below.

Table 7-5: Group 5 Cost Estimates

ID	Solution Components	Solution Alternatives Reported in $M at +50/-25% Accuracy			
		Alt #1	Alt #2	Alt #3	Alt #4
1	Reconductor the 117 line from Brook St to Kingston (3.1 miles)[38]	4.7			4.7
2	Reconductor the 191 line from Auburn to Kingston (15.3 miles)[32]	22.9			
3	Install new line from Carver to Kingston (approximately 8.0 mile)		19.6		
4	Install a bay position at Kingston for new line from Carver[39]		2.7	2.7	
5	Install new line from Manomet to Kingston (approximately 6.0 miles new, 9.2 miles existing)[40]			20.8	

[38] Cost estimate for the replacement of terminal equipment at Kingston is included in the cost estimate for the line work terminating at the Kingston station.

[39] The work is in addition to asset condition and local load reliability need work to be done at Kingston for approximately $13.0M.

[40] Cost estimate for the installation of breakers at Manomet is included in the cost of the new line terminating at Manomet

[redacted]

6	Install a parallel line from Brook St to Carver (4.9 miles) which requires station work and an underground getaway of the new line at Brook Street				19.6
7	Rebuild the Middelborough Gas and Electric (MGE) portion of E1 line from Bridgewater to Middleboro (2.5 miles)[41]	2.9	2.9	2.9	2.9
	Group 5 Solution Alternative Total in $M	**30.5**	**25.2**	**26.4**	**27.2**

Since the cost for the four solution alternatives are very close to each other, the factors shown in Section 7.1 were used to compare the solution alternatives and select the preferred solution. Further discussion is provided in Section 7.3.2.

7.2.6 Group 6 – Cape Cod Subarea

The two solution alternatives for Group 5 are shown below.

Table 7-6: Group 6 Cost Estimates

ID	Solution Components	Solution Alternative #1 Reported in $M at +50/-25% Accuracy	Solution Alternative #2 Reported in $M at +50/-25% Accuracy
1	Install a new line from Bourne to West Barnstable (approximately 13.0 miles) which requires terminal work at West Barnstable and Bourne	36.0	
4	Separate the 122 and 135 line DCT	7.4	7.4
5	Retire the Barnstable SPS	0.2	0.2
6	Reconductor/rebuild the 107 line from Bourne to Falmouth Tap (10.0 miles)		17.4
7	Reconductor/rebuild the 136 line (formerly the 115 line) from Falmouth Tap to West Barnstable (16.5 miles)		16.4
8	Reconductor/rebuild the 122 line from Bourne to Barnstable (16.6 miles)		14.3
10	Terminal equipment and switch upgrades at		3.2

[41] The E1 line was shown as a need in the Needs Assessment but this work was not listed in the Southeastern Massachusetts and Rhode Island (SEMA-RI) 2026 Solutions Study Update PAC presentation delivered in July 2016

[redacted]

	Barnstable and Falmouth Tap		
	Group 6 Solution Alternative Totals in $M	**43.6**	**58.9**

Due to the large gap in cost between the solution alternatives, Alternative #1 is selected as the preferred solution. A comparison of the factors shown in Section 7.1 and is also provided in Section7.3.3 Group 6 Comparison Matrixto be consistent with the December 2016 presentation to the Planning Advisory Committee.[42] The ISO received the comparison information from the Transmission Owner and unnecessarily included it in the presentation. The results of the comparison exercise were not used in the preferred solution determination due to the large cost differential between the solution alternatives.

7.2.7 Boston Area

Solution Alternative #2 was dropped from consideration because it was cost prohibitive due to the amount of reconductoring and new autotransformers required. The remaining solution alternative for the Boston area is shown below. Since only one solution alternative remains for the Boston area, it becomes the preferred solution for the Boston area.

Table 7-7: Boston Area Cost Estimate

ID	Solution Components	Solution Alternatives Reported in $M at +50/-25% Accuracy
1	Separate the 325 and 344 lines from West Medway to West Walpole (approximately 50 structures)	17.9
	Boston Area Preferred Solution Total in $M	**17.9**

7.3 Comparison Matrix of Alternative Solutions

The primary factor in selecting the preferred solution was cost. Other factors included expected ease of permitting, ease of constructability, fewer and shorter construction outages reduced environmental impact, better system performance, and reduced abutter impact. The comparison matrix was used for Groups 1 and 5. A check mark ✓ in the matrix is applied to the alternative which better achieves the objective and an x mark ✗ in the matrix is applied to the alternative which does not achieve the objective as well as the other alternative.

7.3.1 Group 1 Comparison Matrix

To recap, Alternative #2 is the Grand Army solution alternative and Alternative #3 is the solution alternative which installs two new 115 kV lines from Brayton Point to Somerset.

[42] https://smd.iso-ne.com/operations-services/ceii/pac/2016/12/a3_sema_ri_2026_preliminary_preferred_solutions.pdf

Table 7-8: Group 1 Comparison Matrix

Key Factors	Alt #2	Alt #3
Overall System Performance	The overall system performance for these two alternatives is equivalent	
Expected ease of permitting	✓	✗
Ease of constructability	✓	✗
Fewer and shorter construction outages	✓	✗
Shorter length of time to construct	✓	✗
Reduced environmental impact	✓	✗
Reduced abutter impact	✓	✗
Preferred Solution	✓	✗

Based on the expected ease of permitting, ease of constructability, fewer and shorter construction outages, shorter length of time to construct, reduced environmental impact and reduced abutter impact, Alternative #2 is the preferred solution.

7.3.2 Group 5 Comparison Matrix

To recap, Alternative #1 reconductors the 117 (Brook Street to Kingston) and 191 (Auburn to Kingston) lines, Alternative #2 installs a new line from Carver to Kingston, Alternative #3 installs a new line from Manomet to Kingston, and Alternative #4 installs a parallel line from Brook Street to Carver.

Table 7-9: Group 5 Comparison Matrix

Key Factors	Alt #1	Alt #2	Alt #3	Alt #4
Cost	✗	✓	✗	✗
Overall System Performance	✗	✓	✗	✗
Expected ease of permitting	✓	✗	✗	✗
Ease of constructability	✗	✓	✗	✗
Fewer and shorter construction outages	✗	✓	✗	✗
Shorter length of time to construct	✗	✓	✗	✗
Reduced environmental impact	✗	✗	✗	✓
Reduced abutter impact	✗	✗	✗	✓
Preferred Solution	✗	✓	✗	✗

Based on the cost, overall system performance, ease of constructability, fewer and shorter construction outages, and shorter length of time to construct, Alternative #2 is the preferred solution.

7.3.3 Group 6 Comparison Matrix

To recap, Alternative #1 installs a new line from Bourne to West Barnstable and Alternative #2 reconductors the 107 (Bourne to Falmouth Tap), 136 (Falmouth Tap to West Barnstable), and the 122 (Bourne to Barnstable) lines. Due to the large gap in cost between the solution alternatives, Alternative #1 is selected as the preferred solution.

Section 8
Conclusion

Comparison of solutions alternatives was based on the estimated cost and in some cases on other key factors like the overall system performance, expected ease of permitting, ease of constructability, fewer and shorter construction outages, shorter length of time to construct, reduced environmental impact and reduced abutter impact. The preferred solution alternatives to resolve the time-sensitive criteria violations found in the 10-year planning horizon are:

- Alternative #2 from Group 1
- Alternative #2/#3 and Alternative #4 from Group 2
- Replace Kent County T3 345/115 kV transformer from Group 3
- Alternative #1 from Group 4
- Alternative #2 from Group 5
- Alternative #1 from Group 6
- Alternative #1 from the Boston Area

8.1 Recommended Solution Description

The summation of all of the preferred solution alternatives is comprised of several solution components as described in Table 8-1. A more detailed description for each solution component can be found in Section 5.3 and the station one line diagrams of the preferred solution components can be found in Section 16, Appendix H.

Table 8-1: SEMA-RI Solution Components

ID	Solution Components
1	Grand Army 115 kV GIS switching station and loop the E-183E, F-184, X3 and W4 lines
2	Upgrades at Brayton Point (new 115 kV breaker, new 345/115 kV transformer and upgrades to E183E, F184 station equipment)
3	Increase clearances on E-183E & F-184 lines between Brayton Point & Grand Army (~1.5 miles each)
4	Separate X3/W4 DCT and reconductor X3, W4 lines between Somerset and Grand Army (~2.7 miles each).
5	Robinson Ave 115 kV circuit breaker addition and re-terminate Q10 line
6	Install 45.0 MVAR capacitor bank at Berry Street
7	Separate N12/M13 DCT & reconductor N12 & M13 between Somerset and Bell Rock (~3.5 miles)
8	Install new breaker in series with the N12/D21 tie breaker and upgrade the D21 Line switch upgrade at Bell Rock
9	Install a third breaker in a bay to terminate Line 114 at Bell Rock
10	Extend Line 114 – Eversource/NGRID border to Bell Rock (~4.2 miles)
11	Extend Line 114 – Industrial Park Tap to Eversource/NGrid border (~7.9 miles)
12	Install capacitors at Bell Rock (37.5 MVAR), High Hill (35.3 MVAR) and Wing Lane (35.3 MVAR)

[redacted]

13	Reconfigure Bell Rock to breaker and a half station and split M13 line at Bell Rock
14	Reconductor the 108-4 line from Bourne to the Horse Pond Tap (1.9 miles)
15	Reconductor the M13 and L14 line from Bell Rock to the Bates St Tap (8.3 miles)
16	Reconductor the 112 line from Tremont to the Industrial Park Tap (10.3 miles)
17	Replace wave trap on 114 line at Tremont
18	Replace Kent County T3 345/115 kV transformer
19	Loop 201-502 line into the Medway station to form the 201-502N and 201-502S lines
20	Rerate the Eversource portion of the 323 line from Millbury #3 to West Medway by replacing the West Medway substation disconnect switches 107A, 107B, 108A and 108B with 3000A disconnects
21	Install new line from Carver to Kingston (approximately 8.0 mile)
22	Install a bay position at Kingston for new line from Carver
23	Rebuild the Middelborough Gas and Electric Department (MGED) portion of E1 line from Bridgewater to Middleboro (2.5 miles)
24	Install a new line from Bourne to West Barnstable (approximately 13.0 miles) which requires terminal work at West Barnstable and Bourne
25	Separate the 122 and 135 line DCT
26	Retire the Barnstable SPS
27	Separate the 325 and 344 lines from West Medway to West Walpole (approximately 50 structures)

Table 8.2 shows the cost estimate for the preferred solution alternative for each group and the total SEMA-RI preferred solution cost.

Table 8-2: Preferred Solution Cost Summary

Group	Cost Estimate Reported in $M at +50/-25% Accuracy
Group 1 – Alternative #2	78.5
Group 2 – Alternatives #2 and #4	124.5
Group 3 - Kent County T3 345/115 kV transformer replacement	8.1
Group 4 – Alternative #1	8.0
Group 5 – Alternative #2	25.2
Group 6 – Alternative #1	43.6
Boston Area – Alternative #1	17.9
Preferred Solution Total in $M	**305.8**

8.2 Solution Component Year of Need

As discussed in Section 2.3 and in greater detail in Section 9, the findings of the Needs Assessment show that the majority of violations occur in today's system or earlier. Currently operations postures the system by generation re-dispatch and other system adjustments to prevent violations. The projected in-service date of all solution components is by the end of 2021.

[redacted]

8.3 Schedule for Implementation, Lead Times and Documentation of Continuing Need

In accordance with NERC TPL Standards, this assessment provides:

- A written summary of plans to address the time-sensitive system performance issues described in the *Southeastern Massachusetts and Rhode Island Area 2026 Needs Assessment*, dated May 2016[43] and the *Addendum Analysis Report to the Southeastern Massachusetts and Rhode Island Area 2026 Needs Assessment*, dated October 2016[44]
- A schedule for implementation as described below
- A discussion of expected required in-service dates of facilities and associated load level when required as described below
- A discussion of lead times necessary to implement plans.

The planned completion date of the preferred solution, as described in Section 8.1, is 2021. With this schedule, the preferred solution will be in-service after the potential violations of the NERC Standards occur. Currently, system operators posture the system by generation re-dispatch and other system adjustments to prevent these violations. While these steps prevent violations of NERC operating criteria, they are not sufficient to address the requirements of NERC planning criteria. The longest lead time item required to complete the project is the Kent County 345/115 kV autotransformer with a projected lead time of eighteen months.

[43] https://smd.iso-ne.com/operations-services/ceii/pac/2016/05/final_sema_ri_needs_assessment_report.pdf

[44] https://smd.iso-ne.com/operations-services/ceii/pac/2016/10/sema_ri_needs_assessment_addendum_v3.pdf

[redacted]

Section 9
Appendix A: Year of Need/Critical Load Level Results

Table 9-1: SEMA-RI Time-Sensitive Thermal Needs

Solutions Study Group	Needs Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
3	**Farnum**	**Kent County 3X**	Kent County 3X 345/115 kV Autotransformer	26,158	Prior to 2016
3	**Farnum**	**L190-4**	Tower Hill to West Kingston 115 kV Line	27,280	Prior to 2016
3	**Farnum**	**L190-5**	Tower Hill to Davisville Tap 115 kV Line	25,537	Prior to 2016
1	**Farnum**	**V148S-1**	V148 Tap to Washington RI 115 kV Line	16,388	Prior to 2016
1	**Farnum**	**H17-1**	West Farnum to Farnum Tap 115 kV Line	24,960	Prior to 2016
1	**Farnum**	**H17-2**	Riverside to Farnum Tap 115 kV Line	23,141	Prior to 2016
1	**Farnum**	**R9**	Riverside to Valley 115 kV Line	16,130	Prior to 2016
1	**Farnum**	**Valley P11/R9 Bus Tie**	Valley 205 115 kV Bus Equipment	19,682	Prior to 2016
1	**Farnum**	**J16S**	Staples to Highland Drive 115 kV Line	23,792	Prior to 2016
1	**Farnum**	**P11-1**	Pawtucket to P11 Tap 115 kV Line	24,791	Prior to 2016
1	**Farnum**	**P11-2**	Valley to P11 Tap 115 kV Line	19,527	Prior to 2016
1	**Farnum**	**P11-3**	Robinson Ave to P11 Tap 115 kV Line	23,922	Prior to 2016
1	**Farnum**	**Q10**	Robinson Ave to Staples 115 kV Line	27,990	2016
3	**Farnum**	**West Farnum 175T**	West Farnum 345/115 kV Transformer	28,083	2016

[redacted]

REDACTED

Solutions Study Group	Needs Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
3	**Farnum**	**1870**	Kenyon to Wood River 115 kV Line	20,993	Prior to 2016
3	**Farnum**	**1870S**	Wood River to Chase Hill 115 kV Line	24,871	Prior to 2016
3	**Farnum**	**1870S-1**	Chase Hill to Shunock 115 kV Line	28,740	2018
4	**West Medway/ West Walpole**	**323 (Eversource)**	West Medway to Millbury 345 kV Line	28,929	2018
4	**West Medway/West Walpole**	**C-129N-1**	Millbury to Purchase Tap 115 kV Line Section	26,501	Prior to 2016
4	**West Medway/ West Walpole**	**C-129N-6**	Rocky Hill to Purchase Tap 115 kV Line Section	28,669	2017
5	**South Shore**	**191**	Kingston to Auburn 115 kV Line	27,720	2016
5	**South Shore**	**117**	Kingston to Brook St 115 kV Line	28,444	2017
1	**South Shore**	**F19-2**	Auburn St to Belmont Tap 115 kV Line Section	27,913	2016
5	**South Shore**	**E1**	Bridgewater to Middleboro 115 kV Line	28,646	2017
1	**South Shore**	**C2**	Dupont to Auburn St 115 kV Line	27,433	Prior to 2016
1	**South Shore**	**L1**	East Bridgewater to East Bridgewater Tap 115 kV Line Section	27,162	Prior to 2016
2	**Industrial Park**	**111-1**	High Hill to Industrial Park 115 kV Line Section	17,961	Prior to 2016
2	**Industrial Park**	**112-1**	Tremont to Rochester 115 kV Line Section	14,976	Prior to 2016
2	**Industrial Park**	**112-2**	Rochester to Crystal Spring Tap 115 kV Line Section	10,063	Prior to 2016
2	**Industrial Park**	**112-3**	Industrial Park to Crystal Spring Tap 115 kV Line Section	10,270	Prior to 2016
2	**Industrial Park**	**112-4**	Industrial Park to Industrial Park Tap 115 kV Line Section	17,025	Prior to 2016

[redacted]

REDACTED

Solutions Study Group	Needs Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
2	**Industrial Park**	**114-1**	Tremont to Rochester 115 kV Line Section	26,310	Prior to 2016
1	**Somerset/Newport**	**F184-3**	Mink St to Read St 115 kV Line Section	19,181	Prior to 2016
1	**Somerset/ Newport**	**S8-1**	Somerset to S8 Tap 115 kV Line Section	24,471	Prior to 2016
1	**Somerset/ Newport**	**S8-2**	Raynham to S8 Tap 115 kV Line Section	23,572	Prior to 2016
1	**Somerset/ Newport**	**S8-4**	Bridgewater to Raynham 115 kV Line Section	22,645	Prior to 2016
1	**Somerset/ Newport**	**V5-1**	Somerset to Dighton 115 kV Line Section	29,124	2018
1	**Somerset/ Newport**	**V5-2**	Dighton to V5 Tap 115 kV Line Section	27,802	2016
1	**Somerset/ Newport**	**V5-3**	Bridgewater to V5 Tap 115 kV Line Section	25,909	Prior to 2016
2	**Somerset/ Newport**	**N12-1**	Somerset to Sykes Rd 115 kV Line Section	25,159	Prior to 2016
2	**Somerset/ Newport**	**N12-2**	Sykes Rd to Bell Rock 115 kV Line Section	25,524	Prior to 2016
2	**Somerset/ Newport**	**D21**	Bell Rock to High Hill 115 kV Line	28,656	2017
1	**Somerset/ Newport**	**U6-1**	Somerset to Dighton 115 kV Line Section	23,207	Prior to 2016
1	**Somerset/ Newport**	**U6-3**	Dighton to Dighton Tap 115 kV Line Section	23,214	Prior to 2016
1	**Somerset/Newport**	**K15**	Swansea to Robinson Ave 115 kV Line	27,888	2016
2	**Somerset/ Newport**	**M13-3**	Bent Rd to Tiverton Tap 115 kV Line Section	25,864	Prior to 2016
2	**Somerset/ Newport**	**M13-4**	Somerset to Sykes Rd 115 kV Line Section	15,095	Prior to 2016
2	**Somerset/ Newport**	**M13-5**	Tiverton Tap to EMI Tiverton Tap 115 kV Line Section	19,699	Prior to 2016
2	**Somerset/ Newport**	**M13-6**	EMI Tiverton Tap to EMI Tiverton 115 kV Line Section	17,812	Prior to 2016
2	**Somerset/**	**M13-7**	Canonicus to Dexter	27,059	Prior to

Solutions Study Group	Needs Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
	Newport		115 kV Line Section		2016
2	**Somerset/ Newport**	**M13-8**	Sykes Rd to Tiverton Tap 115 kV Line Section	16,457	Prior to 2016
2	**Somerset/ Newport**	**L14-3**	Bent Rd to Tiverton Tap 115 kV Line Section	22,277	Prior to 2016
2	**Somerset/ Newport**	**L14-4**	Bell Rock to Tiverton Tap 115 kV Line Section	21,799	Prior to 2016
2	**Somerset/ Newport**	**L14-5**	Tiverton Tap to EMI Tiverton Tap 115 kV Line Section	15,373	Prior to 2016
2	**Somerset/ Newport**	**L14-6**	EMI Tiverton Tap to EMI Tiverton 115 kV Line Section	12,216	Prior to 2016
2	**Somerset/ Newport**	**L14-7**	Canonicus to Dexter 115 kV Line Section	19,303	Prior to 2016
6	**Cape Cod**	**108-4**	Bourne to Horse Pond Tap 115 kV Line	28,108	2016
Boston	**Boston**	**Kingston 345A**	Kingston 345A 345/115 kV Autotransformer	25,464	Prior to 2016
Boston	**Boston**	**Kingston 345B**	Kingston 345B 345/115 kV Autotransformer	24,748	Prior to 2016
Boston	**Boston**	**329-531**	Brighton to North Cambridge 115 kV Line	28,392	2016
Boston	**Boston**	**385-512**	Kingston St to K Street 1 115 kV Line	23,292	Prior to 2016
Boston	**Boston**	**385-513**	Kingston St to K Street 1 115 kV Line	23,292	Prior to 2016
Boston	**Boston**	**385-510-1**	High St to K Street 1 115 kV Line Section	24,019	Prior to 2016
Boston	**Boston**	**385-510-2**	Kingston St to High St 115 kV Line Section	21,917	Prior to 2016
Boston	**Boston**	**385-511-1**	High St to K Street 2 115 kV Line Section	24,019	Prior to 2016
Boston	**Boston**	**385-511-2**	Kingston St to High St 115 kV Line Section	21,946	Prior to 2016

REDACTED

Table 9-2: SEMA-RI Time-Sensitive Voltage Needs

Solutions Study Group	Needs Subarea	Bus Name	Base kV	Critical Load Level (MW)	Year of Need
1	Farnum	Highland Drive	115	27,243	Prior to 2016
1	Farnum	Riverside	115	27,192	Prior to 2016
1	Farnum	Robinson Avenue	115	27,628	Prior to 2016
1	Farnum	Staples	115	27,327	Prior to 2016
1	Farnum	Valley	115	27,033	Prior to 2016
3	Farnum	Drumrock	115	28,647	2017
3	Farnum	Kenyon	115	25,264	Prior to 2016
3	Farnum	Wood River	115	22,901	Prior to 2016
3	Farnum	West Kingston	115	28,539	2017
4	West Medway/ West Walpole	Beaver Pond	115	27,947	2016
4	West Medway/ West Walpole	Depot Street	115	28,047	2016
4	West Medway/ West Walpole	Purchase Street	115	28,483	2017
4	West Medway/ West Walpole	Rocky Hill	115	28,199	2017
4	West Medway/ West Walpole	Union Street	115	27,913	2016
5	South Shore	Brook Street	115	27,546	Prior to 2016
5	South Shore	Kingston	115	27,950	2016
2	Industrial Park	High Hill	115	28,198	2016
2	Industrial Park	Industrial Park	115	15,279	Prior to 2016
2	Industrial Park	Tremont	115	27,624	Prior to 2016
2	Industrial Park	Acushnet	115	15,415	Prior to 2016
2	Industrial Park	SEMASS	115	27,974	2016
2	Somerset/ Newport	Bell Rock	115	16,827	Prior to 2016

[redacted]

Solutions Study Group	Needs Subarea	Bus Name	Base kV	Critical Load Level (MW)	Year of Need
2	**Somerset/ Newport**	**Canonicus**	115	16,713	Prior to 2016
2	**Somerset/ Newport**	**Dexter**	115	16,719	Prior to 2016
2	**Somerset/ Newport**	**Jepson**	115	17,126	Prior to 2016
2	**Somerset/ Newport**	**Tiverton**	115	16,205	Prior to 2016
1	**Somerset/ Newport**	**Mink Street**	115	27,637	Prior to 2016
1	**Somerset/ Newport**	**Dighton**	115	28,604	2017
1, 2	**Somerset/ Newport**	**Somerset**	115	27,579	Prior to 2016
2	**Somerset/ Newport**	**Sykes Road**	115	27,380	Prior to 2016
1	**Somerset/ Newport**	**Swansea**	115	26,368	Prior to 2016
1	**Somerset/ Newport**	**Pawtucket**	115	25,865	Prior to 2016
1	**Somerset/ Newport**	**Phillipdale**	115	25,988	Prior to 2016
1	**Somerset/Newport**	**Wampanoag**	115	27,462	Prior to 2016
6	**Cape Cod**	**Valley_NB**	115	29,093	2018
6	**Cape Cod**	**Wareham**	115	28,261	2017

Table 9-3: SEMA-RI Time-Sensitive Non-Convergence Needs

Solutions Study Group	Element OOS	Contingency	Critical Load Level (MW)	Year of Need
6	[redacted]		29,189	2018
			29,189	2018
6			29,189	2018
			29,189	2018

REDACTED

Solutions Study Group	Element OOS	Contingency	Critical Load Level (MW)	Year of Need
6	[redacted]		29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
6	[redacted]		29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018
			29,189	2018

REDACTED

Table 9-4: SEMA-RI Thermal Needs Determined to be Not Time-Sensitive

Needs Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
Farnum	**V148S-3**	V148 Tap to Washington RI 115 kV Line Section	29,568	2021
Farnum	**V148N**	Washington to Woonsocket 115 kV Line	29,346	2019
Farnum	**G185N**	Drumrock to Kent County 115 kV Line	29,750	2023
Farnum	**K189**	Drumrock to Kent County 115 kV Line	29,723	2022
West Medway/ West Walpole	**323 (NGrid)**	Millbury to West Medway 345 Line kV	29,346	2019
West Medway/ West Walpole	**325**	West Medway to West Walpole 345 kV Line	29,346	2019
West Medway/ West Walpole	**357 (Eversource)**	West Medway to Millbury 345 kV Line	29,349	2019
West Medway/ West Walpole	**389**	West Medway to West Walpole 345 kV Line	29,346	2019
West Medway/ West Walpole	**331 (Eversource)**	West Walpole to Carver 345 kV Line	29,346	2019
South Shore	**451-536**	Holbrook to East Holbrook Tap 115 kV Line	29,729	2022
South Shore	**Bridgewater 162X**	Bridgewater 345/115 kV Autotransformer	30,021	2024
South Shore	**E20-2**	Auburn St to East Bridgewater Tap 115 kV Line Section	29,897	2024
Somerset/ Newport	**L14-1**	Bent Rd to Canonicus 115 kV Line Section	30,000	2024
Cape Cod	**120W**	Bourne to Canal 115 kV Line	30,307	2026
Boston (External)	**324**	Mystic to Kingston 345 kV Line	29,346	2019
Boston (External)	**372**	Mystic to Kingston 345 kV Line	29,346	2019
Boston (External)	**329-530**	Brighton to Blair Pond 115 kV Line	29,346	2019

[redacted]

Needs Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
Boston (External)	**509-530**	North Cambridge to Blair Pond 115 kV Line	29,346	2019

Table 9-5: SEMA-RI Voltage Needs Determined to be Not Time-Sensitive

Needs Subarea	Bus Name	Base kV	Critical Load Level (MW)	Year of Need
South Shore	**Middleboro**	115	30,228	2025
South Shore	**East Bridgewater**	115	29,215	2019
South Shore	**Mill Street**	115	29,346	2019
South Shore	**Church Hill**	115	29,346	2019
South Shore	**Edgar**	115	29,335	2019
South Shore	**Grove Street**	115	29,346	2019
South Shore	**Holbrook**	115	29,346	2019
South Shore	**Middle Street**	115	29,346	2019
South Shore	**Potter**	115	29,346	2019
South Shore	**Plain Street**	115	29,346	2019
Cape Cod	**Bourne**	115	29,539	2021
Cape Cod	**Canal**	115	29,829	2023

[redacted]

Section 10
Appendix B: Load Forecast

Table 10-1: 2015 CELT Seasonal Peak Load Forecast Distributions

		Peak Load Forecast at Milder Than Expected Weather				Reference Forecast at Expected Weather	Peak Load Forecast at More Extreme Than Expected Weather				
Summer (MW)	2015	27145	27395	27440	27825	28251	28700	29165	29825	30600	31270
	2016	27548	27803	27848	28238	28673	29133	29603	30278	31053	31733
	2017	27921	28181	28226	28626	29066	29531	30011	30696	31481	32171
	2018	28323	28583	28633	29033	29483	29958	30443	31138	31933	32628
	2019	28686	28951	28996	29406	29861	30341	30831	31541	32341	33051
	2020	28992	29262	29307	29722	30182	30667	31167	31877	32697	33417
	2021	29287	29557	29607	30022	30487	30977	31482	32202	33037	33762
	2022	29589	29864	29914	30334	30804	31299	31809	32539	33389	34124
	2023	29901	30181	30231	30656	31131	31631	32146	32886	33746	34491
	2024	30214	30494	30544	30974	31455	31964	32479	33224	34104	34859
	WTHI (1)	**78.49**	**78.73**	**79.00**	**79.39**	**79.88**	**80.30**	**80.72**	**81.14**	**81.96**	**82.33**
	Dry-Bulb Temperature (2)	**88.50**	**88.90**	**89.20**	**89.90**	**90.20**	**91.20**	**92.20**	**92.90**	**94.20**	**95.40**
	Probability of Forecast Being Exceeded	**90%**	**80%**	**70%**	**60%**	**50%**	**40%**	**30%**	**20%**	**10%**	**5%**
Winter (MW)	2015/16	22325	22440	22535	22595	22740	22890	23050	23150	23400	23755
	2016/17	22500	22620	22715	22775	22920	23070	23230	23335	23580	23935
	2017/18	22685	22800	22895	22960	23105	23255	23420	23520	23765	24120
	2018/19	22855	22975	23070	23130	23280	23435	23595	23700	23935	24295
	2019/20	23000	23120	23220	23280	23430	23585	23750	23850	24085	24445
	2020/21	23140	23260	23360	23420	23570	23725	23890	23995	24225	24585
	2021/22	23280	23400	23500	23565	23715	23870	24040	24145	24370	24730
	2022/23	23430	23550	23650	23715	23865	24020	24190	24295	24520	24880
	2023/24	23580	23705	23805	23865	24020	24180	24345	24455	24680	25035
	2024/25	23735	23855	23955	24020	24175	24335	24505	24610	24835	25190
	Dry-Bulb Temperature (3)	**10.72**	**9.66**	**8.84**	**8.30**	**7.03**	**5.77**	**4.40**	**3.58**	**1.61**	**(1.15)**

FOOTNOTES:

(1) WTHI - a three-day weighted temperature-humidity index for eight New England weather stations. It is the weather variable used in producing the summer peak load forecast. For more information on the weather variables see http://www.iso-ne.com/system-planning/system-plans-studies/celt .

(2) Dry-bulb temperature (in degrees Fahrenheit) shown in the summer season is for informational purposes only.

(3) Dry-bulb temperature (in degrees Fahrenheit) shown in the winter season is a weighted value from eight New England weather stations.

[redacted]

Table 10-2: 2026 Detailed Load Distributions by State and Company

ISO New England Basecase DB - Load File Report by Company

Study Date :	07/01/2026	Study Name :	SEMA_RI_Needs_Reassessment		
File Created :	2015-10-19	CELT Forecast :	2015	Forecast Year :	2026
Season :	Summer Peak	Weather :	90/10	Load Distribution :	N+10_SUM
ISO-NE CELT :	35305 MW	% of Peak :	100.000%	Tx Losses :	2.50%

State CELT L&L	-	2.50% Tx Losses	+	Non-CELT Load	+	Station Service	-	Area 104 NE Load	=	Area 101 Load
35310 MW		817.4 MW		367.6 MW		933.9 MW		0.0MW		35794.6 MW

1: State CELT L&L: This represents the sum of the 6 State CELT forecasts. This number can sometimes be 5-10 MW different than the ISO-NE CELT forecast number due to round-off error.
2: Non-CELT Load: This is the sum of all load modeled in the case that is not included in the CELT forecast. An example is the "behind the meter" paper mill load in Maine.
3: Station Service: This is the amount of generator station service modeled. If station service is off-line, the Area 101 report totals will be different since off-line load is not counted in totals.
4: Area 104 NE Load: This load is load modeled in northern VT that is electrically served from Hydro Quebec. To make Area Interchange load independent, this load is assigned Area 104.

Maine State Load = 2525 MW - 2.50% Tx Losses = 2466.55 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
CMP	86.10%	2123.74	689.73	0.951	342.41
EM	13.90%	342.81	122.09	0.942	14.29

New Hampshire State Load = 3350 MW - 2.50% Tx Losses = 3272.45 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
PSNH	78.56%	2570.86	366.33	0.990	5.80
UNITIL	12.08%	395.38	56.35	0.990	
GSE	9.36%	306.23	28.97	0.996	1.85

Vermont State Load = 1265 MW - 2.50% Tx Losses = 1235.72 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
VELCO	100.00%	1235.80	212.90	0.985	92.51

Massachusetts State Load = 16545 MW - 2.50% Tx Losses = 16162.01 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
BECO	28.27%	4568.36	1165.13	0.969	37.79
COMEL	11.47%	1852.98	377.78	0.980	
MA-NGRID	39.09%	6317.83	420.66	0.998	38.49
WMECO	7.03%	1136.36	161.89	0.990	
MUNI:BOST-NGR	3.36%	543.33	96.49	0.985	
MUNI:BOST-NST	1.25%	202.19	31.84	0.988	
MUNI:CNEMA-NGR	2.06%	332.61	42.74	0.992	
MUNI:RI-NGR	0.86%	138.83	16.70	0.993	
MUNI:SEMA-NGR	1.82%	293.82	30.15	0.995	
MUNI:SEMA-NST	1.70%	275.05	50.64	0.983	
MUNI:WMA-NGR	0.94%	151.77	15.37	0.995	
MUNI:WMA-NU	2.16%	349.26	49.73	0.990	

Rhode Island State Load = 2550 MW - 2.50% Tx Losses = 2490.97 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
RI-NGRID	100.00%	2490.94	210.82	0.996	45.44

Connecticut State Load = 9075 MW - 2.50% Tx Losses = 8864.93 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
CLP	76.70%	6799.04	968.86	0.990	107.42
CMEEC	4.58%	406.10	57.87	0.990	
UI	18.72%	1659.78	166.62	0.995	10.00

[redacted]

Table 10-3: 2026 Detailed Demand Response Distributions by Zone

ISO New England Basecase DB - Demand Resources File Report

Study Date : 07/01/2026 **Study Name :** SEMA_RI_Needs_Reassessment
File Created : 2015-10-19 **CCP :** 2018/2019 **Load Season :** 2026 - Summer Peak
Load Distrb : N+10_SUM **Distrb Losses :** 5.50% **DR Season :** SUM

	Demand Reduction Value (DRV)		Load Dependent Capability Assumption (LDCA)		Performance Assumption (PA)		Distribution Losses Gross-Up		Area 104 DR		Area 101 DR
Passive :	2134.81 MW	x	100.00%	x	100.00%	+	117.41 MW	-	0.00 MW	=	2252.20 MW
Forecast EE :	1506.44 MW		100.00%		100.00%		82.85 MW		0.00 MW		1589.31 MW
Active RTDR :	484.06 MW		100.00%		75.00%		19.97 MW		0.00 MW		383.01 MW
Active RTEG :	N/A		N/A		N/A		N/A		N/A		N/A

Demand Reduction Value (DRV): Amount of DR measured at the customer meter without any gross-up values for transmission or distribution losses.
Load Dependent Capability Assumption (LDCA): De-rate factor applied based on % of CELT load. (i.e. Light load is 45% of 50/50 load, so the LDCA would be 45%.)
Performance Assumption (PA): De-rate factor applied based on expected performance of DR after a dispatch signal from Operations.
Area 104 DR: This load is modeled in northern VT and is electrically served from Hydro Quebec. To make Area Interchange load independent, this load is assigned Area

Passive Demand Resources - (On-Peak and Seasonal Peak)

DR Modeled = (DRV_SUM * 100.00% LDCA * 100.00% PA) + 5.50% Distrb Losses Gross-Up

Zone	ID	Description	DRV (MW)	Total P (MW)	Total Q (MVAR)
DR_P_ME	20	Load Zone - Maine	-167.54	-176.76	-61.87
DR_P_NH	21	Load Zone - New Hampshire	-94.90	-100.12	-13.84
DR_P_VT	22	Load Zone - Vermont	-116.80	-123.22	-21.12
DR_P_NEMABOS	23	Load Zone - Northeast Massachusetts & Boston	-526.86	-555.84	-121.69
DR_P_SEMA	24	Load Zone - Southeast Massachusetts	-284.19	-299.82	-33.16
DR_P_WCMA	25	Load Zone - West Central Massachusetts	-330.58	-348.76	-31.57
DR_P_RI	26	Load Zone - Rhode Island	-188.58	-198.96	-16.84
DR_P_CT	27	Load Zone - Connecticut	-425.34	-448.73	-60.40

Forecasted Energy Efficiency

DR Modeled = (DRV_EE * 100.00% LDCA * 100.00% PA) + 5.50% Distrb Losses Gross-Up

Zone	ID	Description	DRV (MW)	Total P (MW)	Total Q (MVAR)
DR_P_ME	20	Load Zone - Maine	-104.02	-109.74	-38.41
DR_P_NH	21	Load Zone - New Hampshire	-63.89	-67.40	-9.32
DR_P_VT	22	Load Zone - Vermont	-101.86	-107.47	-18.43
DR_P_NEMABOS	23	Load Zone - Northeast Massachusetts & Boston	-363.29	-383.27	-83.90
DR_P_SEMA	24	Load Zone - Southeast Massachusetts	-192.26	-202.83	-22.43
DR_P_WCMA	25	Load Zone - West Central Massachusetts	-224.57	-236.92	-21.44
DR_P_RI	26	Load Zone - Rhode Island	-132.41	-139.69	-11.82
DR_P_CT	27	Load Zone - Connecticut	-324.15	-341.98	-46.03

Active Demand Resources - (Real-Time Demand Resource - RTDR)

DR Modeled = (DRV_SUM * 100.00% LDCA * 75.00% PA) + 5.50% Losses Gross-Up

Zone	ID	Description	DRV (MW)	Total P (MW)	Total Q (MVAR)
DR_A_ME_EME	30	Dispatch Zone - ME - Emerea Maine	-27.25	-21.56	-9.29
DR_A_ME_MAIN	31	Dispatch Zone - ME - Maine	-96.93	-76.70	-26.41
DR_A_ME_PORT	32	Dispatch Zone - ME - Portland Maine	-16.59	-13.13	-4.25
DR_A_NH_NEWH	33	Dispatch Zone - NH - New Hampshire	-13.21	-10.45	-1.43
DR_A_NH_SEAC	34	Dispatch Zone - NH - Seacoast	-1.65	-1.31	-0.19
DR_A_VT_NWVT	35	Dispatch Zone - VT - Northwest Vermont	-24.49	-19.38	-3.24
DR_A_VT_VERM	36	Dispatch Zone - VT - Vermont	-5.04	-3.99	-0.72
DR_A_MA_BOST	37	Dispatch Zone - MA - Boston	-50.30	-39.80	-10.07
DR_A_MA_NSHR	38	Dispatch Zone - MA - North Shore	-17.79	-14.07	-1.70
DR_A_MA_CMA	39	Dispatch Zone - MA - Central Massachusetts	-32.00	-25.32	-2.13
DR_A_MA_SPFD	40	Dispatch Zone - MA - Springfield	-7.79	-6.16	-0.85
DR_A_MA_WMA	41	Dispatch Zone - MA - Western Massachusetts	-15.39	-12.18	-0.79
DR_A_MA_LSM	42	Dispatch Zone - MA - Lower Southeast Massachusetts	-7.11	-5.63	-1.01
DR_A_MA_SEMA	43	Dispatch Zone - MA - Southeast Massachusetts	-41.03	-32.46	-2.60
DR_A_RI_RHOD	44	Dispatch Zone - RI - Rhode Island	-55.90	-44.23	-3.74
DR_A_CT_EAST	45	Dispatch Zone - CT - Eastern Connecticut	-7.90	-6.25	-0.89
DR_A_CT_NRTH	46	Dispatch Zone - CT - Northern Connecticut	-28.37	-22.45	-3.20
DR_A_CT_NRST	47	Dispatch Zone - CT - Norwalk-Stamford	-3.36	-2.66	-0.36
DR_A_CT_WEST	48	Dispatch Zone - CT - Western Connecticut	-31.97	-25.30	-3.30

[redacted]

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Section 11
Appendix C: Upgrades Included in Base Case

A summary of the future generation and transmission projects included in the study base cases can be found in the file shown below and is located in the Appendices folder:

Appendix_C_2026_SEMA_RI_Needs - 2026-07-01 - Project Summary Report

Section 12
Appendix D: Case Summaries

Study base case summaries can be found in the files shown below and is located in the Appendices folder:

Appendix_D1_Stress_A_Case_Summary

Appendix_D2_Stress_B_Case_Summary

Appendix_D3_Stress_C_Case_Summary

Section 13
Appendix E: Contingency List

A summary of the contingencies used in the study can be found in the file shown below and is located in the Appendices folder:

Appendix_E_SEMA-RI_Contingency_Summary

Table 13-1: N-1-1 Transmission Line Element-Out Scenarios

Line	kV	Description	[redacted]
342	345	Pilgrim to Canal to Auburn	Yes
322	345	Carver to Canal	Yes
327	345	Brayton Point to Berry Street	Yes
355	345	Carver to Pilgrim	Yes
331	345	West Walpole to Carver	Yes
356	345	Bridgewater to Carver	Yes
399	345	Carver to Bourne to Oak Street	Yes
341	345	Lake Road to West Farnum	Yes
359	345	Kent County to West Farnum	Yes
344	345	West Medway to Bridgewater	Yes
335	345	Holbrook to Auburn Street	Yes
316	345	Stoughton to Holbrook	Yes
3161	345	West Walpole to Stoughton	Yes
3162	345	Stoughton to K Street	Yes
3163	345	Stoughton to K Street	Yes
3164	345	Stoughton to Hyde Park	Yes
3348	345	Killingly to Lake Road	Yes
389	345	West Medway to West Walpole	Yes
325	345	West Medway to West Walpole	Yes
303	345	ANP Bellingham to Brayton Point	Yes
315	345	Brayton Point to West Farnum	Yes
3520	345	ANP Bellingham to West Medway	Yes
333	345	Sherman Road to Ocean State	Yes
336	345	ANP Blackstone to NEA Bellingham to West Medway	Yes
3361	345	ANP Blackstone to Sherman Road	Yes
3271	345	Lake Road to Card Street	Yes
330	345	Lake Road to Card Street	Yes
332	345	West Farnum to Kent County	Yes
328	345	Sherman Road to West Farnum	Yes
347	345	Sherman Road to Killingly	Yes
366	345	Millbury to West Farnum	Yes
107	115	Bourne to Otis to Falmouth Tap	Yes
108	115	Tremont to Wareham to Valley to Manomet to Bourne	Yes
109	115	High Hill to Cross Road to Fisher Road	No
111	115	Industrial Park to High Hill to Dartmouth to Cross Road	No

Line	kV	Description	[redacted]
112	115	Tremont to Rochester to Crystal Spring to Industrial Park to Wing Lane to Arsene to Acushnet	Yes
112-8	115	Acushnet to Pine Street	No
113	115	Tremont to Wareham to Valley to Manomet to Bourne	Yes
114	115	Tremont to Rochester	Yes
114-5	115	Acushnet to Pine Street	No
115-10-16	115	Middle Street to Potter Station	No
115-16-17	115	Potter Station to TA Watson	No
115-4-8	115	Plain Street to Church Hill	No
115-8-10	115	Middle Street to Church Hill	No
115-9-4	115	Plain Street to Grove Street	No
116	115	Carver to Brook Street	Yes
117	115	Kingston to Duxbury	No
118	115	Barnstable to Lothrop Ave. to Harwich to Orleans	No
119	115	Barnstable to Lothrop Ave. to Harwich to Orleans	No
120W	115	Bourne to Canal	Yes
121	115	Bourne to Canal	No
122	115	Bourne to Pave Paws to Sandwich	No
123	115	Barnstable to Hyannis Junction	No
124	115	Barnstable to Hyannis Junction	No
125	115	Wellfleet to Orleans	No
126	115	Bourne to Canal	Yes
126-501	115	Hopkinton Tap to Hopkinton	No
126-502	115	Hopkinton Tap to Hopkinton	No
127	115	SEMass Tap to Carver	Yes
128	115	SEMass Tap to Tremont	Yes
129	115	SEMass Tap to SEMass	Yes
130	115	Acushnet to Pine Street	No
131	115	Barnstable to Merchants Way	No
132	115	Brook Street to West Pond	No
133	115	Brook Street to West Pond	No
134	115	Tremont to Carver	Yes
135	115	West Barnstable to Barnstable	No
136	115	Falmouth Tap to Mashpee	No
137	115	West Barnstable to Mashpee	No
142	115	Acushnet to Pine Street	No
143	115	Acushnet to Pine Street	No
146-502	115	West Walpole to Walpole	Yes
1505	115	Killingly to Brooklyn to Tunnel	No
1607	115	Killingly to Exeter to Fry Brook to Tunnel	No
1621	115	Killingly to Tracy	No
1742	115	Killingly to Tracy	No
1870	115	Kenyon to Wood River	No
1870N	115	Kenyon to West Kingston	No
1870S	115	Wood River to Shunock	No
191	115	Auburn Street to Kingston to Duxbury to Marshfield	Yes

Line	kV	Description	[redacted]
194	115	Auburn Street to Brook Street	Yes
274-509	115	Medway to Sherborn	No
398-537	115	Holbrook to East Holbrook	Yes
447-508	115	West Walpole to Walpole to Canton to South Randolph to Holbrook	Yes
447-509	115	West Walpole to Walpole to Canton to South Randolph to Holbrook	Yes
451-536	115	Holbrook to East Holbrook to Auburn Street	Yes
456-522	115	Dover to West Walpole	Yes
478-502	115	Edgar to Swift's Beach to Holbrook	Yes
478-503	115	Edgar to East Weymouth to Hobart Street to Holbrook	Yes
478-508	115	Edgar to East Weymouth to Hobart Street to Holbrook	Yes
478-509	115	Edgar to Mid Weymouth to Grove Street to Holbrook	Yes
495-532	115	Ellis Avenue to Norwood	No
495-533	115	Ellis Avenue to Norwood	No
517-524	115	North Quincy to Dewar Street	No
517-525	115	North Quincy to Dewar Street	No
517-532	115	North Quincy to Field Street to Edgar	No
517-533	115	North Quincy to Field Street to Edgar	No
65-502	115	Medway to West Walpole	Yes
65-507	115	Medway Jet to West Medway	No
65-508	115	Medway to West Walpole	Yes
A24	115	Bridgewater to Easton to Bird Road	No
A94	115	Auburn Street to Avon to Park View	Yes
B23	115	West Farnum to Nasonville	Yes
C-129	115	Beaver Pond to Union Street	No
C-129N / 201-502	115	Beaver Pond to Depot Street to Milford Power to Rocky Hill to Hopkinton to Millbury	Yes
C-129S	115	Union Street to South Wrentham	No
C-181N	115	South Wrentham to North Attleboro to Mansfield to Chartley Pond	No
C-181S	115	Brayton Point to Chartley Pond	Yes
C2	115	Dupont to Auburn	Yes
C3	115	Auburn Street to Plymouth to North Abington to Hanover to Norwell	Yes
D-130 / 201-501	115	Medway to Depot Street to Milford Power to Hopkinton to Millbury	Yes
E105	115	Franklin Square to Hartford Avenue	Yes
E183E	115	Brayton Point to Warren to Mink Street to Wampanoag	Yes
E183W	115	Manchester Street to Phillipsdale to Wampanoag	No
E20 / L1	115	Bridgewater to East Bridgewater to Auburn Street	Yes
F106	115	Franklin Square to Hartford Avenue	Yes
F184	115	Brayton Point to Warren to Bristol to Mink Street to Read Street	Yes
F19 / S1	115	Bridgewater to Belmont to Auburn Street	Yes
G18	115	Dupont to Bridgewater	Yes
G185N	115	Drumrock to Kent County	Yes

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Line	kV	Description	[redacted]
G185S	115	Kent County to Old Baptist Road to Davisville to West Kingston	Yes
I187	115	Drumrock to Blackburn to Kilvert to Pontiac Avenue to Lincoln Avenue to Sockanosset	Yes
J16	115	Riverside to Staples	No
J188	115	Drumrock to Blackburn to Pontiac Avenue to Lincoln Avenue to Sockanosset	Y
K15	115	Swansea to Robinson Avenue	No
K189	115	Drumrock to Kent County	Yes
L14	115	Canonicus to Bent Road to Bates Street to Tiverton to Bell Rock	No
L190	115	Kent County to Old Baptist Road to Davisville to West Kingston	Yes
P11	115	Pawtucket to Valley to Robinson Avenue	No
Q10	115	Robinson Avenue to Staples	No
Q143N	115	Millbury to Whitins Pond to Uxbridge	Yes
Q143S	115	Uxbridge to Woonsocket to Clarkson to Admiral Street to Franklin Square	Yes
R144	115	Woonsocket to Clarkson to Admiral Street to Franklin Square	Yes
R9	115	Riverside to Valley	No
S171	115	Hartford to Johnston to Rise to Ridgewood	Yes
S171N	115	Woonsocket to West Farnum to Farnum Pike to Wolf Hill to Putnam Pike to Hartford Avenue	Yes
S171S	115	Drumrock to West Cranston to Rise to Johnston to Hartford Avenue	Yes
S8	115	Bridgewater to Raynham to Taunton Cleary to Somerset	Yes
S9 / H1	115	Auburn Street to Plymouth to Hanover to Water Street	Yes
T172N	115	Woonsocket to West Farnum to Farnum Pike to Wolf Hill to Putnam Pike to Hartford Avenue	Yes
T172S	115	Hartford Avenue to Johnston to Rise to West Cranston to Drumrock	Yes
T7	115	Somerset to Pawtucket	Yes
U2	115	Stoughton to Parkview to Belmont	No
U6	115	Bridgewater to Raynham to Dighton to Somerset	Yes
V148N/S	115	Woonsocket to Washington to Robinson Avenue to Read Street	Yes
V5	115	Bridgewater to Dighton to Somerset	Yes
W4	115	Swansea to Somerset	Yes
X3	115	Pawtucket to Phillipsdale to Somerset	Yes
Y2	115	Somerset to Hathaway Street	Yes
Z1	115	Somerset to Hathaway Street	Yes
H17	115	West Farnum to Farnum to Riverside	Yes
A94	115	Auburn Street to Park View	Yes
M1	115	East Bridgewater to Mill Street to Middleboro	No
L14	115	Bell Rock to Tiverton to Bates Street to Canonicus to Dexter	No

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Line	kV	Description	[redacted]
M13	115	Somerset to Sykes Road to Tiverton to Bell Rock to Bates Street to Canonicus to Dexter	No
D21	115	High Hill to Bell Rock	No
N12	115	Somerset to Sykes Road to Bell Rock	Yes
D911	115	Dupont to Ames Street	Yes
D-182N	115	Berry Street to South Wrentham	Yes
D182S	115	Brayton Point to Mansfield to Sherman Street to North Attleboro to Berry Street	Yes
E1	115	Bridgewater to Middleboro	Yes
1505	115	Killingly to Brooklyn to Fry Brook to Plainfield to Tunnel	Yes
Ridgewood Gen Lead	115	Ridgewood	Yes
3763	69	Jepson to Navy Tap to Newport	No
W23W	69	Northboro Road to Mass Water Resources Authority to Woodside to South Marlboro to Marlboro	No

Table 13-2: N-1-1 Autotransformer Element-Out Scenarios

Autotransformer	kV	Description	[redacted]
Auburn 210X	345/115	Auburn Street 210X Autotransformer	Yes
Auburn 220X	345/115	Auburn Street 220X Autotransformer	Yes
Berry 1X	345/115	Berry Street 1X Autotransformer	Yes
Brayton Point 3XA	345/115/20	Brayton Point 3XA Autotransformer	Yes
Bridgewater 161X	345/115	Bridgewater 161X Autotransformer	Yes
Bridgewater 162X	345/115	Bridgewater 162X Autotransformer	Yes
Canal 120X	345/115	Canal 120X Autotransformer	Yes
Canal 121X	345/115	Canal 121X Autotransformer	Yes
Canal 126X	345/115	Canal 126X Autotransformer	Yes
Carver 345A	345/115	Carver 345A Autotransformer	Yes
Carver 345B	345/115	Carver 345B Autotransformer	Yes
Card 5X	345/115	Card Street 5X Autotransformer	Yes

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Autotransformer	kV	Description	[redacted]
Holbrook 345A	345/115	Holbrook 345A Autotransformer	Yes
Kent County 3X	345/115	Kent County 3X Autotransformer	Yes
Kent County 4X	345/115	Kent County 4X Autotransformer	Yes
Kent County 8X	345/115	Kent County 8X Autotransformer	Yes
Killingly 2X	345/115	Killingly 2X Autotransformer	Yes
West Barnstable 345A	345/115	West Barnstable 345A Autotransformer	No
West Farnum 174T	345/115	West Farnum 174T Autotransformer	Yes
West Farnum 175T	345/115	West Farnum 175T Autotransformer	Yes
West Walpole 345A	345/115	West Walpole 345A Autotransformer	Yes

Table 13-3: N-1-1 Generator Element-Out Scenarios

Generator	Station
ANP Bellingham 1	ANP-Bellingham
ANP Bellingham 2	ANP-Bellingham
ANP Blackstone 1	ANP-Blackstone
ANP Blackstone 2	ANP-Blackstone
Canal 1	Canal
Canal 2	Canal
Cleary 8	Cleary
Cleary 9	Cleary
Dartmouth	Dartmouth
Dighton	Dighton
Edgar	Edgar
Lake Road 1	Lake Road
Lake Road 2	Lake Road
Lake Road 3	Lake Road
Manchester 9	Franklin Square
Manchester 10	Franklin Square
Manchester 11	Franklin Square
Milford Power 2	Milford Power
NEA Bellingham	NEA-Bellingham
Oak Bluffs	Falmouth

[redacted]

Generator	Station
Ocean State 1	Ocean State
Ocean State 2	Ocean State
Pawtucket Power	Admiral Street
Pilgrim	Pilgrim
Potter 2	Potter Station
Medway Peaker 1	Medway
Medway Peaker 2	Medway
Ridgewood	Ridgewood
Rise	Rise
SEMASS 1	SEMASS
SEMASS 2	SEMASS
Tiverton	Tiverton
TA Watson 1	Potter Station
TA Watson 2	Potter Station
West Medway Jet	West Medway
West Tisbury	Falmouth

Table 13-4: N-1-1 Shunt Device Element-Out Scenarios

Reactive Device	Station	MVAR
115 kV Capacitor	Barnstable	35.3
Static VAR Compensator	Barnstable	112.5
115 kV Reactor R1	Edgar	40.0
115 kV Reactor R2	Edgar	40.0
115 kV Capacitor	Falmouth	35.3
115 kV Capacitor	Franklin Square	37.8
115 kV Capacitor	Harwich	21.2
115 kV Capacitor	Hyannis Junction	39.0
115 kV Capacitor C2	Kent County	63.0
115 kV Capacitor C5	Kent County	144.0
115 kV Capacitor	Mashpee	35.3
115 kV Capacitor	Orleans	13.6
115 kV Reactor R1	Pine Street	10.0
115 kV Reactor R2	Pine Street	10.0
345 kV Stoughton R1	Stoughton	110.0
345 kV Stoughton R2	Stoughton	110.0
345 kV Stoughton R3	Stoughton	110.0
345 kV Stoughton R4	Stoughton	70.0
115 kV Wing Lane	Wing Lane	35.3

Section 14
Appendix F: Steady State Analysis Results

A summary of the steady state analysis results can be found in the files shown below and are located in the Appendices folder:

Appendix_F1_SEMA-RI_2026_N-1_Thermal_Results

Appendix_F2_SEMA-RI_2026_N-1_Voltage_Results

Appendix_F3_SEMA-RI_2026_N-1-1_Thermal_Results

Appendix_F4_SEMA-RI_2026_N-1-1_Voltage_Results

Section 15
Appendix G: Short Circuit Analysis Results

The complete set of short circuit analysis results can be found in the file shown below and located in the Appendices folder:

Appendix G_SEMA-RI_Short_Circuit_Results

[redacted]

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Section 16
Appendix H: Preferred Solution One Line Diagrams

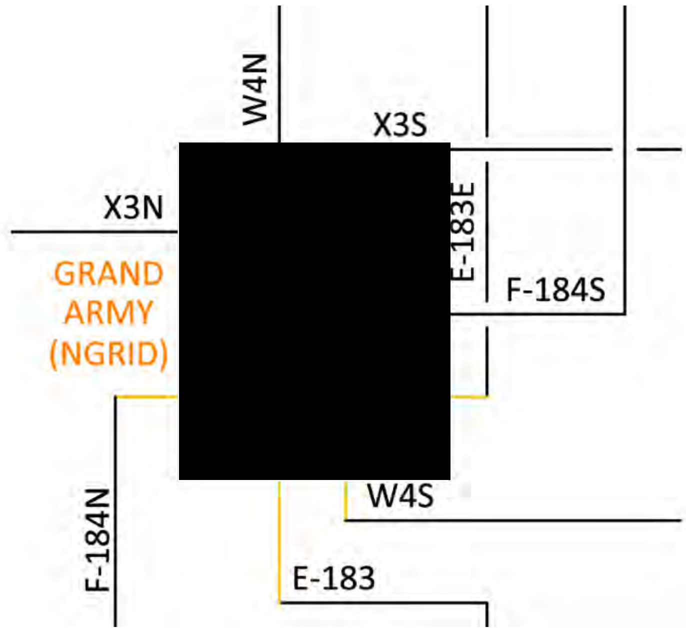

Figure 16-1: Grand Army 115 kV GIS switching station and loop the existing E-183E, F-184, X3 and W4 lines into the station

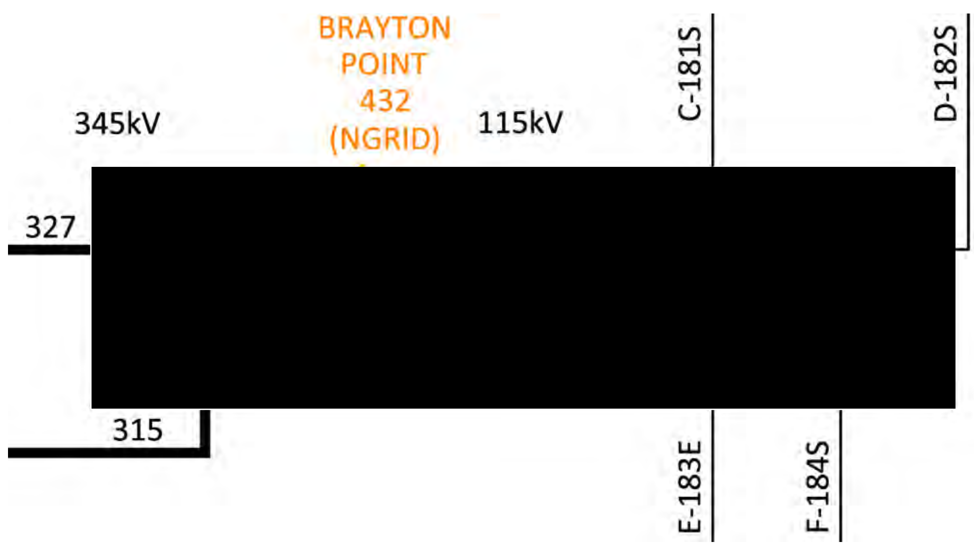

Figure 16-2: Upgrades at Brayton Point (new 115 kV breaker and new 345/115 kV transformer)

[redacted]

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[redacted]

Figure 16-3: Robinson Ave 115 kV circuit breaker addition and re-terminate Q10 line at the station

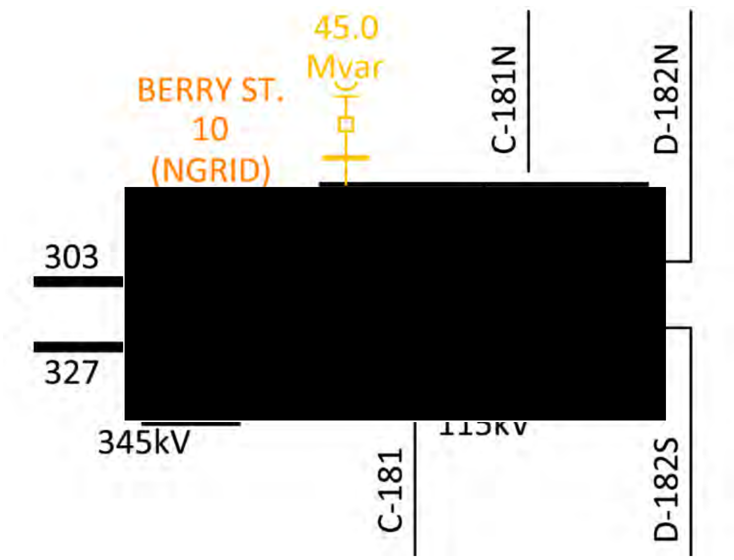

Figure 16-4: Install 45.0 MVAR capacitor bank at Berry Street

[redacted]

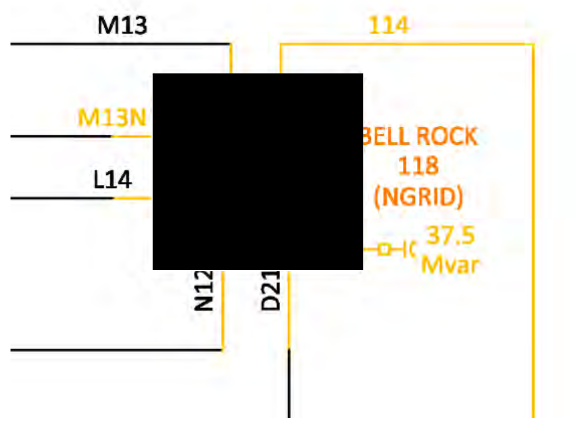

Figure 16-5: Bell Rock Station Upgrades

Bell Rock station upgrades include the following.

- Reconfigure Bell Rock to breaker and a half station and split M13 line
- Install a 37.5 MVAR capacitor
- Install a third breaker in a bay to terminate Line 114
- Install new breaker in series with the N12/D21 tie breaker and upgrade the D21 Line switch

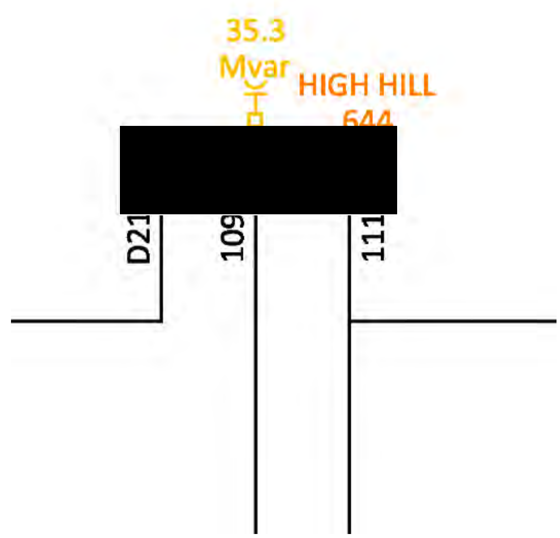

Figure 16-6: Install a 35.3 MVAR capacitor at High Hill

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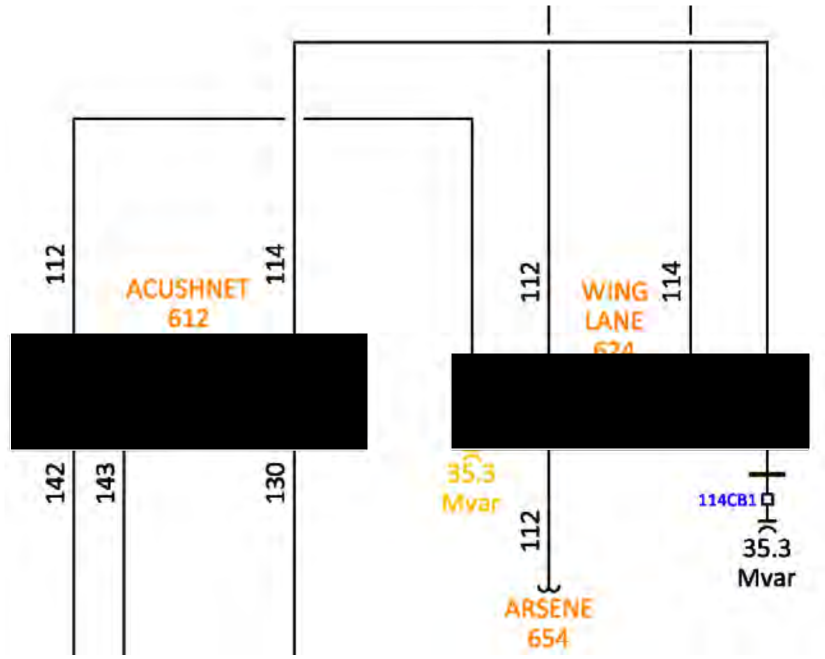

Figure 16-7: Install a 35.3 MVAR capacitor at Wing Lane

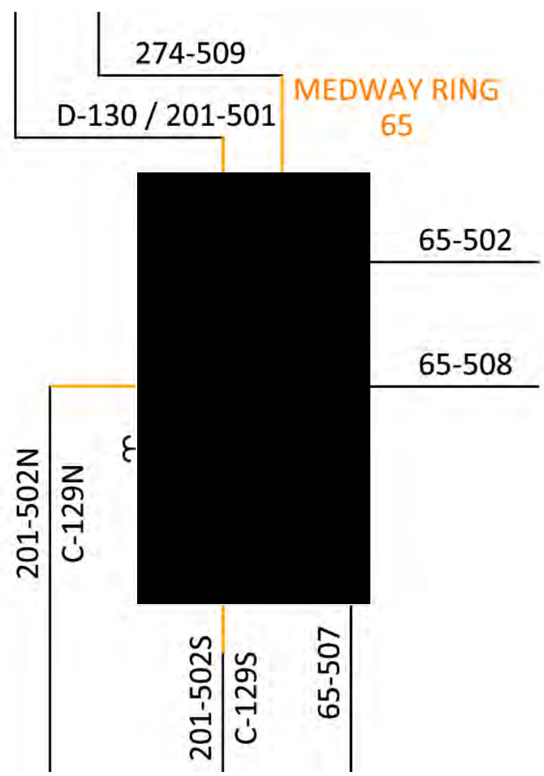

Figure 16-8: Loop 201-502 line into the Medway station to form the 201-502N and 201-502S lines

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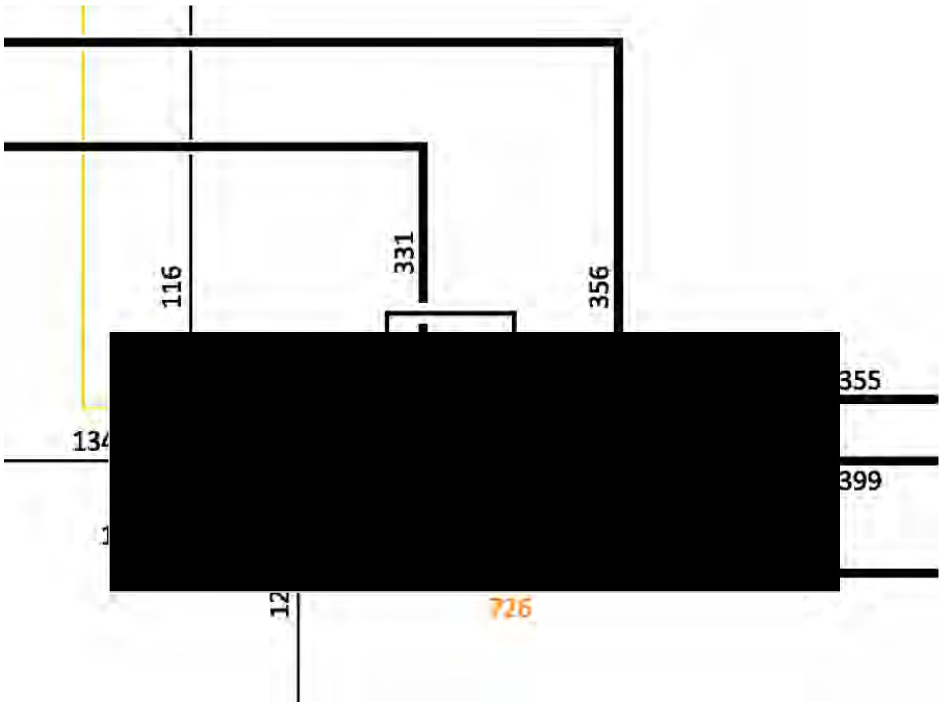

Figure 16-9: Install new line from Carver to Kingston (Termination at Carver)

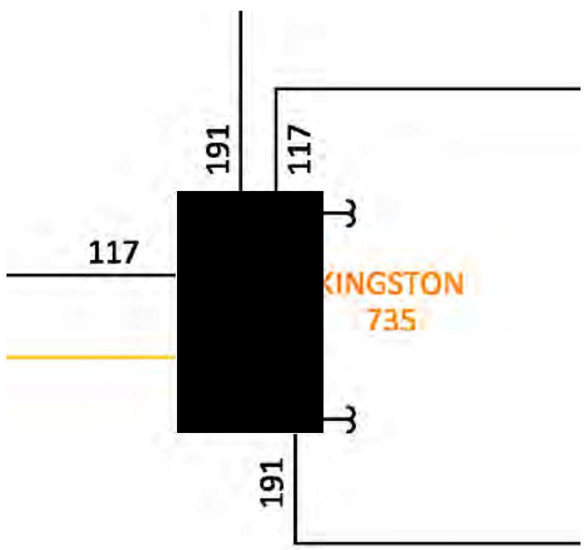

Figure 16-10: Install new line from Carver to Kingston (Termination at Kingston) and rebuild Kingston under separate asset condition and local reliability upgrade projects[45]

[45] https://smd.iso-ne.com/operations-services/ceii/pac/2016/12/a2_kingston_substation_asset_conditions.pdf

[redacted]

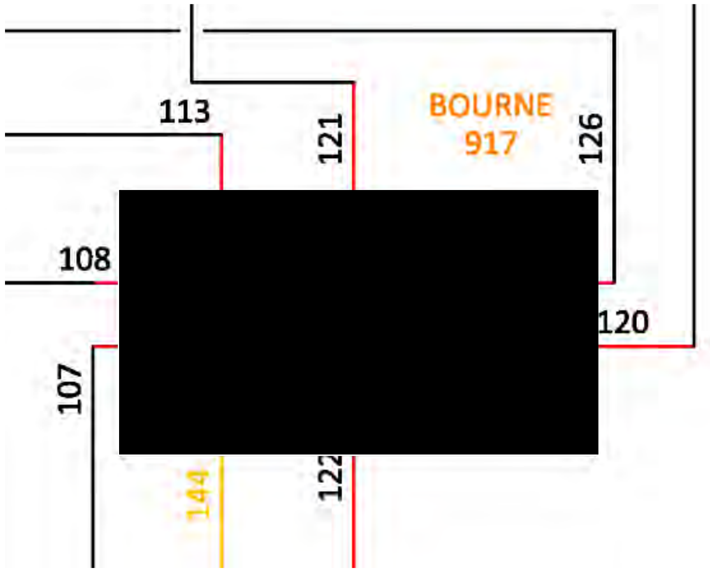

Figure 16-11: Install new line from Bourne to West Barnstable (Termination at Bourne) and rebuild Bourne under a separate asset condition project shown in red[46]

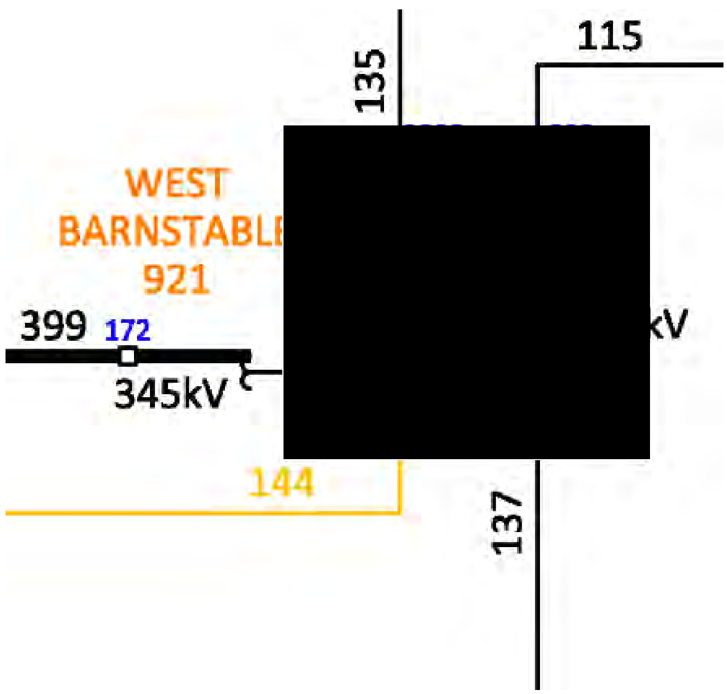

Figure 16-12: Install new line from Bourne to West Barnstable (Termination at West Barnstable)

[46] https://smd.iso-ne.com/operations-services/ceii/pac/2016/11/a3_bourne_asset_conditions_preferred_solutions.pdf

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APPENDIX 2-2 INDEPENDENT SYSTEM OPERATOR OF NEW ENGLAND (ISO NEW ENGLAND) REVISED SEMA/RI 2029 NEEDS ASSESSMENT, REVISION 1

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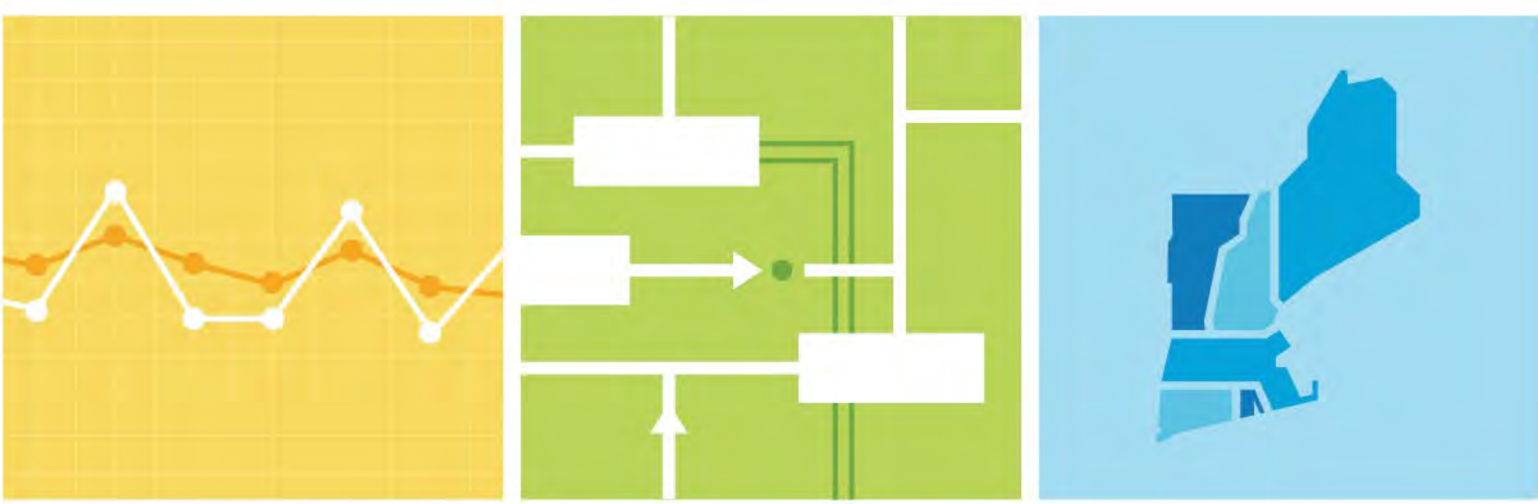
Revised SEMA/RI 2029 Needs Assessment Update

NOVEMBER 2020 - Revision 1

ISO-NE PUBLIC



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Section 1
Objective and Background

1.1 Study Objective

The objective of the Revised SEMA/RI 2029 Needs Assessment Update was to evaluate the solution components from the SEMA/RI 2026 Solutions Study[1] that have not started construction to determine if the solution components or a combination of the solution components were still needed to solve any criteria violations identified in the SEMA/RI study area for the year 2029. The results of the Revised SEMA/RI 2029 Needs Assessment Update were compared to the results of the SEMA/RI 2026 Needs Assessment and Addendums[2].

The Revised SEMA/RI 2029 Needs Assessment Update considered the following:

- Future load conditions to reflect the 2020 Capacity, Energy, Loads, and Transmission (CELT) forecast[3]
- Reliability over a range of generation patterns used in the SEMA/RI 2026 Needs Assessment and transfer levels
- Solution components from the SEMA/RI 2026 Solutions Study that have not started construction were excluded from the cases. The excluded solution components are shown in Appendix I (Section 16). Conversely, the solution components that are under construction or in service were included in the cases and are shown in Appendix J (Section 17)
- Resource changes in the study area based on FCA 13 results[4]
- Retirement of the Mystic 8 and 9 generators
- All applicable North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Corporation (NPCC) and ISO New England transmission planning reliability standards

The Revised SEMA/RI 2029 Needs Assessment Update was restricted to an evaluation of 2029 peak load conditions because the solution components from the SEMA/RI 2026 Solutions Study were developed to address peak load needs. Short circuit and stability analysis were not conducted.

At the April 23, 2020 PAC meeting,[5] stakeholders requested the following sensitivities to be studied.

- Non-coincident peak loads on the Cape – Appendix A (Section 8)

[1] https://smd.iso-ne.com/operations-services/ceii/pac/2017/02/final_sema_ri_2026_solutions_study_report_rev1.pdf

[2] https://smd.iso-ne.com/operations-services/ceii/pac/2016/05/final_sema_ri_needs_assessment_report.pdf, https://smd.iso-ne.com/operations-services/ceii/pac/2016/12/sema_ri_2026_needs_assessment_addendum.pdf, and https://smd.iso-ne.com/operations-services/ceii/pac/2018/06/sema_ri_2026_needs_assessment_seconf_addendum.pdf

[3] 2020 CELT Forecast data link: https://www.iso-ne.com/static-assets/documents/2020/04/2020_celt_report.xlsx

[4] FCA 14 for retirement and permanent de-list bids. A review of the final FCA 14 results (both for de-lists and new capacity supply obligations) showed no need to further modify the study assumptions for the SEMA/RI 2029 Needs Assessment Update.

[5] The SEMA/RI 2029 Needs Assessment Update presentation was presented at the meeting. https://smd.iso-ne.com/operations-services/ceii/pac/2020/04/sema_ri_2029_needs_assessment_update_04232020_v50.pdf. The presentation showed that the needs corresponding to the new line from Bourne to West Barnstable were not observed in 2029 due to the assumptions used in the SEMA/RI 2029 Needs Assessment Update. The Revised SEMA/RI 2029 Needs Assessment Update results show a thermal overload on the 136-1 line from Hatchville to Falmouth Tap for an N-1-1 contingency event.

- Reduced OSW output applied to existing OSW projects (Vineyard Wind and Revolution Wind) – Appendix B (Section 9)
- Addition of future off shore wind (OSW) (Vineyard Wind 2 and Mayflower Wind) projects – Appendix C (Section 10)

1.2 Area Studied

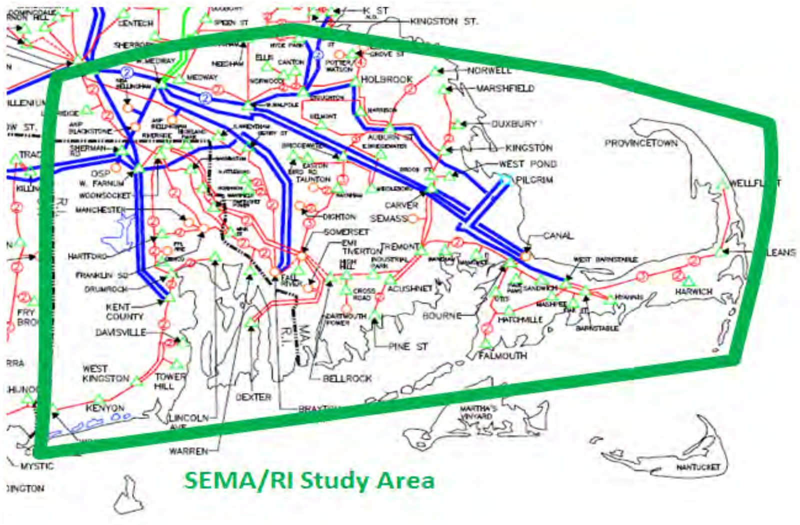

Figure 1-1: SEMA/RI Study Area Map[6]

The study area focused on two load zones, namely, the SEMA and RI load zones as shown in Figure 1-1. This combination of load zones is collectively known as the SEMA/RI load zone and was the study area evaluated in this analysis. These load zones encompass the areas within Massachusetts located south of Boston as well as the entire state of Rhode Island.

The SEMA/RI Interface borders the Boston Import Interface to the north and Connecticut Import Interface to the West.

Figure 1-2 shows the one-line diagram of the study area.

[6] This area map is for illustrative purposes only. It does not show any future projects in the study area. A high-resolution version of the geographical map is available at https://www.iso-ne.com/about/key-stats/maps-and-diagrams.

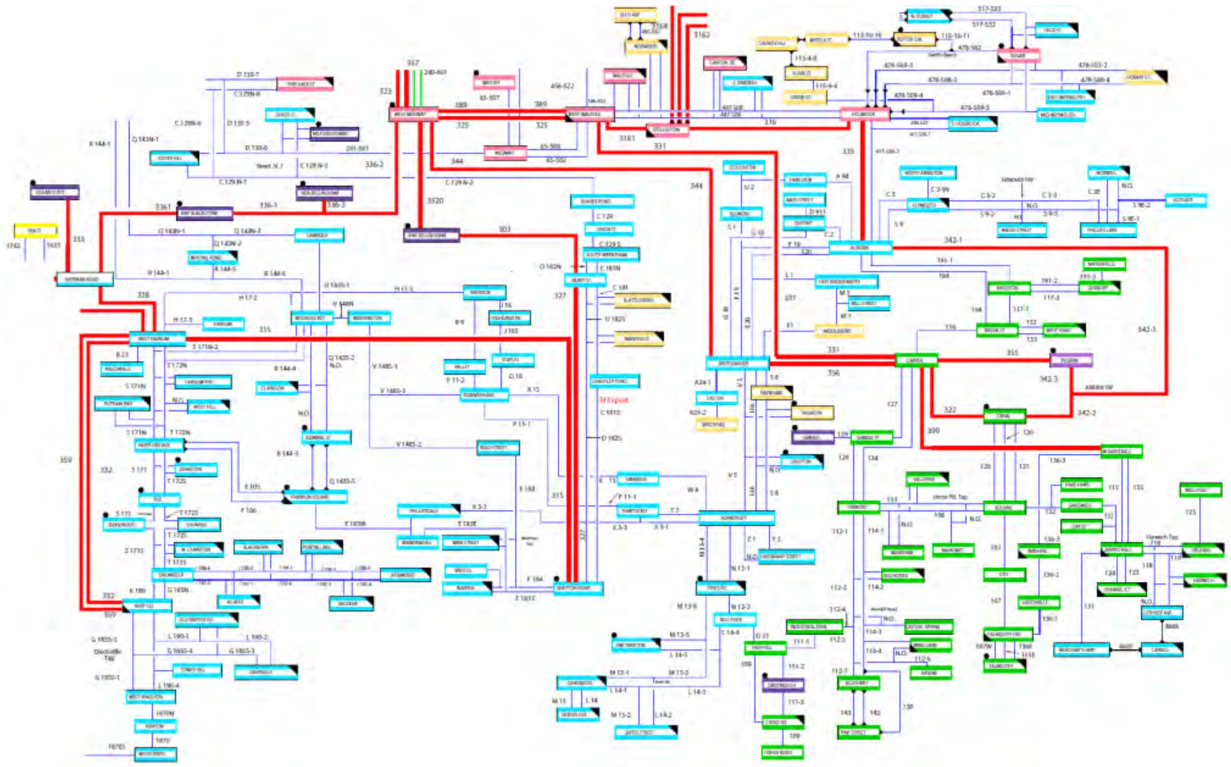

Figure 1-2: SEMA/RI Study Area One Line Diagram[7]

1.3 Study Horizon

This study was focused on the 2029 summer peak load level for the ten-year horizon utilizing the 2020 Capacity, Energy, Loads and Transmission (CELT) Report Forecast.

1.4 Analysis Description

The study included the evaluation of the reliability of the transmission system serving the SEMA/RI study area for the projected system conditions in 2029. The system was tested under N-0 (all-facilities-in), N-1 (all-facilities-in, first contingency), and N-1-1 (facility-out, first contingency) conditions for a number of possible operating scenarios with respect to generating unit unavailability conditions and import levels from external areas.

The following types of analysis were performed:

- **Thermal Analysis** – studies to determine the level of steady-state power flows on transmission circuits under base case conditions and following planned contingency events.
- **Voltage Analysis** – studies to determine steady-state voltage levels and performance under base case conditions and following planned contingency events.

The Needs Assessment was performed in accordance with relevant NERC, NPCC, and ISO criteria.

[7] The diagram is for illustrative purposes to show the study area. It does not show any future projects in the area. A high resolution version of the system diagram is available at: https://www.iso-ne.com/about/key-stats/maps-and-diagrams

For all thermal and voltage violations observed at peak load levels, an analysis was performed to determine if any related needs are time sensitive.

The thermal and voltage analysis was performed using Siemens PTI PSS®E version 33.12.1 and PowerGEM TARA v1802 software.

Section 2
Study Assumptions

2.1 Steady-State Model Assumptions

The case used for the Revised SEMA/RI 2029 Needs Assessment Update was created from the Year 10 Needs Assessment Peak Load Steady-state Base Case – A 2029 topology with 90/10 summer peak load representation – 2029_NA_PK_SS_Case found in the 2019 Transmission Planning Base Case Library.

For a description of the transmission and generation related details included in the case used for the Revised SEMA/RI 2029 Needs Assessment Update refer to the Summary Document for 2019 Transmission Planning Base Case Library[8] in the sections shown below.

- Existing topology
- Maine mill load modeling – This section is not applicable for the Revised SEMA/RI 2029 Needs Assessment Update
- Load power factor assumptions
- Demand resource assumptions
- Photovoltaic (PV) generation modeling and assumptions
- Net load levels studied
- Transmission upgrades included in the base cases
- Generators and ETUs included in the base cases
- Generator profiles (Real and reactive power limits)
- Source for system models outside New England
- Sections on dynamic models are not applicable to the Revised SEMA/RI 2029 Needs Assessment Update

The 2020 Capacity, Energy, Loads, and Transmission (CELT) report was used to determine the forecasted loads for the peak load demand level evaluated. A 90/10 summer peak load was used to represent the peak demand level for 2029. The load, EE, and PV forecasts in the 2020 CELT show a significant reduction in the net load to be served compared to what was assumed in the prior assessments as shown in Table 2-1.

[8] https://www.iso-ne.com/static-assets/documents/2019/11/final_summary_document_for_2019_transmission_planning_base_case_library.pdf

Table 2-1:
Comparison of the net load modeled in New England between the SEMA/RI 2026 Needs Assessment and SEMA/RI 2029 Needs Assessment Update

Category	SEMA/RI 2026 Needs Assessment Summer Peak 2026 90/10 Load (MW) CELT 2015 Data	Revised SEMA/RI 2029 Needs Assessment Update Summer Peak 2029 90/10 Load (MW) CELT 2020 Data	Change in Load (MW) (CELT 2020– CELT 2015)
Gross 90/10 Peak Loads (Excludes Transmission Losses)	34,461	32,946	-1,515
Non-CELT Manufacturing load in New England	364	301	-63
Available EE Forecast for study year (modeled as negative load)	NA	-5,595	-5,359
Available FCA 2015 CELT EE Forecast for study year (modeled as negative load)	-1,590	NA	1,590
Available FCA 14 ADCR (modeled as negative load)	NA	-552	-552
Available FCA 9 Passive DR (modeled as negative load)	-2,253	NA	2,253
Available FCA 9 Active DR (modeled as negative load)	-384	NA	384
Available PV Forecast for study year (modeled as negative load)	-531	-2,055	-1,524
Net load modeled in New England (Excludes Station Service)	30,068	25,045	-5,023

2.2 Transfer Levels

In accordance with the reliability criteria of the NERC, NPCC and the ISO, the regional transmission power grid must be designed for reliable operation during stressed system conditions. The transfer levels used in the Revised SEMA/RI 2029 Needs Assessment Update are the same transfer levels used in the SEMA/RI 2026 Needs Assessment. Please refer to the SEMA/RI 2026 Needs Assessment, section 3.1.10 for further information regarding the transfer levels used in the Revised SEMA/RI 2029 Needs Assessment Update.

2.3 Generation Dispatch Levels

All of the two generator OOS dispatches from the SEMA/RI 2026 Needs Assessment were used with the exception of the dispatch with Pawtucket Power which has since retired. Table 14-3 in Appendix G (Section 14) shows the one unit and two unit generation dispatches used in the Revised SEMA/RI 2029 Needs Assessment Update. Please refer to the SEMA/RI 2026 Needs Assessment, section 3.1.11 for further information regarding the generation dispatch scenarios used in the Revised SEMA/RI 2029 Needs Assessment Update.

2.4 Protection and Control System Devices Included in the Study Area

Refer to the SEMA/RI 2026 Needs Assessment, section 3.1.14 for further information regarding the protection and control system devices included in the Study Area used in the Revised SEMA/RI 2029 Needs Assessment Update.

2.5 Stability Modeling Assumptions

Not applicable for this study.

2.6 Short Circuit Model Assumptions

Not applicable for this study.

Section 3
Analysis Methodology

Refer to the SEMA/RI 2026 Needs Assessment, Section 4.2 for further information regarding the performance criteria used in the Revised SEMA/RI 2029 Needs Assessment Update.

3.1 Contingencies Evaluated

Table 3-1 summarizes the normal contingencies evaluated in the Revised SEMA/RI 2029 Needs Assessment Update.

Table 3-1:
Summary of Normal Contingencies Evaluated

Contingency Type		Number of Element Out Scenarios	Number of Contingencies Tested For N-1 Analysis	Number of Contingencies Tested For N-1-1 Analysis
GN	Generator	34	108	108
LN	Transmission Circuit	172	422	422
TF	Transformer	70	181	181
SD	Shunt Device	24	80	80
SPDC	Single Pole of a DC Line	0	2	2
NF	Opening of a Line Section w/o a Fault	N/A	262	N/A
BO	Opening of a Line Section w/o a Fault	N/A	100	100
BS	Bus Section Fault	N/A	46	46
BF	Internal Breaker Fault (non-Bus-tie Breaker)	N/A	950	950
BF_FR	Failure of a Relay	N/A	1	1
BT	Internal Breaker Fault (Bus-tie Breaker)	N/A	7	7
DC	Double Circuit Tower	N/A	126	126
HVDC	Loss of a bipolar DC Line	0	2	2
SPS	SPS	N/A	2	2
SPSF	SPS Failure	N/A	2	2
	TOTAL	**300**	**2291**	**2029**

3.2 ISO Planning Procedure

ISO Planning Procedure No. 3, “Reliability Standards for the New England Area Pool Transmission Facilities”, was updated on 09/15/2017, which was after the completion of the SEMA/RI 2026 Needs Assessment. In the new PP-3 procedure, N-1-1 contingencies, where the second contingency was a multiple facility event (double circuit tower or breaker failure), for non BPS facilities were no longer respected. Under the Revised SEMA/RI 2029 Needs Assessment Update, these N-1-1 contingencies were respected as this evaluation is an update to SEMA/RI 2026 Needs Assessment study.

3.3 Generation Re-dispatch Testing

As outlined in PP3, allowable actions after the first contingency event and prior to the second contingency event include re-dispatch of generation available within ten minutes. This is also consistent with NPCC Directory #1 and NERC TPL-001-4 where system adjustments are permitted in between contingencies for N-1-1 testing. To simulate these actions in power flow analysis, the Security Constrained Re-Dispatch (SCRD) tool in the TARA software package was used.

During the analysis, all on-line generation in the study area was allowed to be reduced or turned off to mitigate a thermal violation, with the exception of nuclear units. Simultaneously, up to 1200 MW of allocated reserves could be dispatched on. For base cases with imports modeled from adjacent areas, the transfer levels on the import interface could be reduced up to 0 MW while respecting the maximum of 1,200 MW of resources that could be dispatched on within New England.

3.4 Time-Sensitivity and Need-by Date Determination

A time sensitivity analysis was performed as a part of a Needs Assessment for each Pool Transmission Facility (PTF) need that is identified at peak load levels as a part of steady-state analysis.

3.5 Summary of Major Study Assumption Changes for the Revised Needs Assessment Update

The major assumption changes are:

- All SEMA/RI 2026 solution components were included in the cases with the exception of the projects that have not started construction as shown in Appendix I (Section 16)
- Mystic generation was in-service in the SEMA/RI 2026 Needs Assessment but was retired in the Revised SEMA/RI 2029 Needs Assessment Update
- Vineyard Wind was not modeled in the SEMA/RI 2026 Needs Assessment but was modeled at 160 MW[9] in the Revised SEMA/RI 2029 Needs Assessment Update
- Revolution Wind was not modeled in the SEMA/RI 2026 Needs Assessment but was modeled at 120 MW[9] in the Revised SEMA/RI 2029 Needs Assessment update

[9] Per section 2.3.7 the Transmission Planning Technical Guide, off shore wind is modeled at 20% of its nameplate rating.

Section 4
Study Results

The system was tested with all SEMA/RI components in service, except those that have not advanced to the Construction in Progress phase as reported in the June 2020 NEPOOL Participants Committee Report[10].

The results shown in Table 4-1, Table 4-2, Table 4-3, Table 4-4, and Section 4.5 show the same elements with thermal, voltage, and consequential load loss violations as identified in the SEMA/RI 2026 Needs Assessment and Addendums. Therefore, the elements with thermal, voltage, and consequential load loss violations seen in both the Revised SEMA/RI 2029 Needs Assessment Update and the SEMA/RI 2026 Needs Assessment and Addendums are deemed confirmed needs.

The results shown in Table 4-5 and Table 4-6 show elements where thermal and voltage violations identified in the SEMA/RI 2026 Needs Assessment are no longer observed in the Revised SEMA/RI 2029 Needs Assessment Update.

4.1 Confirmed N-1 Thermal Results

Table 4-1:
N-1 Thermal Results

Element ID	Element	Dispatch	Contingency	LTE Rating (MVA)	N-1 %LTE Loading in the Revised 2029 Needs Assessment Update
112-4	Industrial Park Tap to Industrial Park	[redacted]	[redacted]	246	153.7
111-1	High Hill to Industrial Park	[redacted]	[redacted]	243	138.7
L14-3	Bent Rd to Tiverton	[redacted]	[redacted]	210	119.0
L14-4	Bell Rock to Tiverton	[redacted]	[redacted]	250	111.8
L14-7	Canonicus to Dexter W	[redacted]	[redacted]	165	101.8

[10] https://www.iso-ne.com/static-assets/documents/2020/06/june-2020-coo-report.pdf

4.2 Confirmed N-1 Voltage Results

Table 4-2:
N-1 Voltage Results

Bus Name	Base kV	Dispatch	Contingency	Revised 2029 Needs Assessment Update Post Contingency Pre-switching Voltage (p.u.)	Revised 2029 Needs Assessment Update Post Contingency Post-switching Voltage (p.u.)
Purchase Street	115	[redacted]	[redacted]	>0.90	0.924
Hopkinton 501	115	[redacted]	[redacted]	>0.90	0.924
Jepson	115	[redacted]	[redacted]	0.727	0.672
Wing Lane	115	[redacted]	[redacted]	>0.90	0.884
High Hill	115	[redacted]	[redacted]	0.826	0.796
Dexter W	115	[redacted]	[redacted]	0.730	0.676
Bell Rock	115	[redacted]	[redacted]	0.796	0.758
Industrial Park	115	[redacted]	[redacted]	0.848	0.822

4.3 Confirmed N-1-1 Thermal Results

Table 4-3:
N-1-1 Thermal Results

Element ID	Element	Dispatch	Element OOS	Contingency	LTE Rating (MVA)	N-1-1 %LTE Loading in the Revised 2029 Needs Assessment Update
J16S	Staples to Highland Park	[redacted]	[redacted]	[redacted]	115	100.3
C129N-1	Millbury to Purchase	[redacted]	[redacted]	[redacted]	218	117.1
112-1	Tremont N. To Rochester	[redacted]	[redacted]	[redacted]	357	138.2
112-2	Rochester to Crystal Tap	[redacted]	[redacted]	[redacted]	357	137.3
112-3	Industrial Park Tap to Crystal Tap	[redacted]	[redacted]	[redacted]	357	137.3
112-4	Industrial Park Tap to Industrial Park	[redacted]	[redacted]	[redacted]	246	155.3
111-1	High Hill to Industrial Park	[redacted]	[redacted]	[redacted]	243	139.8
L14-3	Bent Rd to Tiverton	[redacted]	[redacted]	[redacted]	210	120.4
L14-4	Bell Rock to Tiverton	[redacted]	[redacted]	[redacted]	250	112.8
L14-7	Canonicus to Dexter W	[redacted]	[redacted]	[redacted]	165	103.6
N12-1	Somerset to Sykes Rd	[redacted]	[redacted]	[redacted]	284	125.9
N12-2	Sykes Rd to Bell Rock	[redacted]	[redacted]	[redacted]	284	115.2
M13-4	Somerset to Sykes Rd	[redacted]	[redacted]	[redacted]	284	129.8
M13-8	Tiverton to Sykes Rd	[redacted]	[redacted]	[redacted]	250	134.9
136-1	Hatchville to Falmouth Tap	[redacted]	[redacted]	[redacted]	257	101.1

4.4 Confirmed N-1-1 Voltage Results

Table 4-4:
N-1-1 Voltage Results

Bus Name	Base kV	Dispatch	Element OOS	Contingency	Revised 2029 Needs Assessment Update Post Contingency Pre-switching Voltage (p.u.)	Revised 2029 Needs Assessment Update Post Contingency Post-switching Voltage (p.u.)
Purchase Street	115	[redacted]	[redacted]	[redacted]	0.789	0.785
Hopkinton 501	115	[redacted]	[redacted]	[redacted]	0.789	0.785
Union Street	115	[redacted]	[redacted]	[redacted]	0.854	0.853
Jepson	115	[redacted]	[redacted]	[redacted]	0.637	0.584
Wing Lane	115	[redacted]	[redacted]	[redacted]	0.784	0.760
High Hill	115	[redacted]	[redacted]	[redacted]	0.725	0.692
Dexter W	115	[redacted]	[redacted]	[redacted]	0.639	0.588
Bell Rock	115	[redacted]	[redacted]	[redacted]	0.698	0.659
Industrial Park	115	[redacted]	[redacted]	[redacted]	0.745	0.716
Brook Street	115	[redacted]	[redacted]	[redacted]	>0.90	0.942

4.5 Confirmed Consequential Load Loss

In 2029, the loss of [redacted] followed by the loss of the [redacted] results in the loss of 467 MW of gross load in the Cape area.

In 2029, the loss of [redacted] followed by the loss of the [redacted] results in the loss of 449 MW of gross load in the Industrial Park and Somerset/Newport areas.

4.6 N-1-1 Thermal Needs No Longer Observed

Table 4-5:
N-1-1 Thermal Needs No Longer Observed

Element ID	Element	Element OOS	Contingency	LTE Rating (MVA)	N-1-1 % LTE Loading in the Revised 2029 Needs Assessment Update
324	Mystic to Kingston 345 kV Line	[redacted]	[redacted]	650	<100
372	Mystic to Kingston 345 kV Line	[redacted]	[redacted]	674	<100
Kingston 345A	Kingston 345A 345/115 kV Autotransformer	[redacted]	[redacted]	540	<100
Kingston 345B	Kingston 345B 345/115 kV Autotransformer	[redacted]	[redacted]	540	<100
329-530	Brighton to Blair Pond 115 kV Line	[redacted]	[redacted]	231	<100
329-531	Brighton to North Cambridge 115 kV Line	[redacted]	[redacted]	231	<100
509-530	North Cambridge to Blair Pond 115 kV Line	[redacted]	[redacted]	231	<100
385-512	Kingston St to K Street 1 115 kV Line	[redacted]	[redacted]	190	<100
385-513	Kingston St to K Street 1 115 kV Line	[redacted]	[redacted]	190	<100
385-510-1	High St to K Street 1 115 kV Line Section	[redacted]	[redacted]	190	<100
385-510-2	Kingston St to High St 115 kV Line Section	[redacted]	[redacted]	190	<100
385-511-1	High St to K Street 2 115 kV Line Section	[redacted]	[redacted]	190	<100
385-511-2	Kingston St to High St 115 kV Line Section	[redacted]	[redacted]	190	<100
Kent County 3X	Kent County 3X 345/115 kV Autotransformer	[redacted]	[redacted]	587	<100
L14-1	Bent Rd to Canonicus 115 kV Line section	[redacted]	[redacted]	210	<100
L14-5	Tiverton Tap to EMI Tiverton Tap 115 kV Line Section	[redacted]	[redacted]	180	<100
L14-6	Tiverton Tap to EMI Tiverton Tap 115 kV Line Section	[redacted]	[redacted]	180	<100
M13-3	Bent Rd to Tiverton Tap 115 kV Line Section	[redacted]	[redacted]	244	<100

Element ID	Element	Element OOS	Contingency	LTE Rating (MVA)	N-1-1 % LTE Loading in the Revised 2029 Needs Assessment Update
M13-5	Tiverton Tap to EMI Tiverton Tap 115 kV Line Section	[redacted]	[redacted]	180	<100
M13-6	EMI Tiverton Tap to EMI Tiverton 115 kV Line Section	[redacted]	[redacted]	180	<100
M13-7	Canonicus to Dexter 115 kV Line Section	[redacted]	[redacted]	165	<100

4.7 N-1-1 Voltage Needs No Longer Observed

Table 4-6:
N-1-1 Voltage Needs No Longer Observed

Bus Name	Base kV	Element OOS	Contingency	Revised 2029 Needs Assessment Update Post Contingency Pre-switching Voltage (p.u.)	Revised 2029 Needs Assessment Update Post Contingency Post-switching Voltage (p.u.)
Berry Street	115	[redacted]	[redacted]	>0.95	>0.95
Kingston	115	[redacted]	[redacted]	>0.90	>0.95

Section 5
Time-Sensitivity Testing

For each confirmed transmission need identified at peak load levels in the steady-state analysis, additional analysis was performed to determine the time-sensitivity of the confirmed need. Transmission needs identified in this study have been deemed time-sensitive if they have a year of need within three years of the completion of this Needs Assessment. Since the publishing date of this assessment occurs after May 31, 2020, the threshold for determining time-sensitive needs is the 2023 summer peak. If a transmission need identified in this study (2029) exists in cases that represent the 2023 summer peak, then those needs are deemed time-sensitive.

5.1 Creation of Time-Sensitive Base Cases

The time-sensitive base cases are created by modifying the loads in the 10-year projection of the 90/10 summer peak load base case (study horizon base cases) to represent the time-sensitive year summer peak load levels. The 2029 peak load base cases were modified to represent 2023 peak load base cases. Table 5-1 provides a comparison of loads between the study horizon year and time-sensitive year base cases.

Table 5-1:
Comparison of Net NE Load Levels Study Horizon Year vs Time-Sensitive Year (Excluding Transmission Losses)

Category	Summer Peak 2029 90/10 Load (MW)	Summer Peak 2023 90/10 Load (MW)
CELT 2020 Forecast	32,946	31,191
Non-CELT Manufacturing load in New England	301	301
Available FCA-14 ADCR (modeled as negative load)	-552	-552
Available 2020 CELT EE Forecast for study year (modeled as negative load)	-5,595	-4,181
Available 2020 CELT PV Forecast for study year (modeled as negative load)	-2,055	-1,377
Net load modeled in New England (Excludes Station Service)	25,045	25,382

The transmission and generation topology in the study horizon base cases is maintained in the time-sensitive base cases.

There are no study area generators that are assumed to be retired in the study horizon year that are expected to be online in the time-sensitive year. Therefore, no generators were added to the time-sensitive year base cases that are not included in the study horizon year base cases.

5.2 Generator Dispatch in Time-Sensitive Base Cases

Since there are no retired generators in the study area and therefore no differences in the generators included in the time-sensitive base cases when compared to the study horizon base cases, the following dispatches for the study horizon base cases were used for the time-sensitive base cases.

- D04 – West-East stress with Edgar and Potter out of service
- D07 – West-East stress with a Milford unit out of service
- D14 – West-East stress with Tiverton and Dartmouth out of service
- D19 – East-West stress with Edgar and Potter out of service
- D22 – East-West stress with a Milford unit out of service
- D23 – East-West stress with Tiverton and Dartmouth out of service

These dispatch cases were selected to be used for the time-sensitivity analysis because the worst thermal and voltage violations in the study horizon cases were observed with these dispatch cases.

5.3 Results of Time-Sensitivity Testing

The time-sensitive results are shown in Table 5-2, Table 5-3, Table 5-4, Table 5-5, and Section 5.4. All thermal and voltage violations identified in the 2029 peak load conditions are time-sensitive needs.

Table 5-2:
N-1 Thermal Results

Element ID	Element	Dispatch	Contingency	LTE Rating (MVA)	N-1 % LTE Loading in the Revised 2023 Needs Assessment Update
112-4	Industrial Park Tap to Industrial Park	[redacted]	[redacted]	246	155.2
111-1	HighHill to Industrial Park	[redacted]	[redacted]	243	139.6
L14-3	Bent Rd to Tiverton	[redacted]	[redacted]	210	118.1
L14-4	Bell Rock to Tiverton	[redacted]	[redacted]	250	110.9
L14-7	Canonicus to Dexter W	[redacted]	[redacted]	165	101.3

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Table 5-3:
N-1 Voltage Results

Bus Name	Base kV	Dispatch	Contingency	Revised 2023 Needs Assessment Update Post Contingency Pre-switching Voltage (p.u.)	Revised 2023 Needs Assessment Update Post Contingency Post-switching Voltage (p.u.)
Purchase Street	115	[redacted]	[redacted]	>0.90	0.921
Hopkinton 501	115	[redacted]	[redacted]	>0.90	0.921
Jepson	115	[redacted]	[redacted]	0.722	0.668
Wing Lane	115	[redacted]	[redacted]	>0.90	0.881
High Hill	115	[redacted]	[redacted]	0.821	0.791
Dexter W	115	[redacted]	[redacted]	0.725	0.672
Bell Rock	115	[redacted]	[redacted]	0.790	0.753
Industrial Park	115	[redacted]	[redacted]	0.843	0.818

REDACTED

**Table 5-4:
N-1-1 Thermal Results**

Element ID	Element	Dispatch	Element OOS	Contingency	LTE Rating (MVA)	N-1-1 %LTE Loading in the Revised 2023 Needs Assessment Update
J16S	Staples to Highland Park	[redacted]	[redacted]	[redacted]	115	100.6
C129N-1	Millbury to Purchase	[redacted]	[redacted]	[redacted]	218	117.6
112-1	Tremont N. To Rochester	[redacted]	[redacted]	[redacted]	357	140.3
112-2	Rochester to Crystal Tap	[redacted]	[redacted]	[redacted]	357	139.3
112-3	Industrial Park Tap to Crystal Tap	[redacted]	[redacted]	[redacted]	357	139.3
112-4	Industrial Park Tap to Industrial Park	[redacted]	[redacted]	[redacted]	246	156.9
111-1	High Hill to Industrial Park	[redacted]	[redacted]	[redacted]	243	140.9
L14-3	Bent Rd to Tiverton	[redacted]	[redacted]	[redacted]	210	119.5
L14-4	Bell Rock to Tiverton	[redacted]	[redacted]	[redacted]	250	112.0
L14-7	Canonicus to Dexter W	[redacted]	[redacted]	[redacted]	165	103
N12-1	Somerset to Sykes Rd	[redacted]	[redacted]	[redacted]	284	127.6
N12-2	Sykes Rd to Bell Rock	[redacted]	[redacted]	[redacted]	284	116.9
M13-4	Somerset to Sykes Rd	[redacted]	[redacted]	[redacted]	284	132.4
M13-8	Tiverton to Sykes Rd	[redacted]	[redacted]	[redacted]	250	137.6
136-1	Hatchville to Falmouth Tap	[redacted]	[redacted]	[redacted]	257	107.1

Table 5-5:
N-1-1 Voltage Results

Bus Name	Base kV	Dispatch	Element OOS	Contingency	Revised 2023 Needs Assessment Update Post Contingency Pre-switching Voltage (p.u.)	Revised 2023 Needs Assessment Update Post Contingency Post-switching Voltage (p.u.)
Purchase Street	115	[redacted]	[redacted]	[redacted]	0.784	0.780
Hopkinton 501	115	[redacted]	[redacted]	[redacted]	0.784	0.780
Union Street	115	[redacted]	[redacted]	[redacted]	0.854	0.852
Jepson	115	[redacted]	[redacted]	[redacted]	0.630	0.579
Wing Lane	115	[redacted]	[redacted]	[redacted]	0.777	0.754
High Hill	115	[redacted]	[redacted]	[redacted]	0.718	0.685
Dexter W	115	[redacted]	[redacted]	[redacted]	0.632	0.583
Bell Rock	115	[redacted]	[redacted]	[redacted]	0.698	0.659
Industrial Park	115	[redacted]	[redacted]	[redacted]	0.738	0.710
Brook Street	115	[redacted]	[redacted]	[redacted]	>0.90	0.935
Kingston	115	[redacted]	[redacted]	[redacted]	>0.90	0.944

5.4 Time-Sensitive Consequential Load Loss

In 2023, the loss of [redacted] followed by the loss of the [redacted] results in the loss of 436 MW of gross load in the Cape area.

In 2023, the loss of [redacted] followed by the loss of the [redacted] results in the loss of 417 MW of gross load in the Industrial Park and Somerset/Newport areas.

5.5 Non-Transmission Options

The Revised SEMA/RI 2029 Needs Assessment Update already considers existing and new generating capacity resources with FCM obligations, and all resources with a binding contract. There are no Elective Transmission Upgrades (ETUs) in the SEMA/RI study area with a Forward Capacity Auction commitment that would resolve these violations. Non-transmission options are not adequate to relieve the reliability criteria violations in SEMA/RI.

5.6 Determination

All of the confirmed needs identified in the Revised SEMA/RI 2029 Needs Assessment Update, as shown in Table 4-1, Table 4-2, Table 4-3, Table 4-4, and Section 4.5 are confirmed to be time-sensitive.

The needs in the SEMA/RI area were first identified in the SEMA/RI 2026 Needs Assessment which was posted to the PAC section of the external website on May 26, 2016 and the SEMA/RI 2026

Needs Assessment Addendum was posted on December 15, 2016, and the SEMA/RI 2026 Needs Assessment Second Addendum was posted on July 13, 2018.

The Revised SEMA/RI 2029 Needs Assessment Update is being done due to the significant reduction in the net load to be served compared to what was assumed in the prior assessments.

The result of the Revised SEMA/RI 2029 Needs Assessment Update shows that the reliability criteria violations shown in Table 4-1, Table 4-2, Table 4-3, Table 4-4, and Section 4.5 seen in the SEMA/RI 2026 Needs Assessment are still present and are still deemed time-sensitive in the Revised SEMA/RI 2029 Needs Assessment Update. The ISO will continue to work with the following Participating Transmission Owners, Eversource and National Grid, to bring the identified projects to completion shown in Table 6-1 and Table 6-5.

Section 6
Project Resolution Based on Updated Study Results

6.1 Projects with Needs that Still Exist

The following projects solve the confirmed needs shown in Table 4-1, Table 4-2, Table 4-3, Table 4-4, and Section 4.5. These projects are being retained and Eversource and National Grid should bring the identified projects to completion.

Table 6-1:
Projects to be Retained

Project ID	Project Description
1732	Loop the 201-502 line into the Medway substation to form the 201-502N and 201-502S lines
1726	Separate the 135/122 DCT
1720	Separate the N12/M13 DCT and reconductor the N12 and M13 lines between Somerset and Bell Rock substations
1722	Extend Line 114 – Dartmouth town line to Bell Rock
1730	Extend Line 114 – Eversource/National Grid border to Industrial Park tap
1721	Install a 37.5 MVAR capacitor at Bell Rock, reconfigure Bell Rock to breaker-and-a-half station, split the M13 line at Bell Rock substation, and terminate 114 line at Bell Rock; install a new breaker in series with N12/D21 tie breaker, and upgrade D21 line switch
1731	Install a 35.3 MVAR capacitor at High Hill substation and install a 35.3 MVAR capacitor at Wing Lane substation
1728	Build a new 115 kV line from Carver to Kingston substations and add a new Carver terminal
1729	Install a new bay position at Kingston substation to accommodate new 115 kV line
1782	Reconductor the J16S line
1725	Build a new 115 kV line (144 line) from Bourne to West Barnstable substations which includes associated terminal work

6.2 Projects which are Candidates for Cancellation

The following projects are candidates to be cancelled because the needs solved by these projects are no longer observed as shown by Table 4-5 and Table 4-6.

**Table 6-2:
Projects to be cancelled**

Project ID	Project Description
1733	Separate the 325/344 DCT – West Medway to West Walpole
1719	Install a 45.0 MVAR capacitor bank at Berry Street substation
1723	Reconductor L14 and M13 lines from Bell Rock substation to Bates Tap
1724	Replace the Kent County T3 345/115 kV transformer

6.3 Feedback from the Transmission Owners

For the four projects with needs no longer observed, the ISO contacted Eversource and National Grid and collected additional information to understand the exact status of each solution component. Table 6-3 shows the amount of project spending for each project alongside of the latest cost estimate from the June 2020 Project List.

**Table 6-3:
Estimated cost versus Project spending**

Project ID	Project Description	June 2020 Project List Estimated Cost ($M)	Project Spending ($M)	Percentage % (Project Spending / Estimated Cost)
1733	Separate the 325/344 DCT – West Medway to West Walpole	$17.9	$1.1	6.1
1719	Install a 45.0 MVAR capacitor bank at Berry Street substation	$5.0	$1.5	30.0
1723	Reconductor L14 and M13 lines from Bell Rock substation to Bates Tap	$38.7	$2.6	6.7
1724	Replace the Kent County T3 345/115 kV transformer	$5.9	$3.0	50.8

In addition to the project spending information received, National Grid also shared the following additional information on the Project ID 1724 - Replace the Kent County T3 345/115 kV transformer.

- The existing Kent County T3 transformer is a McGraw Edison shell type transformer installed in 1971 and is National Grid's last remaining transformer of its kind in their 345 kV autotransformer fleet
- Short circuit levels have increased to 40 kA on the 115 kV system at the Kent County station due to the addition of two new autotransformers and other sources in the network

- There has been a trend of similar units failing over the years due to short circuit events outside of the transformer protection scheme

6.4 Determination

Due to the revised assessment on need and the status of the projects, including the small percentage of project spending versus the projects' estimated costs, Table 6-4 shows the projects which will be cancelled.

Table 6-4:
Projects Cancelled

Project ID	Project Description	Status
1733	Separate the 325/344 DCT – West Medway to West Walpole	Cancelled
1719	Install a 45.0 MVAR capacitor bank at Berry Street substation	Cancelled
1723	Reconductor L14 and M13 lines from Bell Rock substation to Bates Tap	Cancelled

Based on the current age of the Kent County T3 (approximately 50 years), the short circuit considerations, and known asset family history, this unit is a significant concern. In addition, National Grid has spent a high percentage of the estimated cost (approximately 50%). Therefore, Project ID# 1724 – Replace the Kent County T3 345/115 kV transformer will be retained. National Grid had placed the project on hold late last year awaiting the results of the ISO's Needs Assessment Update effort. The new in-service date for the project is March 2022.

Table 6-5:
Project Retained

Project ID	Project Description	Status	Updated In-service Date (ISD)
1724	Replace the Kent County T3 345/115 kV transformer	Retained	March 2022

Section 7
Conclusion

7.1 Confirmed Needs

The results of the steady-state assessment conducted of the SEMA/RI area transmission performance against transmission reliability standards for the projected 2029 system conditions in this study indicate that there are PTF thermal and voltage violations under peak load conditions in the study area. Almost all of the thermal and voltage violations identified were also observed in the SEMA/RI 2026 Needs Assessment and Addendums. See Table 4-1, Table 4-2, Table 4-3, Table 4-4, and Section 4.5. The thermal and voltage violations observed in both the Revised SEMA/RI 2029 Needs Assessment Update and SEMA/RI 2026 Needs Assessment and Addendums indicate that the SEMA/RI area transmission system fails to meet the reliability criteria standards in the study area under the design case testing performed.

7.2 Needs No Longer Observed

In addition, some of the needs identified in the SEMA/RI 2026 Needs Assessment are no longer observed as needs in the Revised SEMA/RI 2029 Needs Assessment Update due to the significant reduction in the net load to be served. See Table 4-5 and Table 4-6.

7.3 Time-Sensitivity Results

7.3.1 Review of Time-Sensitive Needs

Table 5-2, Table 5-3, Table 5-4, Table 5-5, and Section 5.4 list the time-sensitive needs observed at the peak load levels in the SEMA/RI study area. The need-by date for the peak load time-sensitive needs is set to June 1, 2023.

7.3.2 Review of Non-Transmission Options

The Revised SEMA/RI 2029 Needs Assessment Update already considers existing and new generating capacity resources with FCM obligations, and all resources with a binding contract. There are no Elective Transmission Upgrades (ETUs) in the SEMA/RI study area with a Forward Capacity Auction commitment that would resolve these violations. Non-transmission options are not adequate to relieve the reliability criteria violations in ME.

7.3.3 Discussion on if the Identified Time-Sensitive Needs were Previously Seen

The needs in the SEMA/RI area were first identified in the SEMA/RI 2026 Needs Assessment which was posted to the PAC section of the external website on May 26, 2016 and the SEMA/RI 2026 Needs Assessment Addendum was posted on December 15, 2016, and the SEMA/RI 2026 Needs Assessment Second Addendum was posted on July 13, 2018.

7.3.4 Time-Sensitivity Determination

The result of the Revised SEMA/RI 2029 Needs Assessment Update shows that the reliability criteria violations shown in Table 4-1, Table 4-2, Table 4-3, Table 4-4, and Section 4.5 seen in the SEMA/RI 2026 Needs Assessment are still present and are still deemed time-sensitive in the Revised SEMA/RI 2029 Needs Assessment Update. The ISO will continue to work with the following Participating Transmission Owners, Eversource and National Grid, to bring the identified projects to completion.

7.4 Projects to be Retained

The eleven projects shown in Table 6-1 solve the confirmed needs shown in Table 4-1, Table 4-2, Table 4-3, Table 4-4, and Section 4.5. These projects are being retained and Eversource and National Grid should bring the identified projects to completion.

One additional project, Project ID# 1724 – Replace the Kent County T3 345/115 kV transformer will be retained based on asset condition related information and the project spending amount received from National Grid.

7.5 Project to be Cancelled

Due to the revised assessment on need and the status of the projects, including the small percentage of project spending versus the projects' estimated costs, Table 6-4 shows the projects which will be cancelled.

Section 8

Appendix A: Non-Coincident Peak Loads on the Cape

At the April 2020 PAC meeting, Eversource provided comments to the ISO indicating that the loads that were included in 2029 SEMARI Needs Assessment Update presented were significantly lower than the actual loads observed on Cape Cod.

8.1 Tremont-East Load Area

The Tremont East load area (Tremont East) includes the loads on Cape Cod, plus a few substations that are not on Cape Cod. Tremont East is a defined load area for which aggregate data was readily available. More than 85% of Tremont East load is on Cape Cod. Figure 8-1 and Figure 8-2 show the one line diagram and geographical map of the Tremont East.

Figure 8-1:
Tremont East One Line Diagram

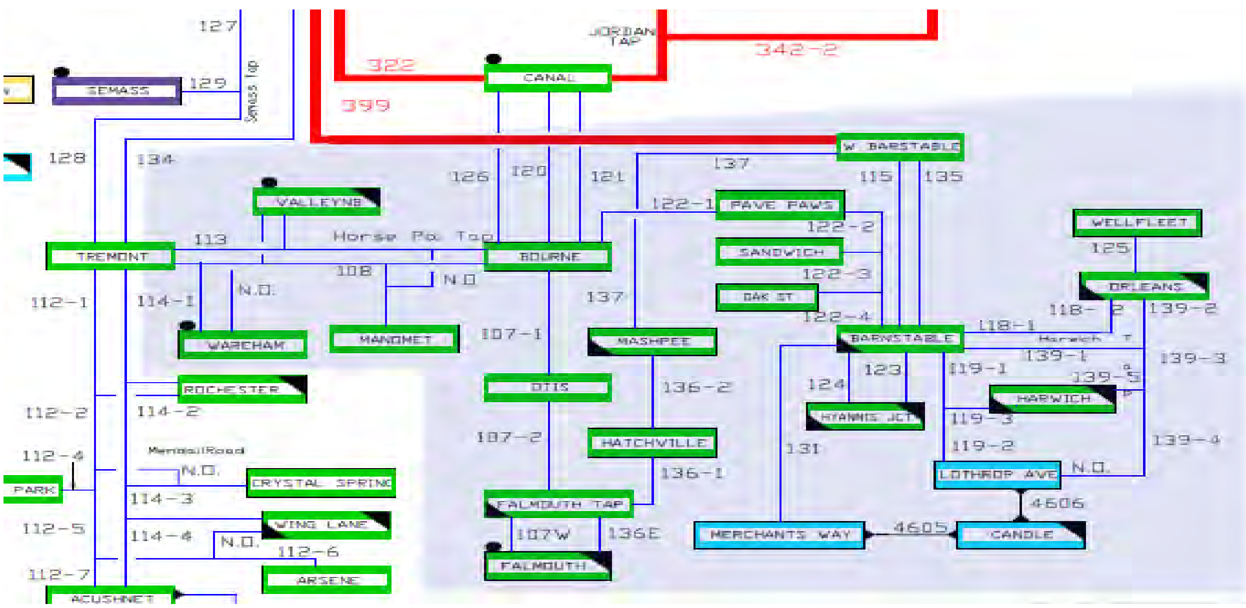
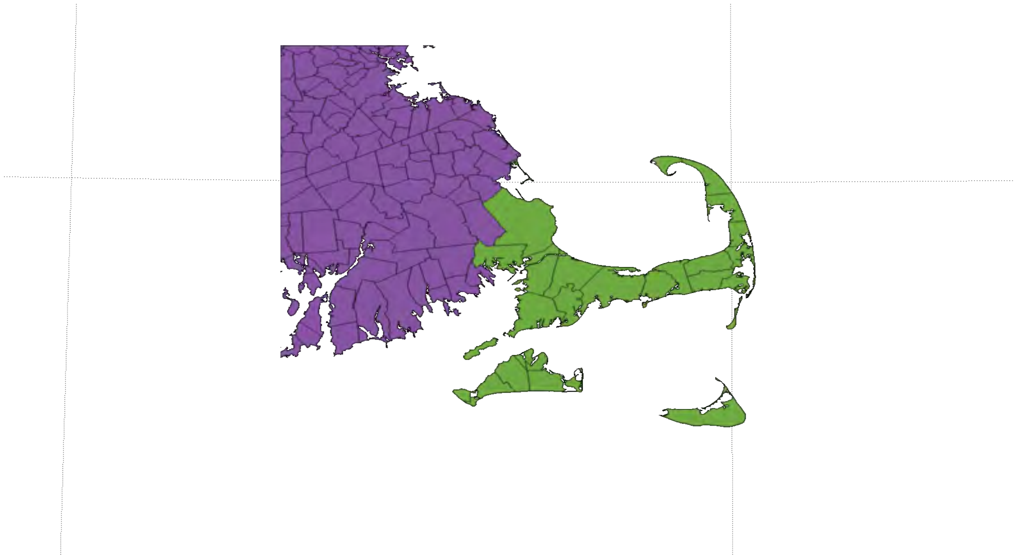


Figure 8-2:
Tremont East Geographical Map



8.2 Historical Loads Versus 2029 Study Loads for Tremont East

The net load for Tremont East in the 2029 study cases that were presented at the April PAC meeting was 556 MW.[11] In the Revised SEMA/RI 2029 Needs Assessment Update study cases based on 2020 CELT data, the net load for the Tremont East area is 587 MW.

There were 25 days in the 2016 to 2019 period when the observed net peak load hour in Tremont East exceeded 570 MW.[12] These net loads include the impact of EE, Active DR and BTM PV.

Table 8-1 show the net peak loads for 2016 to 2019 period, all of which occurred between 17:00 and 19:00.

[11] The load in the study cases presented at the April PAC meeting was based on the 2019 CELT data.

[12] 570 MW was selected as a load level higher than that studied for the April 2020 PAC discussion.

Table 8-1:
Peak load hours

Time	Load (MW)	Time	Load (MW)	Time	Load (MW)
8/14/2016 18:00	688	8/8/2018 18:00	597	8/9/2018 18:00	585
7/21/2019 18:00	665	8/22/2019 18:00	595	7/25/2016 18:00	584
7/20/2019 18:00	646	8/7/2018 18:00	592	7/31/2019 18:00	583
8/12/2016 17:00	637	7/22/2016 18:00	591	8/13/2016 19:00	582
8/11/2016 18:00	623	8/3/2018 18:00	588	7/4/2018 18:00	578
8/6/2018 18:00	609	7/5/2018 18:00	586	8/17/2018 18:00	576
8/19/2019 18:00	606	7/1/2018 18:00	586	8/16/2016 18:00	573
7/30/2019 18:00	604	8/16/2018 18:00	586	7/3/2018 19:00	571
8/15/2016 18:00	600				

The net Summer Peak load hour (includes BTM PV) for Tremont East occurs significantly later than the net Summer Peak load hour for the ISO-NE region. This is at least partially attributed to a higher level of PV penetration in Tremont East compared to the ISO-NE region.

On average, Tremont East net load peaks on weekends when compared to weekdays. In contrast, on average the ISO-NE region net load peaks on weekdays.

The historical data provides information on the net loads that can be expected in the short term, say 2020. However, additional analysis was performed to determine the net load levels to model for Tremont East in 2029 by taking into account future load growth, future EE, future PV and future ADCR.

Table 8-2 summarizes the net loads in the 2020 and 2029 study models.

Table 8-2:
Load comparison

	2020 Study Year (MW)	2029 Study Year (MW)	Delta (MW) 2029 minus 2020
Gross Load (2020 CELT Data)	771	854	83
Load Reduction based on EE Forecast (2020 CELT Data)	-104	-170	-66
Load Reduction based on ADCR (FCA 11 for 2020 and FCA 14 for 2029)	-3.4	-7.1	-3.7
Load Reduction based on PV Forecast (2020 CELT Data)	-41.1	-90.4	-49.3
Net Loads	622.5	586.5	-36.0

8.3 Historical Net Loads Reconstituted for PV

When the net 2029 loads for the Tremont East area are reconstituted for PV, we see a small increase in the net loads reconstituted for PV from 2020 to 2029. It was considered reasonable to assume that net loads reconstituted for PV in 2029 would be comparable to historical net loads reconstituted for PV.

Using PV production data and PV installed capacity data for the towns in the Tremont East load area, the historical net loads were reconstituted for PV. The towns in green in Figure 8-2 were considered to be in the Tremont East load area

Figure 8-3 shows the PV reconstitution for July 21, 2019 and the net load reconstituted for PV for the 25 days where the net peak load hour for Tremont East exceeded 570 MW.

Figure 8-3:
Peak Net Load Reconstituted for PV Curve

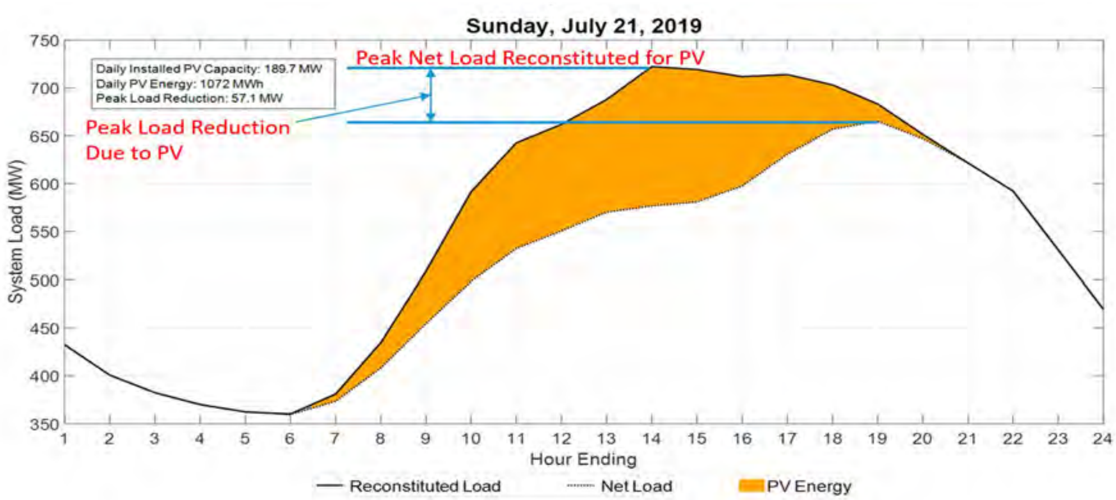
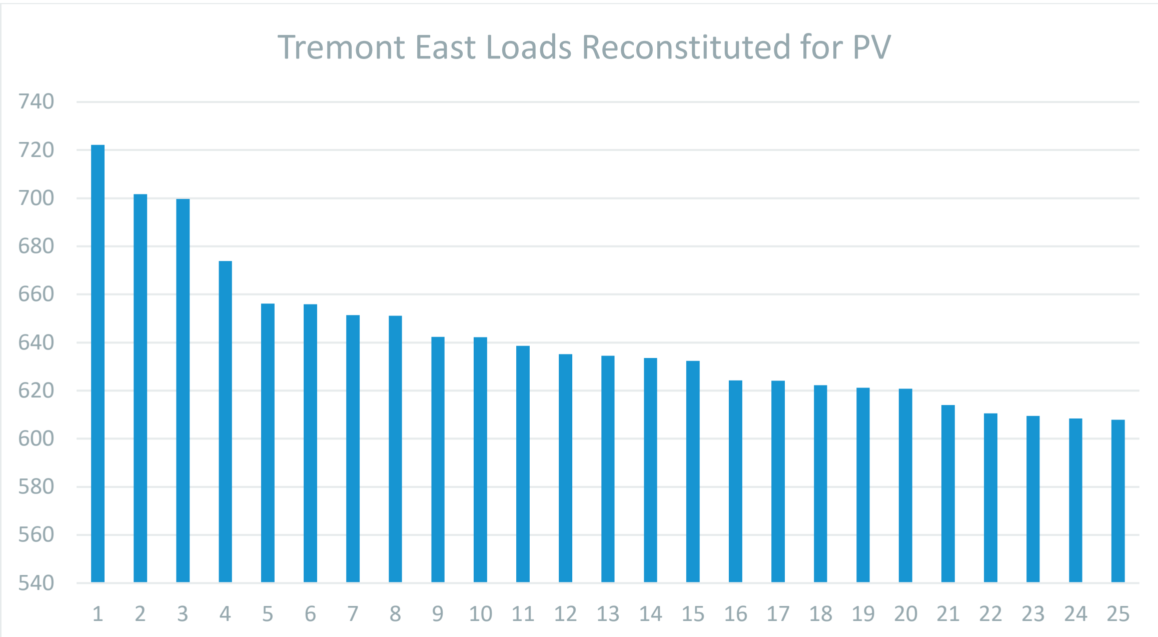


Figure 8-4 shows the range of daily peaks for Tremont East loads reconstituted for PV. The values range between 608 to 722 MW and the time of the daily peak for Tremont East load reconstituted for PV ranges from 1300 to 1700 hours.

Figure 8-4:
Tremont East Load Reconstituted for PV



8.4 Cape Cod Load Sensitivity #1 (CCL1)

The first sensitivity case for the Cape Cod loads (CCL1) was analyzed by adjusting the gross loads, EE forecast and ADCR in Tremont East such that:

- Load – (EE + DR) = 720 MW

The value of 720 MW was selected because historical net loads reconstituted for PV in Tremont East have exceeded 720 MW and forecasted net loads without PV do not change significantly in the planning horizon (2020 to 2029). The CCL1 sensitivity results in an effective increase of the net Tremont East load by 43 MW.

For the CCL1 sensitivity, the assumed availability for the PV in Tremont East was unchanged.[13]

8.5 Cape Cod Load Sensitivity #2 (CCL2)

Tremont East has a high forecasted PV penetration of 330 MW of PV in 2029. For a 720 MW peak load level, the PV penetration level is about 46% of the peak. At such high PV penetration levels, the assumed 26% availability for PV may be too high.

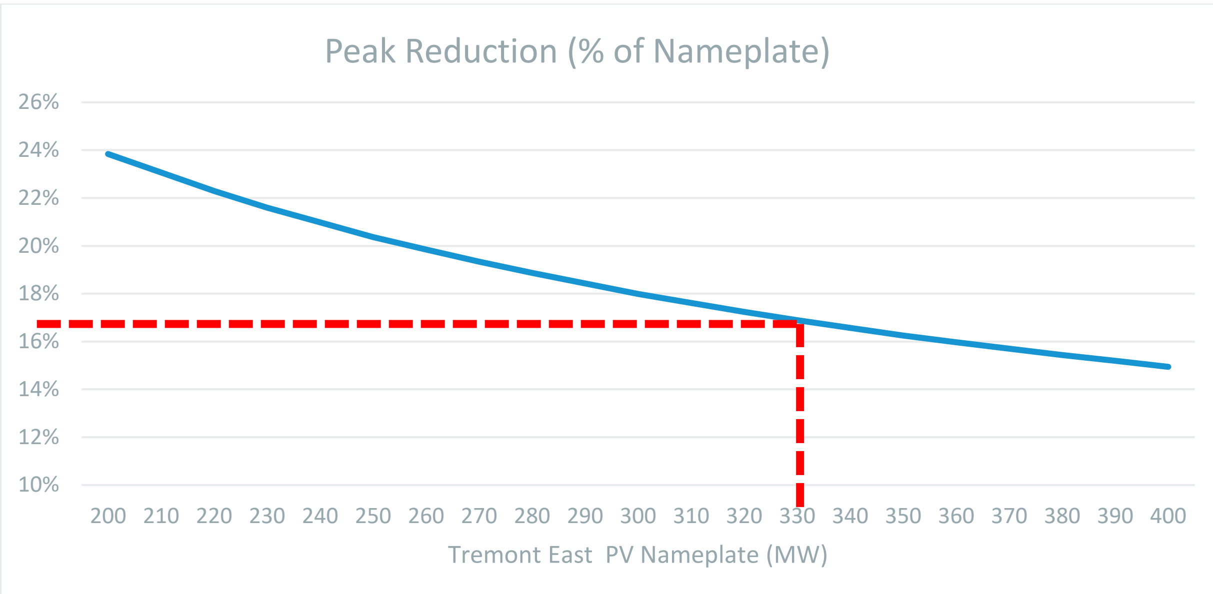
[13] A 26% availability was utilized for the 330 MW of assumed PV in the Tremont East area.

Based on an analysis performed by the ISO, Figure 8-5 shows the peak reduction as a percentage of PV nameplate for Tremont East.[14] The top 10 peak days of reconstituted PV were used for Tremont East. The net load was calculated by the formula:

- Net Load = Net Load reconstituted for PV – (Peak Reduction Percentage x PV Nameplate)

Since there are 330 MW of PV in Tremont East for the 2029 study year, a 17% availability may be more appropriate for the 2029 study year.

Figure 8-5:
Peak Reduction (% of Nameplate)



The second sensitivity for the Cape Cod loads (CCL2) was to evaluate the impact of the reduced PV availability, and higher gross load based on historical data for Tremont East. A peak load level for Tremont East is set at 720 MW and a PV availability percentage of 17% is used. The CCL2 sensitivity results in an effective increase of the net Tremont East load by 74 MW.

8.6 CCL1 and CCL2 Sensitivity Results

The sensitivity analysis was done with a focus on the Cape Cod area. Only criteria violations observed in the Cape Cod area are reported. There are no N-1 thermal or voltage violations. In addition there are no N-1-1 voltage violations. There are N-1-1 thermal overloads observed for the non-coincident peak loads on the Cape sensitivity (CCL1 and CCL2) and are shown in Table 8-3.

[14] The same analytical framework described in the April 29, 2020 presentation titled "Estimating Summer Peak Demand Reductions from Behind-the-Meter Photovoltaics" (https://www.iso-ne.com/static-assets/documents/2020/04/final_btm_pv_peak_reduction.pdf) for the regional summer peak demand was used for load and PV for the Tremont East area.

**Table 8-3:
N-1-1 Thermal in Tremont East Area**

Element ID	Element	Dispatch	Element OOS	Contingency	LTE Rating (MVA)	N-1-1 % LTE Loading in the Revised 2029 Needs Assessment Update 26% PV	N-1-1 % LTE Loading in the 2029 Needs Assessment Update 720 MW & 26 % PV (CCL1)	N-1-1 % LTE Loading in the 2029 Needs Assessment Update 720 MW & 17% PV (CCL2)
136-1	Hatchville to Falmouth Tap	[redacted]	[redacted]	[redacted]	257	101.1	115	125.1
136-2	Hatchville to Mashpee	[redacted]	[redacted]	[redacted]	243	<100	108.1	118.1
107-1	Otis to Bourne	[redacted]	[redacted]	[redacted]	407	<100	<100	105.9
137	W Barnstable to Mashpee	[redacted]	[redacted]	[redacted]	243	<100	<100	100.7

8.7 CCL1 and CCL2 Sensitivity Summary

A review of historical data for Cape Cod area loads indicated that the net load in the Cape Cod area may peak non-coincidentally from ISO-NE and therefore the power flow models representing ISO-NE coincident peaks may not capture the peak loads observed on Cape Cod.

To reflect the expected non-coincident peak loads in the Cape Cod area in 2029, two Cape Cod area load sensitivities were studied with varying assumptions for load, DR, EE and PV availability. These sensitivities resulted in an effective increase in load ranging from 43 MW to 74 MW in the Tremont East area when compared to the base scenario.

The two sensitivity scenarios (CCL1 and CCL2) lead to N-1-1 thermal overloads on elements on the 115 kV system in the Cape Cod area.

The sensitivity scenario with the highest loads (CCL2 = 74 MW) increase of net Tremont East loads results in four elements with N-1-1 thermal overloads.

- 136-1 line from Hatchville to the Falmouth Tap
- 136-2 line from Hatchville to Mashpee
- 107-1 line from Otis to Bourne
- 137 line W Barnstable to Mashpee

Project ID# 1725 – Build a new 115 kV line (144 line) from Bourne to West Barnstable substations identified in the Revised 2029 SEMA/RI Needs Assessment Update will also resolve additional needs observed in the CCL1 and CCL2 sensitivities.

Section 9

Appendix B: Reduced OSW output applied to existing OSW projects (Vineyard Wind and Revolution Wind)

9.1 Reduced OSW Output Applied to Existing OSW Projects Sensitivity

Recent data on offshore wind speeds obtained by ISO-NE shows that offshore wind generation output will be highly variable under summer peak load conditions. Observed wind speeds during peak load conditions would result in wind generation output as low as 1.47% of turbine nameplate ratings. Given this information, an output of 5% of nameplate captures reasonably likely conditions.[15]

For this sensitivity, the Revised SEMA/RI 2029 Needs Assessment Update cases were updated to include the following for the reduced OSW output applied to existing OSW projects:

- Vineyard Wind and Revolution Wind were modeled at 5% of their nameplate rating
- The Cape Cod Load sensitivity CCL2 is included
    - Load-DR-EE for Tremont Area set to 720 MW
    - PV availability of 17% was used
    - The CCL2 sensitivity results in an effective increase of the net Tremont East load by 74 MW

9.2 Reduced OSW Output Applied to Existing OSW Projects Sensitivity Results

The results of the sensitivity to reduced OSW output applied to existing OSW projects are shown in Table 9-1, Table 9-2, Table 9-3, and Table 9-4 and are compared to the results of the Revised SEMA/RI 2029 Needs Assessment Update.

[15] https://www.iso-ne.com/static-assets/documents/2020/02/a7a_wind_power_time_series_isone.pdf

Table 9-1:
N-1 Thermal Violation Results

Element ID	Element	Dispatch	Contingency	LTE Rating (MVA)	N-1 %LTE Loading in the Revised 2029 Needs Assessment Update	N-1 %LTE Loading in the Reduced OSW Output Applied to Existing OSW Projects Sensitivity
112-4	Industrial Park Tap to Industrial Park	[redacted]	[redacted]	246	153.7	153.4
111-1	High Hill to Industrial Park	[redacted]	[redacted]	243	138.7	138.5
L14-3	Bent Rd to Tiverton	[redacted]	[redacted]	210	119.0	118.8
L14-4	Bell Rock to Tiverton	[redacted]	[redacted]	250	111.8	111.6
L14-7	Canonicus to Dexter W Line	[redacted]	[redacted]	165	101.8	101.6

Table 9-2:
N-1 Voltage Violation Results

Bus Name	Base kV	Dispatch	Contingency	Revised 2029 Needs Assessment Update Worst Case Post Contingency Pre-switching Voltage (p.u.)	Reduced OSW Output Applied to Existing OSW Projects Sensitivity Post Contingency Pre-switching Voltage (p.u.)	Revised 2029 Needs Assessment Update Worst Case Post Contingency Post-switching Voltage (p.u.)	Reduced OSW Output Applied to Existing OSW Projects Sensitivity Post Contingency Post-switching Voltage (p.u.)
Purchase Street	115	[redacted]	[redacted]	>0.90	>0.90	0.924	0.924
Hopkinton 501	115	[redacted]	[redacted]	>0.90	>0.90	0.924	0.924
Jepson	115	[redacted]	[redacted]	0.727	0.726	0.672	0.671
Wing Lane	115	[redacted]	[redacted]	>0.90	>0.90	0.884	0.883
High Hill	115	[redacted]	[redacted]	0.826	0.825	0.796	0.795
Dexter W	115	[redacted]	[redacted]	0.730	0.729	0.676	0.675
Bell Rock	115	[redacted]	[redacted]	0.796	0.794	0.758	0.757
Industrial Park	115	[redacted]	[redacted]	0.848	0.847	0.822	0.821

Table 9-3:
N-1-1 Thermal Violation Results

Element ID	Element	Dispatch	Element OOS	Contingency	LTE Rating (MVA)	Revised N-1-1 %LTE Loading in the 2029 Needs Assessment Update	N-1-1 %LTE in the Reduced OSW Output Applied to Existing OSW Projects Sensitivity
J16S	Staples to Highland Park	[redacted]	[redacted]	[redacted]	115	100.3	100.3
C129N-1	Millbury to Purchase Tap	[redacted]	[redacted]	[redacted]	218	117.1	117.1
112-1	Tremont N. To Rochester	[redacted]	[redacted]	[redacted]	357	138.2	138.1
112-2	Rochester to Crystal Tap	[redacted]	[redacted]	[redacted]	357	137.3	137.1
112-3	Industrial Park Tap to Crystal Tap	[redacted]	[redacted]	[redacted]	357	137.3	137.1
112-4	Industrial Park Tap to Industrial Park	[redacted]	[redacted]	[redacted]	246	155.3	155.2
111-1	High Hill to Industrial Park	[redacted]	[redacted]	[redacted]	243	139.8	139.8
L14-3	Bent Rd to Tiverton	[redacted]	[redacted]	[redacted]	210	120.4	120.2
L14-4	Bell Rock to Tiverton	[redacted]	[redacted]	[redacted]	250	112.8	112.7
L14-7	Canonicus to Dexter W	[redacted]	[redacted]	[redacted]	165	103.6	103.5
N12-1	Somerset to Sykes Rd	[redacted]	[redacted]	[redacted]	284	125.9	125.9
N12-1	Sykes Rd to Bell Rock	[redacted]	[redacted]	[redacted]	284	115.2	115.2
M13-4	Somerset to Sykes Rd	[redacted]	[redacted]	[redacted]	284	129.8	129.7
M13-8	Tiverton to Sykes Rd	[redacted]	[redacted]	[redacted]	250	134.9	134.9

Element ID	Element	Dispatch	Element OOS	Contingency	LTE Rating (MVA)	Revised N-1-1 %LTE Loading in the 2029 Needs Assessment Update	N-1-1 %LTE in the Reduced OSW Output Applied to Existing OSW Projects Sensitivity
107-1	Otis to Bourne	[redacted]	[redacted]	[redacted]	407	<100	146.6
107-2	Falmouth Tap to Otis	[redacted]	[redacted]	[redacted]	408	<100	140.0
136-1	Hatchville to Falmouth Tap	[redacted]	[redacted]	[redacted]	257	101.1	187.2
136-2	Hatchville to Mashpee	[redacted]	[redacted]	[redacted]	243	<100	182.9
137	W Barnstable to Mashpee	[redacted]	[redacted]	[redacted]	243	<100	165
122-1	Bourne to Pave Paws	[redacted]	[redacted]	[redacted]	463	<100	110.1
122-2	Pave Paws to Sandwich	[redacted]	[redacted]	[redacted]	466	<100	109
122-3	Sandwich to Oak St	[redacted]	[redacted]	[redacted]	466	<100	104.3
122-4	Barnstable to Oak St	[redacted]	[redacted]	[redacted]	410	<100	110.2

Table 9-4:
N-1-1 Voltage Results

Bus Name	Base kV	Dispatch	Element OOS	Contingency	Revised 2029 Needs Assessment Update Worst Case Post Contingency Pre-switching Voltage (p.u.)	Reduced OSW Output Applied to Existing OSW Projects Sensitivity Post Contingency Pre-switching Voltage (p.u.)	Revised 2029 Needs Assessment Update Worst Case Post Contingency Post-switching Voltage (p.u.)	Reduced OSW Output Applied to Existing OSW Projects Sensitivity Post Contingency Post-switching Voltage (p.u.)
Purchase Street	115	[redacted]	[redacted]	[redacted]	0.789	0.789	0.785	0.785
Hopkinton 501	115	[redacted]	[redacted]	[redacted]	0.789	0.789	0.785	0.785
Union Street	115	[redacted]	[redacted]	[redacted]	0.854	0.854	0.853	0.853
Jepson	115	[redacted]	[redacted]	[redacted]	0.637	0.635	0.584	0.584
Wing Lane	115	[redacted]	[redacted]	[redacted]	0.784	0.782	0.760	0.759
High Hill	115	[redacted]	[redacted]	[redacted]	0.725	0.724	0.692	0.691
Dexter W	115	[redacted]	[redacted]	[redacted]	0.639	0.638	0.588	0.587
Bell Rock	115	[redacted]	[redacted]	[redacted]	0.698	0.696	0.695	0.658
Industrial Park	115	[redacted]	[redacted]	[redacted]	0.745	0.744	0.716	0.715
Brook Street	115	[redacted]	[redacted]	[redacted]	>0.90	>0.90	0.942	0.942
Falmouth	115	[redacted]	[redacted]	[redacted]	>0.90	>0.90	>0.95	0.929
Hatchville	115	[redacted]	[redacted]	[redacted]	>0.90	>0.90	>0.90	0.938

The results show a larger number and more severe thermal overload levels on the 115 kV lines along the path between Bourne and West Barnstable than the results of the non-coincident peak loads on the Cape sensitivity. All other results are relatively unchanged when compared to the Revised SEMA/RI 2029 Needs Assessment Update results.

The reduced OSW output applied to existing OSW projects sensitivity results in eleven elements becoming needs due to N-1-1 thermal overloads.

- 107-1 line from Bourne to Otis
- 107-2 line from Otis to Falmouth Tap

- 136-1 line from Falmouth Tap to Hatchville
- 136-2 line from Hatchville to the Falmouth Tap
- 137 line from Mashpee to West Barnstable
- 122-1 line from Bourne to Pave Paws
- 122-2 line from Pave Paws to Sandwich
- 122-3 line from Sandwich to Oak Street
- 122-4 line from Oak Street to Barnstable
- Low voltage at Falmouth and Hatchville

Project ID# 1725 – Build a new 115 kV line (144 line) from Bourne to West Barnstable substations identified in the Revised 2029 SEMA/RI Needs Assessment Update will also resolve additional needs observed in the Reduced OSW Output Applied to Existing OSW Projects sensitivity.

Section 10

Appendix C: Addition of future OSW projects at a reduced OSW output (Vineyard Wind 2 and Mayflower Wind)

10.1 Addition of Future OSW Projects at a Reduced OSW Output Sensitivity

As per stakeholder comments at April 2020 PAC meeting, Vineyard Wind 2[16] and Mayflower Wind[17] projects were close to, signing the binding contracts.

The Revised SEMA/RI 2029 Needs Assessment Update cases were updated to include the following for the Addition of Future OSW Projects sensitivity:

- Vineyard Wind 2 and Mayflower Wind were added and modeled at 5% of the their nameplate rating
- Vineyard Wind and Revolution Wind are modeled at 5% of their nameplate rating
- The Cape Cod Load sensitivity (CCL2) is included
    - Load-DR-EE for Tremont Area set to 720 MW
    - PV availability of 17% used
    - The CCL2 sensitivity results in an effective increase in Tremont East load of 74 MW

10.2 Addition of Future OSW Projects at a Reduced OSW Output Sensitivity Results

The results of the addition of future OSW projects at a reduced OSW output sensitivity are shown in Table 10-1, Table 10-2, Table 10-3, and Table 10-4 and are compared to the results of the Revised SEMA/RI 2029 Needs Assessment Update.

[16] Vineyard Wind 2 is an 800 MW off shore wind project that connects to the 345 kV at West Barnstable substation in Massachusetts (https://www.vineyardwind.com/vineyard-wind-2)

[17] Mayflower Wind was modeled as an 804 MW* off shore wind project connected to the 345 kV at West Barnstable substation in Massachusetts (https://www.mayflowerwind.com/). The referenced memo provides further information regarding the modeling of Mayflower Wind at West Barnstable. https://www.iso-ne.com/static-assets/documents/2020/11/sema_ri_pac_announcement.pdf

Table 10-1:
N-1 Thermal Violation Results

Element ID	Element	Dispatch	Contingency	LTE Rating (MVA)	N-1 %LTE Loading in the Revised 2029 Needs Assessment Update	N-1 %LTE Loading in the Addition of Future OSW Projects at a Reduced OSW Output Sensitivity
112-4	Industrial Park Tap to Industrial Park	[redacted]	[redacted]	246	153.7	153.1
111-1	High Hill to Industrial Park	[redacted]	[redacted]	243	138.7	138.1
L14-3	Bent Rd to Tiverton	[redacted]	[redacted]	210	119.0	118.5
L14-4	Bell Rock to Tiverton	[redacted]	[redacted]	250	111.8	111.2
L14-7	Canonicus to Dexter W Line	[redacted]	[redacted]	165	101.8	101.4

Table 10-2:
N-1 Voltage Violation Results

Bus Name	Base kV	Dispatch	Contingency	Revised 2029 Needs Assessment Update Post Contingency Pre-switching Voltage (p.u.)	Addition of Future OSW Projects at a Reduced OSW Output Sensitivity Post Contingency Pre-switching Voltage (p.u.)	Revised 2029 Needs Assessment Update Post Contingency Post-switching Voltage (p.u.)	Addition of Future OSW Projects at a Reduced OSW Output Sensitivity Post Contingency Post-switching Voltage (p.u.)
Purchase Street	115	[redacted]	[redacted]	>0.90	>0.90	0.924	0.924
Hopkinton 501	115	[redacted]	[redacted]	>0.90	>0.90	0.924	0.924
Jepson	115	[redacted]	[redacted]	0.727	0.724	0.672	0.669
Wing Lane	115	[redacted]	[redacted]	>0.90	>0.90	0.884	0.880
High Hill	115	[redacted]	[redacted]	0.826	0.822	0.796	0.792
Dexter W	115	[redacted]	[redacted]	0.730	0.727	0.676	0.673
Bell Rock	115	[redacted]	[redacted]	0.796	0.792	0.758	0.754
Industrial Park	115	[redacted]	[redacted]	0.848	0.844	0.822	0.819
Falmouth	115	[redacted]	[redacted]	>0.90	>0.90	>0.95	0.942

REDACTED

Table 10-3:
N-1-1 Thermal Violation Results

Element ID	Element	Dispatch	Element OOS	Contingency	LTE Rating (MVA)	N-1-1 % LTE Loading in the Revised 2029 Needs Assessment Update	N-1-1 % LTE Loading in the Addition of Future OSW Projects at a Reduced OSW Output Sensitivity
J16S	Staples to Highland Park Line	[redacted]	[redacted]	[redacted]	115	100.3	100.3
C129N-1	Millbury to Purchase Line	[redacted]	[redacted]	[redacted]	218	117.1	117.1
112-1	Tremont N. To Rochester	[redacted]	[redacted]	[redacted]	357	138.2	138.4
112-2	Rochester to Crystal Tap	[redacted]	[redacted]	[redacted]	357	137.3	137.5
112-3	Industrial Park Tap to Crystal Tap	[redacted]	[redacted]	[redacted]	357	137.3	137.5
112-4	Industrial Park Tap to Industrial Park Line	[redacted]	[redacted]	[redacted]	246	155.3	154.9
111-1	High Hill to Industrial Park Line	[redacted]	[redacted]	[redacted]	243	139.8	139.4
L14-3	Bent Rd to Tiverton Line	[redacted]	[redacted]	[redacted]	210	120.4	119.8
L14-4	Bell Rock to Tiverton Line	[redacted]	[redacted]	[redacted]	165	112.8	112.3
L14-7	Canonicus to Dexter W Line	[redacted]	[redacted]	[redacted]	250	103.6	103.1
N12-1	Somerset to Sykes Rd	[redacted]	[redacted]	[redacted]	284	125.9	125.9
N12-1	Sykes Rd to Bell Rock	[redacted]	[redacted]	[redacted]	284	115.2	115.2

REDACTED

Element ID	Element	Dispatch	Element OOS	Contingency	LTE Rating (MVA)	N-1-1 % LTE Loading in the Revised 2029 Needs Assessment Update	N-1-1 % LTE Loading in the Addition of Future OSW Projects at a Reduced OSW Output Sensitivity
M13-4	Somerset to Sykes Rd	[redacted]	[redacted]	[redacted]	284	129.8	129.7
M13-8	Tiverton to Sykes Rd	[redacted]	[redacted]	[redacted]	250	134.9	134.9
107-1	Otis to Bourne	[redacted]	[redacted]	[redacted]	407	<100	118.3
107-2	Falmouth Tap to Otis	[redacted]	[redacted]	[redacted]	408	<100	111.9
136-1	Hatchville to Falmouth Tap	[redacted]	[redacted]	[redacted]	257	101.1	144.0
136-2	Hatchville to Mashpee	[redacted]	[redacted]	[redacted]	243	<100	137.7
137	W Barnstable to Mashpee	[redacted]	[redacted]	[redacted]	243	<100	120.3

Table 10-4:
N-1-1 Voltage Results

Bus Name	Base kV	Dispatch	Element OOS	Contingency	Revised 2029 Needs Assessment Update Post Contingency Pre-switching Voltage (p.u.)	Addition of Future OSW Projects at a Reduced OSW Output Sensitivity Post Contingency Pre-switching Voltage (p.u.)	Revised 2029 Needs Assessment Update Post Contingency Post-switching Voltage (p.u.)	Addition of Future OSW Projects at a Reduced OSW Output Sensitivity Post Contingency Post-switching Voltage (p.u.)
Purchase Street	115	[redacted]	[redacted]	[redacted]	0.789	0.789	0.785	0.785
Hopkinton 501	115	[redacted]	[redacted]	[redacted]	0.789	0.789	0.785	0.785
Union Street	115	[redacted]	[redacted]	[redacted]	0.854	0.854	0.853	0.853
Jepson	115	[redacted]	[redacted]	[redacted]	0.637	0.635	0.584	0.583
Wing Lane	115	[redacted]	[redacted]	[redacted]	0.784	0.779	0.760	0.756
High Hill	115	[redacted]	[redacted]	[redacted]	0.725	0.721	0.692	0.688
Dexter W	115	[redacted]	[redacted]	[redacted]	0.639	0.637	0.588	0.586
Bell Rock	115	[redacted]	[redacted]	[redacted]	0.698	0.694	0.659	0.655
Industrial Park	115	[redacted]	[redacted]	[redacted]	0.744	0.741	0.716	0.712
Brook Street	115	[redacted]	[redacted]	[redacted]	>0.90	>0.90	0.942	0.940
Falmouth	115	[redacted]	[redacted]	[redacted]	>0.90	>0.90	>0.95	0.922
Hatchville	115	[redacted]	[redacted]	[redacted]	>0.90	>0.90	>0.95	0.932

The results show a lower number and less severe thermal overload levels on the 115 kV lines along the path between Bourne and West Barnstable than the results of the reduced OSW output applied to existing OSW projects sensitivity results. All other results are relatively unchanged when compared to the Revised SEMA/RI 2029 Needs Assessment Update results.

The addition of future OSW projects at a reduced OSW output sensitivity results in seven elements becoming needs due to N-1-1 thermal overloads.

- 107-1 line from Bourne to Otis
- 107-2 line from Otis to Falmouth Tap
- 136-1 line from Falmouth Tap to Hatchville
- 136-2 line from Hatchville to the Falmouth Tap

- 137 line from Mashpee to West Barnstable
- Low voltage at Falmouth and Hatchville

Project ID# 1725 – Build a new 115 kV line (144 line) from Bourne to West Barnstable substations identified in the Revised 2029 SEMA/RI Needs Assessment Update will also resolve additional needs observed in the Addition of Future OSW Projects at a Reduced OSW Output sensitivity.

Section 11

Appendix D: Contingency List

11.1 Appendix D1: Revised SEMA/RI 2029 Needs Assessment Update N-1 Contingencies Summary Report

Appendix D1 is included in the zip file titled "Revised_SEMARI_2029_Needs_Assessment_Update _Appendices.zip" which is posted on the ISO website under the key study area for Southeastern Massachusetts and Rhode Island.[18]

N-1 Contingencies for all analysis:

Appendix_D1_N-1.pdf

11.2 Appendix D2: Revised SEMA/RI 2029 Needs Assessment Update Initial Element Out Summary Report

Appendix D2 is included in the zip file titled "Revised_SEMARI_2029_Needs_Assessment_Update _Appendices.zip" which is posted on the ISO website under the key study area for Southeastern Massachusetts and Rhode Island.

Element Out Contingencies for all analysis:

Appendix_D2_Element_Out.pdf

11.3 Appendix A3: Revised SEMA/RI 2029 Needs Assessment Update N-1-1 Second Level Contingency List Summary Report

Appendix A3 is included in the zip file titled "Revised_SEMARI_2029_Needs_Assessment_Update _Appendices.zip" which is posted on the ISO website under the key study area for Southeastern Massachusetts and Rhode Island.

N-1-1 Second Level Contingencies for the all analysis:

Appendix_D3_N-1-1.pdf

[18] https://www.iso-ne.com/system-planning/key-study-areas/sema-ri/

11.4 Appendix A4: Revised SEMA/RI 2029 Needs Assessment Update Contingency Changes

Three contingencies were added to the contingencies listed above.

Table 11-1:
Contingency List Changes

Contingency Name	Contingency Description	Contingency Change Description	Used for Base System	Used for Non-Coincident Peak Loads on the Cape Sensitivity	Used for Reduced OSW output applied to existing OSW projects Sensitivity	Used for Addition of future OSW projects at a reduced OSW output Sensitivity
GN_RevWnd	Generator contingency to remove Revolution Wind	Addition to the contingency list	X	X	X	X
GN_MayFl	Generator contingency to remove Mayflower Wind	Addition to the contingency list				X
GN_VW2	Generator contingency to remove Vineyard Wind 2	Addition to the contingency list				X

Section 12
Appendix E: Case Summaries

The case summaries for the Revised SEMA/RI 2029 Needs Assessment Update are available in the zip file titled "Revised_SEMARI_2029_Needs_Assessment_Update _Appendices.zip" which is posted on the ISO website under the key study area for Southeastern Massachusetts and Rhode Island.[19]

Case summaries for the base system:

Appendix_E1_2029_SEMARI_base.pdf

Case summaries for the Non-Coincident Peak Loads on the Cape CCL1 Sensitivity:

Appendix_E2_2029_SEMARI_CCL1.pdf

Case summaries for the Non-Coincident Peak Loads on the Cape CCL2 Sensitivity:

Appendix_E3_2029_SEMARI_CCL2.pdf

Case summaries for Reduced OSW output applied to existing OSW projects (Vineyard Wind and Revolution Wind) Sensitivity:

Appendix_E4_2029_SEMARI_5pctRevVW.pdf

Case summaries for Addition of future OSW projects at a reduced OSW output (Vineyard Wind 2 and Mayflower Wind) Sensitivity:

Appendix_E5_2029_SEMARI_5pctOSW.pdf

Case summaries for Time-Sensitive analysis:

Appendix_E6_2029_SEMARI_TimeSens.pdf

[19] https://www.iso-ne.com/system-planning/key-study-areas/sema-ri/

Section 13

Appendix F: TARA Options and Process Used for Analysis

The TARA Options and Process Used for Analysis for the Revised SEMA/RI 2029 Needs Assessment Update are included in the zip file titled "Revised_SEMARI_2029_Needs_Assessment_Update _Appendices.zip" which is posted on the ISO website under the key study area for Southeastern Massachusetts and Rhode Island.[20]

[20] https://www.iso-ne.com/system-planning/key-study-areas/sema-ri/

Section 14

Appendix G: Generator Dispatches - SEMA/RI 2026 Needs Assessment

14.1 SEMA/RI 2026 Needs Assessment Generator Dispatches

Table 14-1:
One Unit Out of Service Dispatches

Unit OOS	Modeled Capacity (MW)	One Unit OOS Dispatch Number																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Canal 2	545.1	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Edgar	688.3	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Potter	74.2	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Tiverton	244.6	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Dighton	160.3	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Cleary / Taunton	130.8	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
RISE	548.0	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Manchester / Franklin Square 11	149.0	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON
NEA Bellingham	277.6	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON
ANP Bellingham 1	236.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON
Ocean State Power C1, C2, S1	270.9	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON
ANP Blackstone 1	221.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON
Lake Road 1	245.8	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON
SEMass	69.2	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON
Dartmouth Power	83.1	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON
Milford Power	149.0	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON
Pawtucket Power	61.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF

Table 14-2:
Two Unit Out of Service Dispatches

Unit OOS	Modeled Capacity (MW)	Two Units OOS Dispatch Number															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Canal 1	549.9	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Canal 2	545.1	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Edgar	688.3	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Potter	74.2	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Tiverton	244.6	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	OFF	ON
Dighton	160.3	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Cleary/Taunton	130.8	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON
RISE	548.0	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Manchester / Franklin Square 11	149.0	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON
Manchester / Franklin Square 10	149.0	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
NEA Bellingham	277.6	ON	ON	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	OFF
ANP Bellingham 1	236.4	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON
ANP Blackstone 1	221.4	ON	ON	ON	ON	ON	ON	ON	OFF	ON	OFF	ON	ON	ON	ON	ON	ON
Ocean State Power G3, G4, S2	270.2	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON
Ocean State Power G1, G2, S1	270.9	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON
Lake Road 2	251.2	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON
Lake Road 1	245.8	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON
Dartmouth Power	83.1	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	OFF	ON	ON
Pawtucket Power	61.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON
SEMass	69.2	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON
Milford	149.0	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF

14.2 Revised SEMA/RI 2029 Needs Assessment Update Generator Dispatches

Table 14-3:
Revised SEMA/RI 2029 Needs Assessment Update Dispatches

Dispatch No	Stress	Generator OOS
D01	West-East	ANP Blackstone 1 and Ocean State Power G3,G4,S2
D02	West-East	Canal 1 and Canal 2
D03	West-East	Dighton and Cleary/Taunton
D04	West-East	Edgar and Potter
D05	West-East	Lake Road 1 and Lake Road 2
D06	West-East	Manchester/ Franklin square 10 and Manchester/Franklin square 11
D07	West-East	Milford Power
D08	West-East	NEA Bellingham and ANP Bellingham
D09	West-East	NEA Bellingham and ANP Blackstone 1
D10	West-East	Ocean State Power 1 and Ocean state Power 2
D11	West-East	Rise and Manchester/Franklin square 11
D12	West-East	SEMass and Dartmouth Power
D13	West-East	Tiverton and Clearly/Taunton
D14	West-East	Tiverton and Dartmouth Power
D15	West-East	Tiverton and Dighton
D16	East-West	ANP Blackstone 1 and Ocean State Power G3,G4,S2
D17	East-West	Canal 1 and Canal 2
D18	East-West	Dighton and Cleary/Taunton
D19	East-West	Edgar and Potter
D20	East-West	Lake Road 1 and Lake Road 2
D21	East-West	Manchester/ Franklin square 10 and Manchester/Franklin square 11

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Dispatch No	Stress	Generator OOS
D22	East-West	Milford Power
D23	East-West	NEA Bellingham and ANP Bellingham
D24	East-West	NEA Bellingham and ANP Blackstone 1
D25	East-West	Ocean State Power 1 and Ocean state Power 2
D26	East-West	Rise and Manchester/Franklin square 11
D27	East-West	SEMass and Dartmouth Power
D28	East-West	Tiverton and Clearly/Taunton
D29	East-West	Tiverton and Dartmouth Power
D30	East-West	Tiverton and Dighton

Section 15

Appendix H: Steady-State Testing Results

The steady-state testing results for the Revised SEMA/RI 2029 Needs Assessment Update are included in the zip file titled "Revised_SEMARI_2029_Needs_Assessment_Update _Appendices.zip" which is posted on the ISO website under the key study area for Southeastern Massachusetts and Rhode Island.[21]

Appendix_H1_N-1_2029_SEMARI_Results.xlsx

Appendix_H2_N-1-1_2029_SEMARI_Results.xlsx

Appendix_H3_N-1_2029_SEMARI_Results_CCL1.xlsx

Appendix_H4_N-1-1_2029_SEMARI_Results_CCL1.xlsx

Appendix_H5_N-1_2029_SEMARI_Results_CCL2.xlsx

Appendix_H6_N-1-1_2029_SEMARI_Results_CCL2.xlsx

Appendix_H7_N-1_2029_SEMARI_Results_CCL2_5pct_Existing_OSW.xlsx

Appendix_H8_N-1-1_2029_SEMARI_Results_CCL2_5pct_Existing_OSW.xlsx

Appendix_H9_N-1_2029_SEMARI_Results_CCL2_5pct_AddFuture_OSW.xlsx

Appendix_H10_N-1-1_2029_SEMARI_Results_CCL2_5pct_AddFuture_OSW.xlsx

Appendix_H11_N-1_2029_SEMARI_Results_TimeSensitive.xlsx

Appendix_H12_N-1-1_2029_SEMARI_Results_TimeSensitive.xlsx

[21] https://www.iso-ne.com/system-planning/key-study-areas/sema-ri/

Section 16

Appendix I: Solution Components from the SEMA/RI 2026 Solutions Study that have not Started Construction

Project costs are reported as of the June 2020 RSP Project List update.

- Bell Rock area projects
  - ID# 1720 – Separate the N12/M13 DCT and reconductor the N12 and M13 between Somerset and Bell Rock substations - $39.0M
  - ID# 1721 – Reconfigure Bell Rock to breaker-and-a-half station, split the M13 line at Bell Rock substation, and terminate 114 line at Bell Rock; install a new breaker in series with N12/D21 tie breaker, upgrade D21 line switch, and install a 37.5 MVAR capacitor - $30.8M
  - ID# 1722 – Extend Line 114 – Dartmouth town line to Bell Rock - $12.3M
  - ID# 1730 – Extend Line 114 – Eversource/National Grid border to Industrial Park tap - $16.2M
  - ID# 1723 – Reconductor L14 and M13 lines from Bell Rock substation to Bates Tap – $38.7M

- West Barnstable area projects
  - ID# 1725 – Build a new 115 kV line (144 line) from Bourne to West Barnstable substations which includes associated terminal work - $59.1 M
  - ID# 1726 – Separate the 135/122 DCT from West Barnstable to Barnstable substations – $10.4M
  - ID# 1727 – Retire the Barnstable SPS - $0.2M

- Kingston area projects
  - ID# 1728 – Build a new 115 kV line from Carver to Kingston substations and add a new Carver terminal - $29.7M
  - ID# 1729 – Install a new bay position at Kingston substation to accommodate new 115 kV line - $3.4M

- Kingston area projects Capacitor installation projects
  - ID# 1719 – Install a 45.0 MVAR capacitor bank at Berry Street substation - $5.0M
  - ID# 1731 – Install a 35.3 MVAR capacitor at High Hill and Wing Lane substations - $8.0M

- Miscellaneous projects
  - ID# 1732 – Loop the 201-502 line into the Medway substation to form the 201-502N and 201-502S lines - $27.0M
  - ID# 1733 – Separate the 325/344 DCT – West Medway to West Walpole - $17.9M
  - ID# 1782 – Reconductor the J16S line - $0.7M
  - ID# 1724 – Replace Kent County 345/115 kV autotransformer - $5.9M

Section 17

Appendix J: Solution Components from the SEMA/RI 2026 Solutions Study that have started construction or are in-service

Project ID	Upgrade	Expected/ Actual In-Service
1714	Construct a new 115 kV GIS switching station (Grand Army) which includes remote terminal station work at Brayton Point and Somerset substations, and the looping in of the E-183E, F-184, X3, and W4 lines	May-20
1742	Conduct remote terminal station work at the Wampanoag and Pawtucket substations for the new Grand Army GIS switching station	Nov-20
1715	Install upgrades at Brayton Point substation which include a new 115 kV breaker, new 345/115 kV transformer, and upgrades to E183E, F184 station equipment	Jun-20
1716	Increase clearances on E-183E & F-184 lines between Brayton Point and Grand Army substations	Nov-19
1717	Separate the X3/W4 DCT and reconductor the X3 and W4 lines between Somerset and Grand Army substations; reconfigure Y2 and Z1 lines	Nov-19
1718	Add 115 kV circuit breaker at Robinson Ave substation and re-terminate the Q10 line	Dec-20
1734	Reconductor and upgrade the 112 Line from the Tremont substation to the Industrial Tap	Jun-18
1736	Reconductor the 108 line from Bourne substation to Horse Pond Tap	Oct-18
1737	Replace disconnect switches on 323 line at West Medway substation and replace 8 line structures	Dec-20
1741	Rebuild the Middleborough Gas and Electric portion of the E1 line from Bridgewater to Middleborough	Apr-19

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APPENDIX 2-3 INDEPENDENT SYSTEM OPERATOR OF NEW ENGLAND (ISO NEW ENGLAND) SOUTHEASTERN MASSACHUSETTS AND RHODE ISLAND AREA 2026 NEEDS ASSESSMENT

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Southeastern Massachusetts and Rhode Island Area 2026 Needs Assessment

Transmission Planning

MAY 2016

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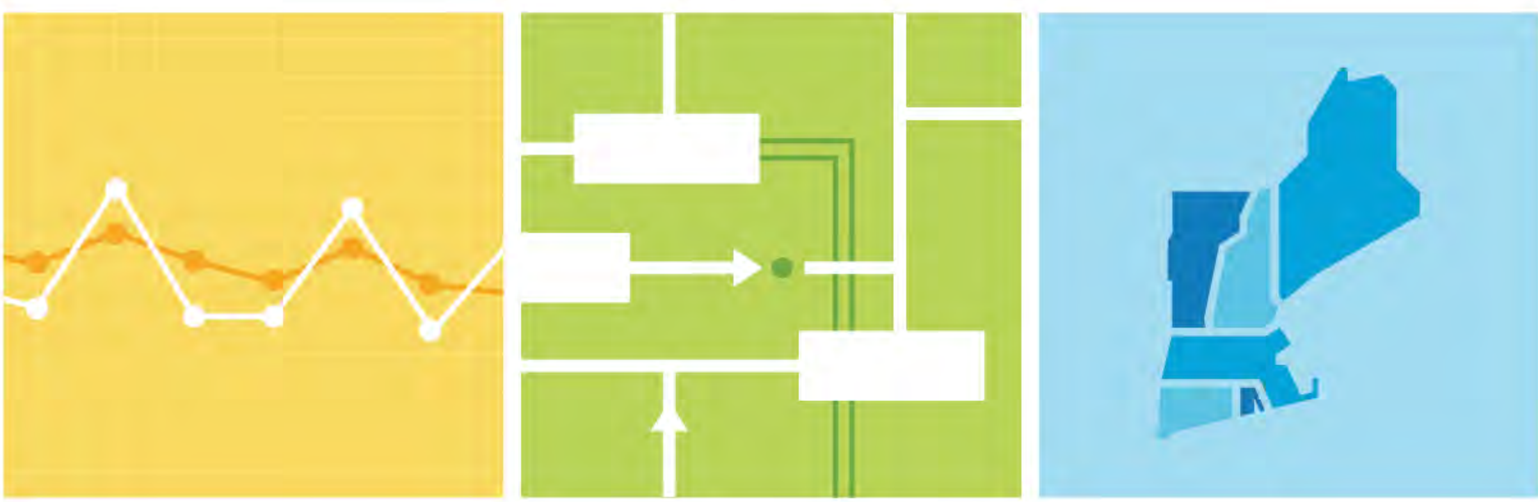

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Figures

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Tables

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Section 1
Executive Summary

1.1 Study Objective

The objective of Southeastern Massachusetts and Rhode Island (SEMA-RI) Needs Assessment study is to evaluate the reliability performance and identify reliability-based transmission needs in the SEMA-RI study area for the year 2026 while considering the following:

- Future load growth
- Reliability over a range of generation patterns and transfer levels
- Limited short circuit margin in the SEMA-RI area
- Coordination with plans in Boston, Northeastern Massachusetts and Eastern CT
- Existing and Forward Capacity Market-cleared supply resources
- All applicable North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Corporation (NPCC) and ISO New England (ISO-NE) transmission planning reliability standards

The Needs Assessment is the first step in the study process defined in accordance with the Regional Planning Process as outlined in Attachment K of the ISO-NE Open Access Transmission Tariff (OATT). If necessary, development of transmission solutions to address criteria violations identified in this Needs Assessment will be handled using either the Solutions Study process or Competitive Solicitation process described in Attachment K of the OATT.

This 2026 Needs Assessment has been initiated as a follow-up to the 2022 Needs Assessment for this study area. The 2022 Needs Assessment PAC presentation[1] identified a number of criteria violations in the SEMA-RI area. Pilgrim Nuclear Power Station submitted a full Non-Price Retirement Request in October 2015 with the intent to retire by June 1, 2019 and significant new resources in the study area received obligations in FCA #10. Due to these new developments, ISO-NE has completed a new Needs Assessment study for the SEMA-RI area.

1.2 Method and Criteria

The Needs Assessment was performed in accordance with NERC TPL-001-4[2] Transmission System Standards[3], Northeast Power Coordinating Council (NPCC) Regional Reliability Reference Directory # 1[4], "*Design and Operation of the Bulk Power System*", and ISO New England Planning Procedure 3[5], "Reliability Standards for the New England Area Bulk Power Supply System," as well as the criteria found in Section 4.2 of this report.

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[1] https://smd.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/ceii/mtrls/2014/feb192014/a8_sema_ri_needs_
https://smd.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/ceii/mtrls/2014/jul152014/a5_sema_ri_area_needs
https://smd.iso-ne.com/planning/ceii/reports/2010s/archive/sema_ri_area_needs_assessment_critical_load_level_analysis.pdf

[2] http://www.nerc.com/pa/Stand/Reliability%20Standards/TPL-001-4.pdf

[3] NERC TPL-001-4 also requires an evaluation of the power system one year, five years, and ten years out. This study only evaluated the ten years out load level and system configuration. However, a critical load level assessment was conducted that identified the year of need.

[4] https://www.npcc.org/Standards/Directories/Directory%201%20-%20Design%20and%20Operation%20of%20the%20Bulk%20Power%20System%20%20Clean%20April%2020%202012%20GJD.pdf

[5] http://www.iso-ne.com/static-assets/documents/rules_proceds/isone_plan/pp03/pp3_final.pdf

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The results of the analysis provided in this report have been organized by subareas to facilitate geographic orientation of the information. A set of defined subareas was developed based on a review of the thermal and voltage violations. The set of defined subareas include the following:

1) **Farnum Subarea** – This is an area that runs along the northern section of SEMA-RI across northern Rhode Island.
2) **West Medway – West Walpole Subarea** – This is the area running across northern SEMA-RI from the Rhode Island boarder to the Walpole area.
3) **South Shore Subarea** – This is an area that runs along the northern section of SEMA-RI from the area south of Boston to the Massachusetts southern shore line.
4) **Industrial Park Subarea** – This is an area running across southern SEMA-RI from the New Bedford area through to the Cape Cod Canal.
5) **Somerset – Newport Subarea** – This is an area that runs along the lower part of SEMA-RI from lower Rhode Island through to lower southeastern Massachusetts.
6) **Cape Cod Subarea** – This area includes Cape Cod and the islands of Martha's Vineyard and Nantucket.

1.3 Study Assumptions

The regional steady-state model was developed to be representative of the 10-year projection of the 90/10 summer peak system demand levels for the 2026 model year to assess reliability performance under stressed system conditions. The assumptions included consideration of area generating unit unavailability conditions as well as variations in surrounding area regional interface transfer levels. These study assumptions are consistent with ISO-NE Planning Procedure No. 3(PP-3), "Reliability Standards for the New England Area Bulk Power Supply System." For the load levels tested, demand resources (DR) in the form of Active DR and Passive DR that cleared the Forward Capacity Market (FCM), forecasted Energy Efficiency (EE) and distributed solar generation (PV) as a part of the 2015 Capacity, Energy, Loads and Transmission (CELT) forecast were modeled as load reductions. The details for these load reductions are included in Section 3.1.6.

Section 3 of this report contains more details of all assumptions used to complete this study.

1.4 Specific Areas of Concern

1.4.1 Steady State Testing Results

The results of the analysis for all of the study work completed indicated that there were a number of design case thermal overloads and voltage violations for N-1 and N-1-1 conditions. One design case thermal overload was observed for N-0 conditions.

1.4.2 Review of N-0 Testing

N-0 (also known as "all-lines-in") conditions were reviewed for the cases modeled. The results indicate that under all tested dispatch and transfer level conditions there was one 115 kV element N-0 thermal overload observed. Additionally, there were no N-0 voltage criteria violations observed.

1.4.3 Review of N-1 Testing

N-1 testing was performed for all the system conditions described above. Overall, by 2026, N-1 contingency overloads were observed for elements within the SEMA-RI area across the 115 kV and 345 kV transmission facilities.

There were a total of one 345/115 kV element and twenty-nine 115 kV elements that were found to be overloaded under N-1 outage conditions. Additionally there were nineteen 115 kV buses that were found to have voltage violations under N-1 outage conditions.

More detailed information on the observed N-1 criteria violations is provided in Section 5.2.2.

1.4.4 Review of N-1-1 Testing

Initial element-out-of-service (N-1-1) testing included all 115 kV, 230 kV and 345 kV transmission lines as well as 345 kV autotransformers in the SEMA-RI and Boston areas that are considered Bulk Electric System (BES) elements. These element-out-of-service conditions were tested against the full set of contingencies used in the N-1 tests, with noted exceptions made for the treatment of no-fault contingencies as described in Section 4.3.2.

Table 1-1 provides a summary of the total number of elements by subarea that had thermal or voltage criteria violations under N-1-1 contingency conditions, as well as the critical load level range (in terms of projected net New England load) and earliest reported year of need. No N-1-1 high voltage violations were observed. The values shown include all 69 kV, 115 kV, 230 kV and 345 kV elements in the study area.

Table 1-1: Number of N-1-1 Criteria Violations

Subarea	2026 Study Year			
	LTE Overloaded Elements	Voltage Violations	Critical Load Level Range (MW)	Earliest Year of Need
Farnum	21	9	16,130 – 29,750	Prior to 2016
West Medway - West Walpole	7	5	26,501 – 29,346	Prior to 2016
South Shore	9	12	27,162 – 30,228	Prior to 2016
Industrial Park	6	5	10,063 – 28,198	Prior to 2016
Somerset - Newport	26	13	12,216 – 30,000	Prior to 2016
Cape Cod	2	4	28,108 – 30,307	Prior to 2016
Boston Area (External to Study)	13	0	21,917 – 29,346	Prior to 2016

In addition to the noted N-1-1 criteria violations, a number of non-convergent cases were observed for various contingency combinations associated with [redacted].

More detailed information on the observed N-1-1 criteria violations is provided in Section 5.2.3.

1.4.5 Short Circuit Testing

A short circuit assessment was also conducted for this study; the results indicated that no substations had any breakers that would be over-dutied for 2026 system model conditions. Overall results of short circuit testing indicated that there were a total of three 345 kV circuit breakers that could see fault current levels over 95% of their interrupting capability in 2026.

1.5 Statements of Need

The results of the assessment conducted of the SEMA-RI area transmission performance against transmission reliability standards for the projected 2026 system conditions in this study indicate that there are a significant number of thermal and voltage violations across all subareas within the SEMA-RI system. The SEMA-RI area transmission system fails to meet the reliability criteria standards in several geographical subareas under the design case testing performed and measures should be developed to mitigate the problems identified. A determination of the year of need was established for each element that resulted in criteria violations under contingency conditions. The specific worst case criteria violations for each element are summarized in Section 5.1. The results of the critical load level analysis can be found in Section 5.5.

1.6 NERC Compliance Statement

This report is the first part of a two part process used by ISO-NE to assess and address compliance with NERC TPL standards. This Needs Assessment report provides documentation of an evaluation of the performance of the system as contemplated under the TPL standards to determine if the system meets compliance requirements. If necessary, development of transmission solutions to address criteria violations identified in this Needs Assessment will be handled using either the Solutions Study process or Competitive Solicitation process described in Attachment K of the OATT. This Needs Assessment report and any report documentation developed as part of the solutions development process provide the necessary evaluations and determinations required under the NERC TPL standards. See Section 13 for the complete NERC compliance statement.

Section 2
Introduction and Background Information

2.1 Study Objective

The objective of this study was to identify reliability-based transmission needs in the Southeastern Massachusetts and Rhode Island (SEMA-RI) study area while considering the following:

- Future load growth
- Reliability over a range of generation patterns and transfer levels
- Limited short circuit margin in the SEMA-RI area
- Coordination with plans in Boston, Northeastern Massachusetts and Eastern CT
- Existing and Forward Capacity Market-cleared supply resources
- All applicable North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Corporation (NPCC) and ISO New England (ISO-NE) transmission planning reliability standards

The scope of the Needs Assessment study performed for the SEMA-RI area included evaluation of the reliability performance of the transmission system serving this area of New England for the year 2026 projected system conditions. The system was tested with all elements in-service i.e. N-0 and under N-1 and N-1-1 contingency conditions for a number of possible operating conditions with respect to related interface transfer levels and generating unit availability conditions.

2.2 Area(s) Studied

The study area focused on two load zones, namely, the SEMA and RI load zones as shown in Figure 2-1. This combination of load zones is collectively known as the SEMA-RI load zone and was the study area evaluated in this analysis. These load zones encompass the areas within Massachusetts located south of Boston as well as the entire state of Rhode Island.

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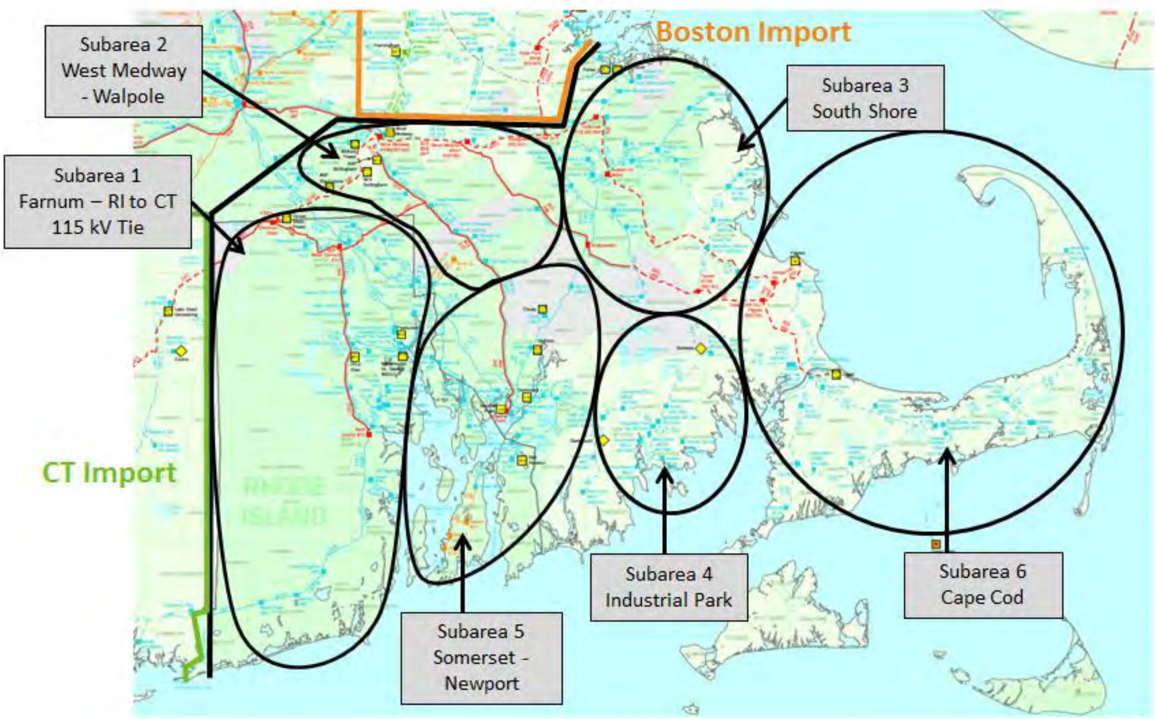

Figure 2-1: SEMA-RI Area Map

As stated in Section 1.2, the set of defined study subareas include the following:

1) **Farnum Subarea** – This is an area that runs along the northern section of SEMA-RI across northern Rhode Island.
2) **West Medway – West Walpole Subarea** – This is the area running across northern SEMA-RI from the Rhode Island boarder to the Walpole area.
3) **South Shore Subarea** – This is an area that runs along the northern section of SEMA-RI from the area south of Boston to the Massachusetts southern shore line.
4) **Industrial Park Subarea** – This is an area running across southern SEMA-RI from the New Bedford area through to the Cape Cod Canal.
5) **Somerset – Newport Subarea** – This is an area that runs along the lower part of SEMA-RI from lower Rhode Island through to lower southeastern Massachusetts.
6) **Cape Cod Subarea** – This area includes Cape Cod and the islands of Martha's Vineyard and Nantucket.

The SEMA-RI Interface borders the Boston Import Interface to the north and the Connecticut Import Interface to the West. Figure 2-2 shows the one-line diagram of the SEMA-RI subarea.

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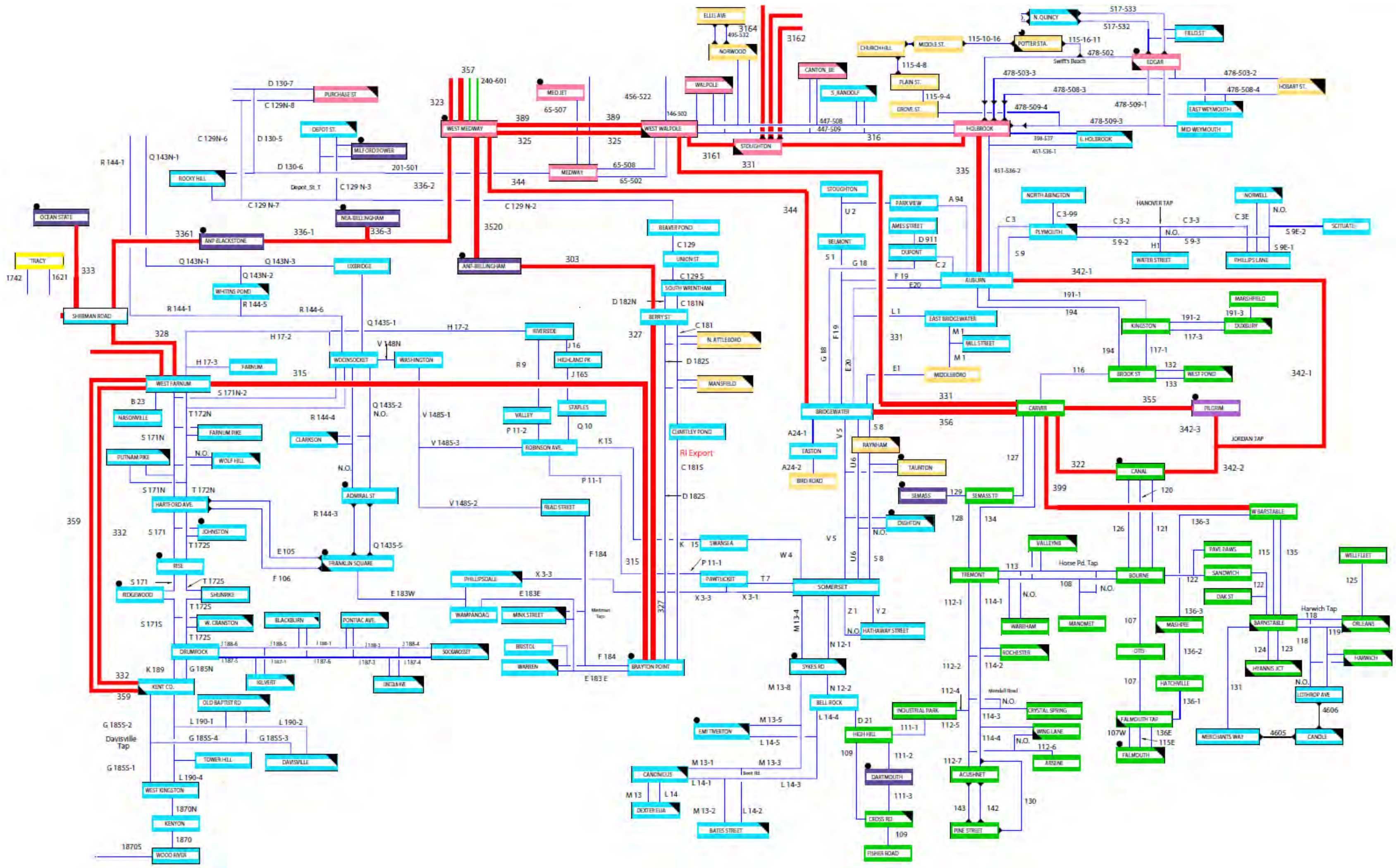

Figure 2-2: SEMA-RI Study Area One Line Diagram[6]

[6] The diagram is for illustrative purposes to show the study area. It does not show any future projects in the area.

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The SEMA-RI interface is defined by the major transmission lines listed in Table 2-1 below.

Table 2-1: List of Major Transmission Lines That Define SEMA-RI Zone

Line ID	From	To	Voltage (kV)
347	Sherman Road	Killingly	345
341	Lake Road	West Farnum	345
366	West Farnum	Millbury 3	345
1870S	Shunock	Wood River	115
C-129	Hopkinton	Millbury 2	115
D-130	Hopkinton	Millbury 2	115
Q143	Whitins Pond	Millbury 2	115
R144	Whitins Pond	Millbury 2	115
357	Millbury	West Medway	345
323	Millbury	West Medway	345
345A	West Medway 345A Autotransformer		345/115
345B	West Medway 345B Autotransformer		345/115
274-509	Medway	Sherborn	115
456-522	West Walpole	Dover	115
3162	Stoughton	K Street	345
3163	Stoughton	K Street	345
3164	Stoughton	Hyde Park	345
517-524	North Quincy	Dewar Street	115
517-525	North Quincy	Dewar Street	115

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The SEMA-RI study area is characterized by multiple 345 kV loops, the most significant of which are listed below.

- West Medway Loop (West Medway - ANP Bellingham – Berry Street – Brayton Point – West Farnum – Sherman Road – ANP Blackstone – NEA Bellingham – West Medway)
- West Walpole Outer Loop (West Walpole – Stoughton – Holbrook – Auburn Street – Pilgrim – Canal – Carver - Bridgewater – West Medway – West Walpole)
- West Walpole Inner Loop (West Walpole – Stoughton – Holbrook – Auburn Street – Pilgrim – Carver – West Walpole)

In addition, there are many 345/115 kV autotransformers that feed the underlying lower kV transmission networks.

2.3 Study Horizon

A 10-year planning horizon was used for this study. This study was based on the 2026 summer peak load forecast taken from the 2015 CELT Report[7]. The 2015 CELT load forecast is given in Appendix A: Load Forecast[8].

2.4 Analysis Description

The study included the evaluation of the long term reliability of the transmission system serving the SEMA-RI study area for the projected system conditions in 2026. The system was tested under N-0 (all-facilities-in), N-1 (all-facilities-in, first contingency), and N-1-1 (first contingency after a facility out) conditions for a number of possible operating scenarios with respect to related interface transfer levels and generating unit unavailability conditions.

The following types of analysis were performed:

- **Thermal Analysis** – studies to determine the level of steady-state power flows on transmission circuits under base case conditions and following contingency events.
- **Voltage Analysis** – studies to determine steady-state voltage levels and performance under base case conditions and following contingency events.
- **Short Circuit Analysis –** Short circuit studies was conducted to determine if available fault current exceeds the capabilities of the substation equipment in the SEMA-RI study area.
- **Critical Load Level Analysis –** Studies was conducted to determine the load level at which system concerns occur under the assumed conditions.

The following analyses may be performed during the solution development process as outlined in Sections 4.2 and 4.3 in Attachment K of the ISO-NE Open Access Transmission Tariff (OATT):

- **Stability Analysis** – detailed studies to determine the dynamic performance of electric machines with respect to rotor angle displacement, system voltage stability and system frequency deviations following a fault.

[7] The 2015 CELT Report, published on May 1, 2015, is available at http://www.iso-ne.com/static-assets/documents/2015/05/2015_celt_report.pdf

[8] The 2015 CELT forecast only has projected peak demands for the years 2015-2024. To determine the 2026 peak demand forecasted load, the growth rate from years 2023-2024 was applied to the 2024 forecast twice.

[redacted] – [redacted]

For the various elements having thermal violations and for buses with voltage violations, a critical load level assessment was performed to determine the New England load level and the year at which these violations would be eliminated.

The needs assessment was performed in accordance with all relevant North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Council, Inc. (NPCC), and ISO New England (ISO-NE) criteria as described in Section 4.2.

The thermal, voltage and critical load level analysis was performed using PowerGEM TARA version 8.50 and Siemens PTI PSS/E version 32.2.3 software. The short circuit analysis was performed using ASPEN version 11 software.

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Section 3
Study Assumptions

3.1 Steady State Model Assumptions

3.1.1 Study Assumptions

The regional steady-state model was developed to be representative of the 10-year projection of the 90/10 summer peak system demand levels to assess reliability performance under stressed system conditions. The assumptions include consideration of area generation unit unavailability conditions as well as variations in surrounding area regional interface transfer levels. These study assumptions are consistent with ISO-NE Planning Procedure No. 3 (PP-3), "Reliability Standards for the New England Area Bulk Power Supply System".

3.1.2 Source of Power Flow Models

The power flow study cases used in this study were obtained from the ISO Model on Demand (MOD) system with selected upgrades to reflect the system conditions in 2026. A detailed description of the system upgrades included is described in later sections of this report.

3.1.3 Transmission Topology Changes

Transmission projects with Proposed Plan Application (PPA) approval in accordance with Section I.3.9 of the Tariff, as of the May 2015 RSP Project Listing, have been included in the study base case. In addition, any projects in the listing that were considered "Proposed" and determined to have an effect on the SEMA-RI study area were included. The Aquidneck Island Reliability Projects (RSP ID: 1669, 1670, and 1671) were also included in the base case because they are located in the SEMA-RI study area and could eliminate potential needs. A listing of the major future projects in Massachusetts, Rhode Island, and Connecticut is included below:

Massachusetts

- Greater Boston Upgrades (RSP ID: 965, 1199, 1212, 1213, 1220, 1260, 1327, 1329, 1330, 1335-1339, 1352-1357, 1363-1365, 1516, 1518-1522, 1527, 1528, 1549-1554, 1558, 1636, 1637, 1640, 1645-1647)
- Central/Western Massachusetts Upgrades (RSP ID: 937, 945, 946, 949-951, 953-955)
- NEEWS – Interstate Reliability Project (RSP ID: 190, 1094, 1293)
- Pittsfield/Greenfield Project (RSP ID: 1208-1210, 1221-1226)

Rhode Island

- NEEWS – Interstate Reliability Project (RSP ID: 794, 1233, 1252, 1298)
- Chase Hill (Crandall Street) Substation (RSP ID: 1253)
- Aquidneck Island Reliability Projects (RSP ID: 1669, 1670, 1671)
- Brayton Point Non-Price Retirement Short-Term Reliability Upgrades (RSP ID: 1623)[9]

Connecticut

[9] The West Farnum 175T and Kent County 3X 345/115 kV autotransformer rating increases also proposed as part of this set of upgrades were not listed in the RSP Project Listing. These rating increases have been included in the study base cases.

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- NEEWS – Interstate Reliability Project (RSP ID: 191, 802, 1245)
- Southwestern Connecticut (SWCT) Transmission Solutions (RSP ID: 1380, 1381, 1383-1386, 1389, 1399, 1400, 1559-1579, 1620-1622)
- Greater Hartford/Central Connecticut (GHCC) Transmissions Solutions (RSP ID: 1580-1605, 1659)

3.1.4 Generation Assumptions (Additions & Retirements)

All generation projects in New England with a Forward Capacity Market (FCM) Capacity Supply Obligation (CSO) as of Forward Capacity Auction 9 (FCA #9) were included in the study base case. In addition, two generators that received CSOs in the most recent Forward Capacity Auction (FCA # 10) in the SEMA-RI area were also included. A listing of the major new future projects cleared in FCA #1 through FCA #10 and not yet in service in the SEMA-RI study area is included below:

- QP 444 – Medway Peakers (195 MW - FCA #9)
- QP 449 – Canal #3 (333 MW - FCA #10)
- QP 489 – Burrillville Energy Center (485 MW - FCA #10)

A summary of major Non-Price Retirement (NPR) requests in southern New England is provided in Table 3-1.

Table 3-1: Summary of Non-Price Retirement Requests

Resource Name	Summer Qualified Capacity (MW)	NPR Request Date	NPR Determination Date
AES Thames	182.653	9/18/2012	11/19/2012
Bridgeport Harbor 2	0.000	9/20/2013	10/16/2013
Brayton Point 1	228.205	10/6/2013	12/20/2013
Brayton Point 2	225.750	10/6/2013	12/20/2013
Brayton Point 3	610.000	10/6/2013	12/20/2013
Brayton Point 4	422.000	10/6/2013	12/20/2013
John Street 3	2.000	9/26/2013	10/16/2013
John Street 4	2.000	9/26/2013	10/16/2013
John Street 5	1.900	9/26/2013	10/16/2013
Norwalk Harbor 1	162.000	9/30/2013	12/20/2013
Norwalk Harbor 2	168.000	9/30/2013	12/20/2013
Norwalk Harbor 10	11.925	9/30/2013	12/20/2013
Pilgrim Nuclear Power Station	677.284	10/12/2015	12/18/2015

Due to the NPR request submitted for the Pilgrim Nuclear Power Station for FCA #10, the unit was modeled as OOS in all study base cases. No other significant NPR requests were submitted for FCA #10 that would have an effect on the SEMA-RI study area; therefore, these NPRs were not reflected in the study. All other NPR requests across New England through FCA #9 were modeled as OOS in the study base case. An 11.8 MW Active DR partial NPR was also submitted in SEMA-RI, but the acceptance of this NPR has a negligible effect on the study area, and was not included in the study.

[redacted] – [redacted]

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Real Time Emergency Generation (RTEG) are distributed generation which have air permit restrictions that limit their operations to ISO Operating Procedure 4 (OP-4), Action 6 – an emergency action which also implements voltage reductions of five percent (5%) of normal operating voltage that require more than 10 minutes to implement. RTEG cleared in the FCM was not included in the reliability analyses because in general, long-term analyses should not be performed such that the system must be in an emergency state as required for the implementation of OP-4, Action 6.

3.1.5 Explanation of Future Changes Not Included

The following projects were not included in the study base cases:

- Transmission projects that have not been fully developed and were not classified as "Proposed" as of the May 2015 RSP Project Listing. These projects were not modeled in the study base case due to the uncertainty concerning their final development or lack of an impact on the SEMA-RI study area.
- With the exception of the Greater Boston projects, which are expected to receive PPA approval in the near future, transmission projects outside of the SEMA-RI area that have received PPA approval since the May 2015 RSP Project Listing was published. These projects were not modeled due to the lack of an impact on the SEMA-RI study area.
- Transmission upgrades associated with the Canal #3 and Burrillville Energy Center (BEC) generation projects were not included in the study base cases. However, the results presented reflect the presence of upgrades associated with Canal 3. Once the upgrades for BEC are established, any identified reliability concerns resolved by the BEC upgrades will be removed from the identified Needs.

3.1.6 Forecasted Load

A ten-year planning horizon was used for this study based on the most recently available Capacity, Energy, Loads, and Transmission (CELT) Report issued in May 2015. This study was based on the forecasted 2026 peak demand load levels for the ten-year horizon[10].

The 2026 summer peak 90/10 demand forecast for New England is 35,310 MW.

The CELT load forecast includes both system load and losses (transmission & distribution) from the power system. Since power flow modeling programs calculate losses on the system, the actual system load modeled in the case was reduced to account for system losses which are explicitly calculated in the system model.

Demand Resources (DR) are treated as capacity resources in the Forward Capacity Auctions (FCA). DR is split into two major categories, Passive and Active DR. Passive DR is largely comprised of energy efficiency and is expected to lower the system demand during designated peak hours in the summer and winter. Active DR is commonly known as Demand Side Management (DSM) and can be dispatched on a zonal basis if a forecasted or real-time capacity shortage occurs on the system. Starting in 2012, forecasting passive DR has become part of the annual load forecasting process. This forecast takes into account additional electrical efficiency (EE) savings beyond FCM results across the ten-year planning horizon. This forecast is primarily based on forecasted financial investment in state-sponsored EE programs and its correlation with historical data on reduction in

[10] The 2015 CELT forecast only has projected peak demands for the years 2015-2024. To determine the 2026 peak demand forecasted load, the growth rate from years 2023-2024 was applied to the 2024 forecast twice.

[redacted] – [redacted]

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peak demand per dollar spent. This EE forecast was published in the annual CELT Report beginning in spring 2012.

Active DR are modeled in the base case at the levels of the most recent FCA #9, multiplied by a Performance Factor of 75% based on historical performance of similar resources. Passive DR are modeled at 2026 levels based on the passive DR cleared through FCA #9 (2010-2019) and the aforementioned EE forecast for the years until 2026 (2020-2026).

Since Demand Resources are modeled at the low side of the distribution bus in the power flow model, all DR values were increased by 5.5% to account for the reduction in losses on the local distribution network. Passive DR is modeled by load zone and Active DR is modeled by dispatch zone. The amounts modeled in the cases are listed in Table 3-2 and Table 3-3 and detailed reports can be seen in Section 7.

Table 3-2: 2026 Passive DR through FCA #9 and EE Forecast

Load Zone	Passive DR (FCA #1-9) DRV[11] (MW)	EE Forecast (2020-2026) DRV[11] (MW)	Total Passive DR DRV[11] (MW)
Maine	168	104	227
New Hampshire	95	64	159
Vermont	117	102	219
Northeast Massachusetts & Boston	527	363	890
Southeast Massachusetts	284	192	476
West Central Massachusetts	331	225	556
Rhode Island	189	132	321
Connecticut	425	324	749
New England Total[12]	**2,135**	**1,506**	**3,641**

[11] DRV = Demand Reduction Value = the actual amount of load reduced measured at the customer meter; these totals are forecasted values for the commitment period beginning June 1, 2025. These values exclude transmission and distribution losses.

[12] The sum of individual values may not equal the total value due to rounding.

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Table 3-3: Active DR Values through FCA #9

Dispatch Zone	Active DR (FCA #1-9) DRV[11] (MW)
Bangor Hydro	27
Maine	97
Portland, ME	17
New Hampshire	13
New Hampshire Seacoast	2
Northwest Vermont	24
Vermont	5
Boston, MA	50
North Shore Massachusetts	18
Central Massachusetts	32
Springfield, MA	8
Western Massachusetts	15
Lower Southeast Massachusetts	7
Southeast Massachusetts	41
Rhode Island	56
Eastern Connecticut	8
Northern Connecticut	28
Norwalk-Stamford, Connecticut	3
Western Connecticut	32
New England Total[12]	**484**

3.1.7 Forecasted Photovoltaic (PV) Generation

In addition to the resources that cleared the FCM, the PV generation forecast was used to model PV generation in the study base cases. The 2015 CELT PV generation forecast includes the PV generation that has been installed as of the end of 2014 and provides a forecast by state of the total PV (by AC Nameplate) that is expected to be in service by the end of each forecast year for the next 10 years. As an example, the 2015 PV forecast provides data on the PV that is in service as of the end of 2014 as well as an annual forecast for the PV that will be in service for end of 2015, end of 2016 and so on until the end of 2024. For years beyond 2024, the rate of PV generation growth from 2023-2024 was used to extrapolate the PV generation forecast.

An availability factor of 26% was applied to the values from the PV generation forecast. Table 3-4 summarizes the PV generation modeled for the initial study files for New England.

Table 3-4: Forecasted PV Generation Modeled in New England Modeled in Study Base Cases

Load Zone		2026 Peak
New England	A - PV generation (nameplate) in New England	1,937
	B - 5.5% Reduction in Distribution Losses	107
	C - Unavailable PV generation (A+B)*(1-26%)	1,512
	PV Generation Modeled in Case as Negative Load (A+B)-C	**531**

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3.1.8 **Load Levels Studied**

Consistent with ISO planning practices, transmission planning studies utilize the ISO extreme weather 90/10 forecast assumptions for modeling summer peak load profiles in New England. A breakdown of the load modeled in the 2026 cases, taking into account transmission and distribution losses, is shown in Table 3-5. A more detailed report of the loads modeled and how the numbers were derived from the CELT values can be seen in Section 7.

Table 3-5: Load Levels Studied

State	2026 CELT 90/10 Load[13] (MW)
Maine[14]	2,525
New Hampshire	3,350
Vermont	1,265
Massachusetts	16,545
Rhode Island	2,550
Connecticut	9,075
New England Total	**35,310**

After taking into account the aforementioned transmission losses, the contributions of demand resources and forecasted EE, and the addition of non-CELT and station service loads, the actual load level modeled in the base cases for this study is approximately 31,103 MW.

3.1.9 **Load Power Factor Assumptions**

Load power factors consistent with the local transmission owner's planning practices were applied uniformly at each substation. Eversource Energy's load power factor was modeled as 0.983 in SEMA. National Grid's load power factor was modeled as 0.995 in SEMA and 0.996 in RI. Demand resource power factors were set to match the power factor of the load at that bus in the model. A list of overall power factors by company territory can be found in the detailed load report in Appendix A: Load Forecast.

3.1.10 **Transfer Levels**

In accordance with the reliability criteria of the NERC, NPCC and the ISO, the regional transmission power grid must be designed for reliable operation during stressed system conditions. A detailed list of all transfer levels can be found in the study base summaries in Section 9. The following external transfers were utilized for the study.

Table 3-6: Interface Levels Tested

Case	Interface Level Condition	North-South Transfers	East-West Transfers	West to East Transfers	Boston Import	CT Import
A	High East to West with High North-South	High	High	Low	Low	High

[13] These values exclude transmission and distribution losses.

[14] The value does not include 365 MW of paper mill load where the mills have on site generation located behind their meter.

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B	High West to East with Low North-South	Medium	Low	High	Low	Low
C	High West-East with Medium North-South	Medium	Low	High	Medium	Low

Case A: This case represents a scenario with high East-West flows. In this case, the stress is from East-to-West with SEMA-RI transfer levels being dictated by the load in the area and unit unavailability. All units in the Boston area were assumed in-service for this scenario. Imports from Hydro-Quebec over the HVDC circuits and on the New-Brunswick to New England (NB-NE) ties were adjusted accordingly to achieve a high East-to-West bias. Flows over the New-York tie lines were allowed to adjust within acceptable limits to meet New England load.

Case B: This case represents a scenario with high West-East flows. In this case, the North-South interface was held at a low value with SEMA-RI zone being stressed from the West. In this scenario, all units in the Boston area were assumed in service. The flows on the HVDC tie from Quebec and NB-NE were adjusted as needed to maintain a high West-to-East interface flow. Flows over the New-York tie lines were allowed to adjust within acceptable limits to meet New England load.

Case C: This case represents a scenario with high West-East flows. In this scenario, one unit in the Boston area was assumed out-of-service. Imports from Hydro-Quebec over the HVDC circuits and on the New-Brunswick to New England (NB-NE) ties were adjusted accordingly to achieve a high West-East interface flow. Imports/Exports over New-York tie lines were allowed to adjust within acceptable limits to meet New England load.

3.1.11 Generation Dispatch Scenarios

Table 3-7 shows a list of the generating units in the study area and their modeled generation capacities.

Table 3-7: Modeled Generating Capacities of Study Area Units

Generating Unit	Modeled Capacity (MW)	Fast-Start Unit[15]
NEA Bellingham	277.621	No
Edgar / Fore River	700.000	No
ANP Blackstone 1	239.634	No
ANP Blackstone 2	245.314	No
SEMASS 1	46.955	No
SEMASS 2	22.174	No
Canal 1	547.059	No
Canal 2	545.125	No
Canal 3 (FCA #10)	333.000	No[16]

[15] "Fast-start" generators are those units that can go from being off-line to their full Seasonal Claimed Capability in 10 minutes. These units do not need to participate in the 10-minute reserve market to be considered a fast-start unit in planning studies.

[16] Since this unit's ramping capability has not yet been tested and verified, this study has assumed that it is not a fast-start unit.

[redacted] – [redacted]

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Generating Unit	Modeled Capacity (MW)	Fast-Start Unit[15]
Dartmouth Power	62.156	No
Potter	73.927	No
Milford Power	149.000	No
ANP Bellingham 1	237.102	No
ANP Bellingham 2	243.587	No
Cleary 8	24.825	No
Cleary 9/9A	104.931	No
Dighton Power	160.539	No
Ocean State Power G1/G2/S1	270.901	No
Ocean State Power G3/G4/S2	270.180	No
Manchester / Franklin Square 9/9A	149.000	No
Manchester / Franklin Square 10/10A	149.000	No
Manchester / Franklin Square 11/11A	149.000	No
Pawtucket Power	59.810	No
Tiverton Power	244.086	No
RISE	543.455	No
Ridgewood Landfill	26.000	No
Burrillville Energy Center (FCA #10)	485.000	No[16]
Lake Road 1[17]	245.792	No
Lake Road 2[17]	251.213	No
Lake Road 3[17]	255.000	No
West Medway Jet 1[17]	42.000	Yes
West Medway Jet 2[17]	40.835	Yes
West Medway Jet 3[17]	35.441	Yes
West Tisbury	5.568	Yes
Oak Bluffs	8.120	Yes
Thomas A. Watson	105.200	Yes

At all locations in the study area where a single fast-start unit is available, that unit was assumed OOS for each dispatch. For subareas where there are multiple fast-start units, one of the fast-start units was taken out of service and the rest were assumed online and available in that subarea.

Of all the fast-start units available in SEMA-RI study area, approximately 20% of them were considered out of service (OOS) for each dispatch. The rest of the fast-start units were assumed available for dispatch. For all cases except Edgar or Edgar and Potter out-of-service, West Medway Jet 2 and Oak Bluffs are considered the best helpers[18], and were assumed OOS. For Edgar or Edgar

[17] While these units are located outside of the SEMA-RI area, they do have a significant influence on the performance of the study area and are therefore listed.

[18] In this case, a "helper" unit is the fast-start unit that would be most beneficial, for the given situation, to turn on in order to help offset the loss of a certain base generation unit.

[redacted] – [redacted]

and Potter OOS, Thomas A. Watson 1 is considered the best helper, and was assumed OOS. In all cases, approximately 80% of the fast-starts were assumed in-service.

Generating units in the rest of the New England system outside of the SEMA-RI study area were dispatched to create the stress conditions shown in Table 3-6: Interface Levels Tested.

The most up-to-date voltage schedules obtained from ISO-NE Operating Procedure 12 (OP-12) were utilized in this study. The fast-start dispatch assumptions detailed above were turned on in the base case and no adjustments were made to these fast-start units post-first contingency. Canal 3 and Burrillville Energy Center are in service in all cases.

Table 3-8 and Table 3-9 show the dispatch scenarios and the list of units that were assumed unavailable in each of the base cases. These scenarios have been set up to stress different parts of SEMA-RI study area.

New one-unit-out and two-units-out generation dispatches were not required for the Canal 3 and Burrillville Energy Center due to their interconnection points which are shared with other units or are within the same proximity. Canal 3 will be connected with the other Canal units at the Canal substation and the Burrillville Energy Center will be connected into the Sherman Road 345 kV substation, similar to the Ocean State Power generation units. The existing two-units-out generation dispatches serve as the worst case scenario. Canal 3 and Burrillville Energy Center are in service in all cases.

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Table 3-8: One-Unit-Out Generation Dispatches

Unit OOS	Modeled Capacity (MW)	One Unit OOS Dispatch Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Canal 2	545.1	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Edgar	688.3	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Potter	74.2	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Tiverton	244.6	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Dighton	160.3	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Cleary / Taunton	130.8	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
RISE	548	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Manchester/ Franklin Square 11	149	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON
NEA Bellingham	277.6	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON
ANP Bellingham 1	236.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON
Ocean State Power C1, C2, S1	270.9	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON
ANP Blackstone 1	221.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON
Lake Road 1	245.8	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON
SEMASS	69.2	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON
Dartmouth Power	83.1	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON
Milford Power	149	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON
Pawtucket Power	61.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF

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Table 3-9: Two-Units-Out Generation Dispatches

Unit OOS	Modeled Capacity (MW)	Two Units OOS Dispatch Number														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Canal 1	549.9	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Canal 2	545.1	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Edgar	688.3	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Potter	74.2	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Tiverton	244.6	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	OFF
Dighton	160.3	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Cleary/Taunton	130.8	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF
RISE	548	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Manchester / Franklin Square 11	149	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	OFF	ON	ON
Manchester / Franklin Square 10	149	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON
NEA Bellingham	277.6	ON	ON	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	ON
ANP Bellingham 1	236.4	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON
ANP Blackstone 1	221.4	ON	ON	ON	ON	ON	ON	ON	OFF	ON	OFF	ON	ON	ON	ON	ON
Ocean State Power G3, G4, S2	270.2	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON
Ocean State Power G1, G2, S1	270.9	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON
Lake Road 2	251.2	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON
Lake Road 1	245.8	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON	ON
Dartmouth Power	83.1	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	OFF	ON
Pawtucket Power	61.4	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON
SEMASS	69.2	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON

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3.1.12 **Reactive Resource and Dispatch Assumptions**

All area shunt reactive resources were assumed available and dispatched when required. Reactive output of generating units was modeled to reflect defined limits. A summary of the reactive output of units and shunt devices connected to the transmission system that played a significant role in the study area can be found in the power flow case summaries included in Section 9.

3.1.13 **Demand Resources**

As stated in Section 3.1.6, Passive DR as forecasted for the year 2026 and Active DR that cleared as of FCA #9 in 2015 were modeled for this study. Passive DR were assumed to perform to 100% of their qualified amount. The passive DR included the forecasted EE which were assumed to perform to 100% of the forecasted amount. Active DR were assumed to perform to 75% of their qualified amount. A summary of assumed DR performance is shown in Table 3-10. Real Time Emergency Generation (RTEG) were not modeled, consistent with all needs and solutions planning analyses.

Table 3-10: New England Demand Resource Performance Assumptions

Region	Passive DR	Active DR	Forecasted EE	RTEGs
New England	100%	75%	100%	0%

3.1.14 **Protection and Control System Devices Included in the Study Area**

There are five Special Protection Systems that are in operation in the SEMA-RI study area:

1. Barnstable SPS – NPCC Type III
2. ANP Bellingham SPS – NPCC Type III
3. Edgar Station SPS – NPCC Type III
4. Tiverton SPS – NPCC Type III
5. Stoughton Station SPS – NPCC Type III

The Barnstable SPS is a flow-based SPS which will initiate load shedding on the Cape based on [redacted].

The ANP Bellingham SPS will trip the Bellingham Unit #2 generator breaker following [redacted].

The Edgar SPS trips specific Edgar station generation (EDG1, EDST) if [redacted]

[redacted].

The Tiverton SPS is a flow-based SPS that reduces the output of [redacted].

The Stoughton SPS trips certain lines in the Boston area for N-1-1 conditions. The operation of this SPS is needed to avoid [redacted].

Contingencies affected by the operation of these SPSs were tested both with the SPS operating and out-of-service.

3.1.15 Explanation of Operating Procedures and Other Modeling Assumptions

The SEMA-RI area transmission power flows are managed on a daily basis through the use of generation dispatch. For the purposes of the contingency testing conducted as part of this study generation adjustments were modeled in the analysis to reflect system adjustments that could occur between outages under N-1-1 contingency conditions. These adjustments were primarily limited to unit back-downs in the SEMA-RI study area and HVDC terminal adjustments. The reductions in resource output were limited to a total of 1,200 MW across the New England system to reflect consistency with operating reserve constraints.

Additionally, the SEMA-RI area has two operating guides. The first is associated with the operation of the Canal 1 and 2 generating units when certain facilities are out of service or following the loss of certain facilities. These procedures serve to limit the output of the Canal units to avoid potential loss of generation due to instability following specific contingency events. Modeling of these operating procedures was captured through base case dispatch conditions and/or through system adjustments performed between contingency events.

The second operating guide is associated with the Tremont – East Area. This guide specifies facility-out stability limits for the Pilgrim and Canal units for line out and breaker out conditions should a "normally open" 345 kV breaker 863 at Carver have to be closed. Modeling of these operating procedures was captured through base case dispatch conditions and/or through system adjustments performed between contingency events. With the retirement of Pilgrim the operating guide will be re-evaluated to determine its applicability.

3.2 Stability Modeling Assumptions

Not applicable for this study.

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3.3 Short Circuit Model Assumptions

3.3.1 Study Assumptions

The short circuit study evaluated the projected 2026 available fault current levels around the SEMA-RI area. It also included the effects of area reliability project upgrades as well as proposed generation interconnection projects as outlined in Sections 3.1.3 and 3.1.4.

3.3.2 Short Circuit Model

The ASPEN Circuit Breaker Rating Module software was used to calculate all circuit breaker duties. The case for the short circuit study was obtained from the 2015 short circuit base case library and all “Proposed”, “Planned”, and “Under Construction” projects from the May 2015 RSP Project Listing, as discussed in Section 3.1.3 of this scope document, were added to that model. In addition, the Aquidneck Island Reliability Projects (RSP ID: 1669, 1670, and 1671) were also included in the case.

3.3.3 Contributing Generation Assumptions (Additions & Retirements)

The model included proposed generation interconnection projects that have PPA approval as well as those generator projects that have FCA Capacity Supply Obligations (CSOs).

The following relevant proposed generation projects were modeled for this study:

- QP 444 – Medway Peakers (195 MW - FCA #9)
- QP 449 – Canal #3 (333 MW - FCA #10)
- QP 489 – Burrillville Energy Center (485 MW - FCA #10)

The Non-Price Retirements listed in Table 3-1 were also reflected in the short circuit base cases.

3.3.4 Generation and Transmission System Configurations

NPCC Regional Reliability Reference Directory #1, “Design and Operation of the Bulk Power System” and PP-3 required short circuit testing to be conducted with all transmission and generation facilities in-service for all potential operating conditions.

3.3.5 Boundaries

This study included testing of all 115 kV and 345 kV substations and breakers in the SEMA-RI study area as well as select substations and breakers in neighboring portions of the Greater Boston and Eastern Connecticut study areas.

3.3.6 Other Relevant Modeling Assumptions

Not applicable for this study.

[redacted] – [redacted]

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Section 4
Analysis Methodology

4.1 Planning Standards and Criteria

The applicable NERC, NPCC and ISO-NE standards and criteria were tested as part of this evaluation. Descriptions of each of the NERC, NPCC and ISO-NE standard tests that were used to assess system performance are discussed later in this section.

4.2 Performance Criteria

4.2.1 Steady State Criteria

The Needs Assessment was performed in accordance with NERC TPL-001-4 Transmission Planning System Standards, NPCC "Regional Reliability Reference Directory #1, Design and Operation of the Bulk Power System", dated 09/30/15, and ISO Planning Procedure No. 3, "Reliability Standards for the New England Area Bulk Power Supply System", dated 03/01/13. The contingency analysis steady-state voltage and loading criteria, solution parameters and contingency specifications that were used in this analysis are consistent with these documents.

As a part of this needs analysis the robustness of the system with respect to limited extreme contingency events was evaluated.

In this study report, only criteria violations on PTF transmission elements and substations were reported. Information on non-PTF violations can be found in Section 11, but will not be considered in transmission solution development.

4.2.1.1 *Steady State Thermal and Voltage Limits*

Loadings were monitored on all transmission facilities rated at 115 kV and above in the study area and in the Greater Boston and Eastern Connecticut study area which is in close proximity to the SEMA-RI study area. The thermal violation screening criteria defined in Table 4-1 was applied.

Table 4-1: Steady State Thermal Criteria

System Condition	Maximum Allowable Facility Loading
Pre-Contingency (All Lines In)	Normal Rating
Post-Contingency	Long Time Emergency (LTE) Rating

Voltages were monitored at all buses with voltages 115 kV and above in the study area and in the Greater Boston and Eastern Connecticut study area which is in close proximity to the SEMA-RI study area. System bus voltages outside of limits identified in Table 4-2 were identified for all normal (pre-contingency) and post-contingency conditions.

[redacted] – [redacted]

Table 4-2: Steady State Voltage Criteria

Transmission Owner	Voltage Level	Bus Voltage Limits (Per-Unit) Normal Conditions (Pre-Contingency)	Bus Voltage Limits (Per-Unit) Emergency Conditions (Post-Contingency)
National Grid	230 kV and above	0.98 to 1.05	0.95 to 1.05
	115 kV and below	0.95 to 1.05	0.90[19] to 1.05
Eversource Energy	69 kV & above	0.95 to 1.05	0.95 to 1.05
Eversource Energy (NSTAR)	230 kV and above	0.95 to 1.05	0.95 to 1.05
	115 kV and below	0.95 to 1.05	0.95 to 1.05
Millstone / Seabrook[20]	345 kV	1.00 to 1.05	1.00 to 1.05
Pilgrim[20]	345 kV	0.995 to 1.05	0.99 to 1.05
Vermont Yankee[20]	115 kV	1.00 to 1.05	1.00 to 1.05

4.2.1.2 *Steady State Solution Parameters*

The steady-state analysis was performed with pre-contingency solution parameters that allowed for adjustment of load tap-changing transformers (LTCs), static VAR devices (SVDs, including automatically-switched capacitors), and phase angle regulators (PARs). Table 4-3 summarizes the solution parameters used in the study.

Table 4-3: Study Solution Parameters

Case	Area Interchange Control	Tap Adjustments	Adjust Phase Shift	Switched Shunt Adjustments
Base	Tie Lines and Loads Enabled	Stepping	Enabled	Enabled
Contingency	Disabled	Stepping	Disabled[21]	Disabled

[19] This minimum voltage criterion only applies to non-Bulk Power System (BPS) designated substations. BPS stations must be >0.95 post contingency.

[20] This is in compliance with NUC-001-2, *"Nuclear Plant Interface Coordination Reliability Standard,"* adopted August 5, 2009.

[21] Results with NNC PARs 'Disabled' will be reported in the Needs Assessment report. To accurately model the operation of the NNC PARs as described in Section 3.1.15, the analysis will be completed with the Adjust Phase Shift setting set to both 'Enabled' and 'Disabled' for post-contingency conditions in order to compare results.

4.2.2 **Stability Performance Criteria**

Not applicable for this study.

4.2.3 **Short Circuit Performance Criteria**

This study was performed in accordance with appropriate IEEE C37 standards and specific design parameters of the circuit breakers. This includes specific considerations for total-current rated and symmetrical-current rated breakers as appropriate.

The circuit breakers were evaluated for short circuit adequacy based on the following criteria:

- *Acceptable-duty*: Circuit breaker fault interrupting duty less than 100% of the available fault current. No action required.
- *Over-duty Condition*: Circuit Breaker Fault Interrupting Duty greater than 100%. This is considered an unacceptable operating condition requiring a solution to be developed to eliminate the over-duty condition.

4.2.4 **Other Performance Criteria**

Not applicable for this study.

4.3 System Testing

4.3.1 **System Conditions (Sensitivities) Tested**

Testing of system conditions included the evaluation of system performance under a number of resource outage scenarios, variation of related transfer levels, and an extensive number of transmission equipment contingency events.

4.3.2 **Steady State Contingencies / Faults Tested**

Each base case was subjected to single element contingencies such as the loss of a transmission circuit or an autotransformer. In addition, single contingencies which may cause the loss of multiple transmission circuit facilities, such as those on a common set of tower line structures were simulated. The steady-state contingency events in this study also included circuit breaker failures and substation bus fault conditions that could result in removing multiple transmission elements from service. A comprehensive set of contingency events, listed in Appendix D: Contingency List were tested to monitor thermal and voltage performance of the Southwest Connecticut study area transmission network. A listing of all contingency events that were tested is included in Table 4-4.

Additional analyses evaluated N-1-1 conditions with an initial outage of a NERC Bulk Electric System (BES) transmission element followed by another contingency event. The N-1-1 analyses examined the summer peak load case with stressed conditions. For these N-1-1 cases, regional reliability standards, including ISO Planning Procedure 3, allowed specific manual system adjustments, such as fast-start generation re-dispatch, phase-angle regulator adjustment or HVDC adjustments prior to the next single contingency event.

A class of contingencies is the loss of elements without a fault. A distinction was made in this assessment based on the nature of a no-fault contingency as follows:

- Type 1: No-fault contingencies involving the opening of a terminal of a line independent of the design of the terminating facility

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- Type 2: A subset of the above contingencies that involves the opening of a single breaker

For N-1 testing, all Type 1 contingencies above were simulated. However, for N-1-1 testing only the Type 2 contingencies were simulated as second contingencies.

A listing of all contingency types that were tested is included in Table 4-4 and a summary of Element-Out scenarios is provided in Table 4-5. A complete listing of the element-out scenarios can be seen in Appendix D: Contingency List.

Contingency events were also applied in the eastern Connecticut area to evaluate the system performance along the Connecticut to Rhode Island 115 kV tie (the path from Buddington station in CT to West Kingston station in RI).

Table 4-4: Summary of NERC, NPCC and/or ISO-NE Category Contingencies to be Included

Standard	Event Categories
NERC TPL-001-4[22]	P0, P1, P2, P3, P4, P6, P7, Extreme (Limited)
NPCC Directory 1[23]	Performance Requirement iii, I.1, I.2, I.3, I.4[24], I.6, I.8[25], II, Extreme (Limited)
ISO PP-3[26]	3.2.a-c, 3.2.e, 3.2.h, 5.a-c (Limited)

Table 4-5: Summary of N-1-1 First Element-Out Scenarios

Contingency Type	Number of Element-Out Scenarios	Number of Contingencies Tested For N-1/N-1-1 Analysis
Transmission Circuit	165	476
Transformer	69	208
Generator	36	122
Reactive Devices	19	81
Breaker Failure	N/A	1067
Loss of Element w/o Fault	N/A	504
Double Circuit Tower	N/A	163
Multi Circuit Tower	N/A	1
Bus Section	N/A	59
Special Protection System	N/A	59
Loss of Right-of-Way	N/A	125
Loss of Substation	N/A	126
Loss of Generation Station	N/A	10
Total Number of Scenarios	**289**	**3001**

[22] NERC Category P5 events are not included since delayed clearing cannot be reflected in steady state analysis.

[23] NERC Category I.7 events are not included in this study since no bipolar HVDC facilities are connected in or near the SEMA-RI study area. This also applies to ISO PP-3 3.2.f events.

[24] For the purposes of this study, NPCC Category I.5 events will be covered by testing Category I.4 events; in steady state, these two types of events are modeled similarly.

[25] For the purposes of this study, NPCC Category I.9 events will be covered by testing Category I.8 events; in steady state, these two types of events are modeled similarly.

[26] ISO PP-3 3.2.g events will not be tested since modeling SPS inaction is generally the same as not modeling the operation of the SPS at all; these will be covered as part of testing of other PP-3 events.

4.3.3 **Generation Re-Dispatch Testing**

As outlined in ISO Planning Procedure #3 (PP-3), allowable actions after the first contingency event and prior to the second contingency event include re-dispatch of generation. To simulate these actions in power flow analysis, the Security Constrained Re-Dispatch (SCRD) tool in the TARA software package was used.

During the analysis, all available generation within the study area was allowed to be reduced up to a maximum of 1200 MW in total or turned off to mitigate a thermal violation.

4.3.4 **Critical Load Level (CLL) Analysis**

For all violations that could not be resolved by the re-dispatch analysis, a critical load level analysis was performed to determine at what system load level the violation would first occur. This was then used to determine the year each violation could occur on the system.

For each criteria violation, the worst base case stress and contingency event pair was used to determine the CLL. Due to the retirement of Pilgrim Nuclear Power Station by May 31, 2019, the CLL analysis was conducted in two periods over the ten year study horizon. One period is the present year (2016) to 2019 which, represents a system with the Pilgrim Nuclear Power Station in service. The other period is from 2019 to 2026, which represents a system with the Pilgrim Nuclear Power Station OOS. SEMA-RI load was scaled down to 2019 peak load conditions with Pilgrim in service and OOS and down to 2018 peak load[27] conditions with Pilgrim in-service. Meanwhile, generation far away from the study area in Maine, New Hampshire, Vermont, western Massachusetts and western Connecticut was scaled down to maintain a balanced system.

Using the linear extrapolation method described in Section 23 of the ISO-NE Planning Technical Guide, Critical Load Levels were determined and compared to previously-established net load levels for the years 2016-2019 with Pilgrim Nuclear Power Station in-service and 2019-2026 with the Pilgrim Nuclear Power Station OOS to determine a Year of Need.

Table 4-6 shows the net New England load levels by study year used as part of this analysis. Criteria violations with a reported critical load level in-between two respective study years' net peak loads will be reported with the year of need of the higher load level.

Table 4-6: Net New England Load Levels Used for CLL Analysis

Study Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Net NE Load (MW)	27,716	28,198	28,689	29,189	29,346	29,467	29,583	29,729	29,892	30,068	30,238	30,407

[27] The year 2018 was selected for two reasons. First, the year establishes a second point in the period where the Pilgrim Nuclear Power Station is in-service. Secondly, the 2018 peak load point establishes which needs are time-sensitive as described in Section 4.1(j) of Attachment K of the OATT. Time-sensitive needs are those that occur within three years of the completion of the Needs Assessment report. This Needs Assessment report is expected to be posted in April or May 2016. The three year period begins in May 2016 and ends in May 2019. The latest peak load case in this three year period is the 2018 peak load case. The needs assessment analysis was conducted using the 2018 peak load case. Those needs identified in both the 2026 and 2018 needs assessment analysis were deemed time-sensitive. Those needs identified in the 2026 needs assessment analysis but not in the 2018 needs assessment analysis will be deemed as not time sensitive.

4.3.5 **Stability Contingencies / Faults Tested**

Not applicable for this study.

4.3.6 **Short Circuit Faults Tested**

The ASPEN circuit breaker rating module software was used to calculate all circuit breaker duties. The pre-fault operating voltage for all the SEMA-RI study area buses was 1.04 per unit (p.u.). Figure 4-1 shows the ASPEN options used in this study.

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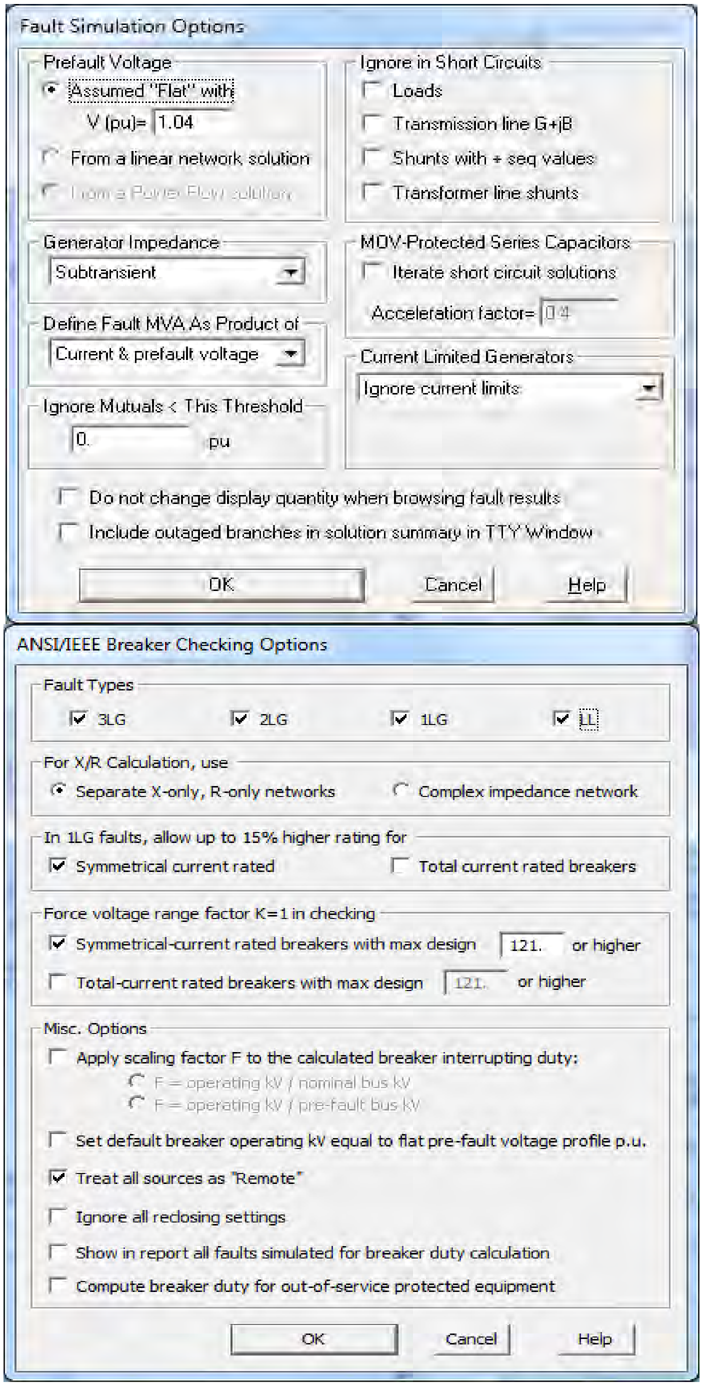

Figure 4-1: ASPEN Fault Simulation Options

Section 5
Results of Analysis

5.1 Overview of Results

The results of steady-state analysis for the SEMA-RI study area indicated that there was one N-0 thermal overload and no N-0 unacceptable voltage conditions. There were a number of N-1 and N-1-1 thermal overloads and unacceptable voltage conditions for each of the subareas within the SEMA-RI study area.

The summary of results presented in Sections 5.2.1 through 5.2.3 includes thermal overload results and unacceptable voltage results organized by subarea. The subareas were selected based on the transmission topology as well as geographic orientation of facilities. The list of SEMA-RI subareas by which the results have been organized is as follows:

1) **Farnum Subarea** – This is an area that runs along the northern section of SEMA-RI across northern Rhode Island.
2) **West Medway – West Walpole Subarea** – This is the area running across northern SEMA-RI from the Rhode Island boarder to the Walpole area.
3) **South Shore Subarea** – This is an area that runs along the northern section of SEMA-RI from the area south of Boston to the Massachusetts southern shore line.
4) **Industrial Park Subarea** – This is an area running across southern SEMA-RI from the New Bedford area through to the Cape Cod Canal.
5) **Somerset – Newport Subarea** – This is an area that runs along the lower part of SEMA-RI from lower Rhode Island through to lower southeastern Massachusetts.
6) **Cape Cod Subarea** – This area includes Cape Cod and the islands of Martha's Vineyard and Nantucket.

The geographic locations of the defined subareas listed above are shown in Figure 5-1**.**

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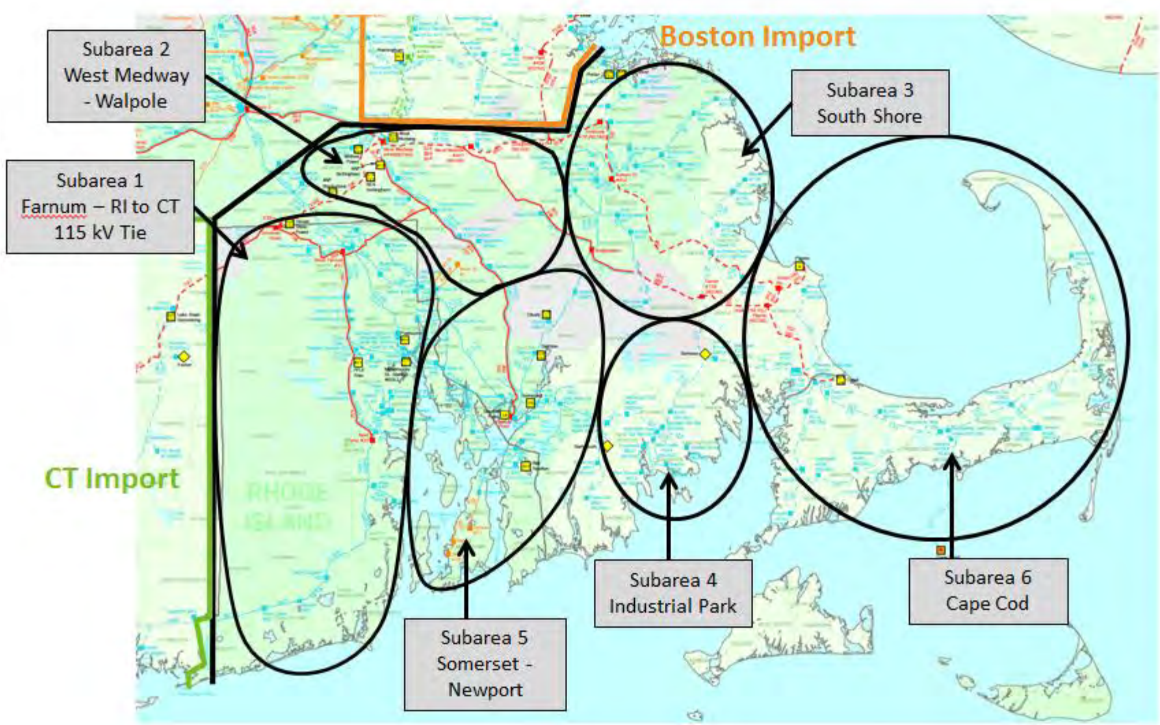

Figure 5-1: SEMA-RI Needs Assessment Study Subareas

5.2 Steady State Performance Criteria Compliance

Steady state test results varied as a function of the generation dispatch and transfer level conditions modeled. One base case thermal overload was observed. A number of post-contingency overloads and voltage violations were observed in all of the various base cases modeled. There were also a number of post-contingency overloads and voltage violations that were only associated with specific system conditions.

5.2.1 N-0 Thermal and Voltage Violation Summary

Under N-0 base case modeled conditions, there was one overload observed in the Farnum subarea on the [redacted]. There were no N-0 base case thermal overloads in any other subarea. There were no observed N-0 base case voltage violations in any study subarea.

Table 5-1: [redacted] Thermal Overload

Element ID	Element Description	Normal Rating (MW)	Dispatch	Worst-Case Thermal Loading (% LTE)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]				

[redacted] – [redacted]

REDACTED

[redacted]

[redacted]

5.2.2 **N-1 Thermal and Voltage Violation Summary**

N-1 testing was performed for all of the system conditions described in Section 3.1. An overview of the results that showed thermal overloads and unacceptable voltage performance is listed below. Every subarea with the exception of Cape Cod had single contingency overload or voltage violation events. The complete set of results of overloaded elements and unacceptable voltage performance can be found in Section 11.

5.2.2.1 *Farnum Subarea N-1 Thermal Overloads and Voltage Violations Results*

The elements listed in the following tables and shown on the one-line diagrams following the tables were overloaded for the contingency and generation dispatch conditions noted in the results tables for the Farnum subarea.

The results for this subarea indicate that, absent generation at [redacted], N-1 overloads occur on lines supplying the load pocket encompassed by the Woonsocket, Washington, Robinson Ave, Valley and Riverside substations.

No N-1 voltage violations were observed in this subarea.

[redacted] – [redacted]

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Table 5-2: V148S, R9, and J16S N-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MW)	Contingency	Worst-Case Thermal Loading (% LTE)
V148S-1	V148 Tap to Washington RI 115 kV Line Section	218	[redacted]	114.39
R9	Riverside to Valley 115 kV Line	110	[redacted]	173.15
J16S	Staples to Highland Park 115 kV Line	115	[redacted]	112.56
Worst case overloads occur [redacted], [redacted]. With much of the major generation [redacted], additional stress is placed on the 115 kV paths leading into and out of the area.				

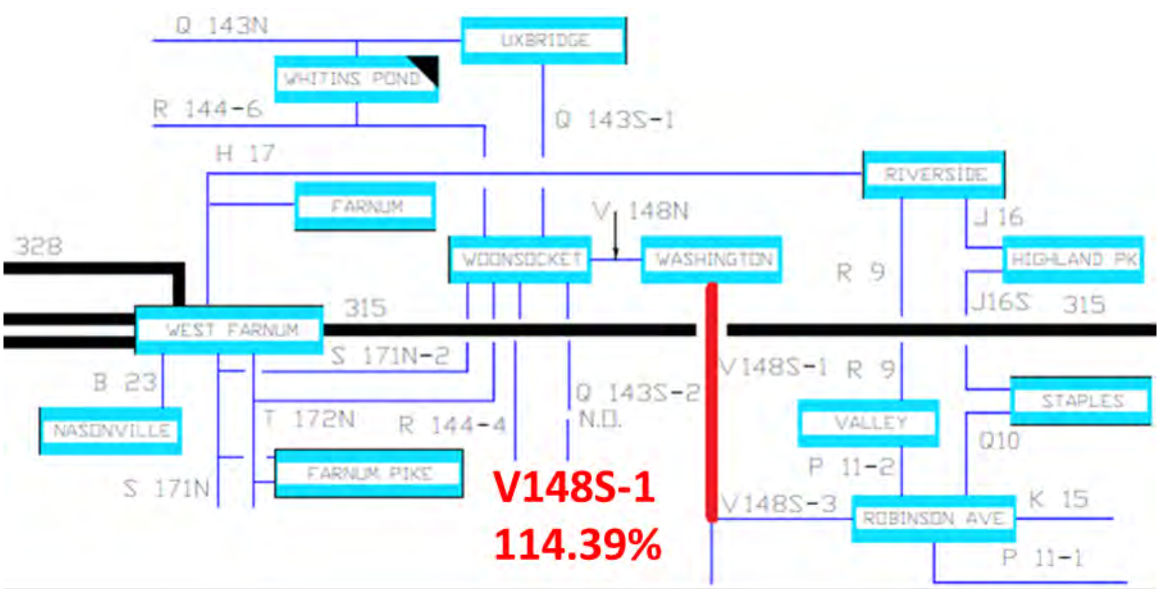

Figure 5-3: V148S-1 N-1 Thermal Overload

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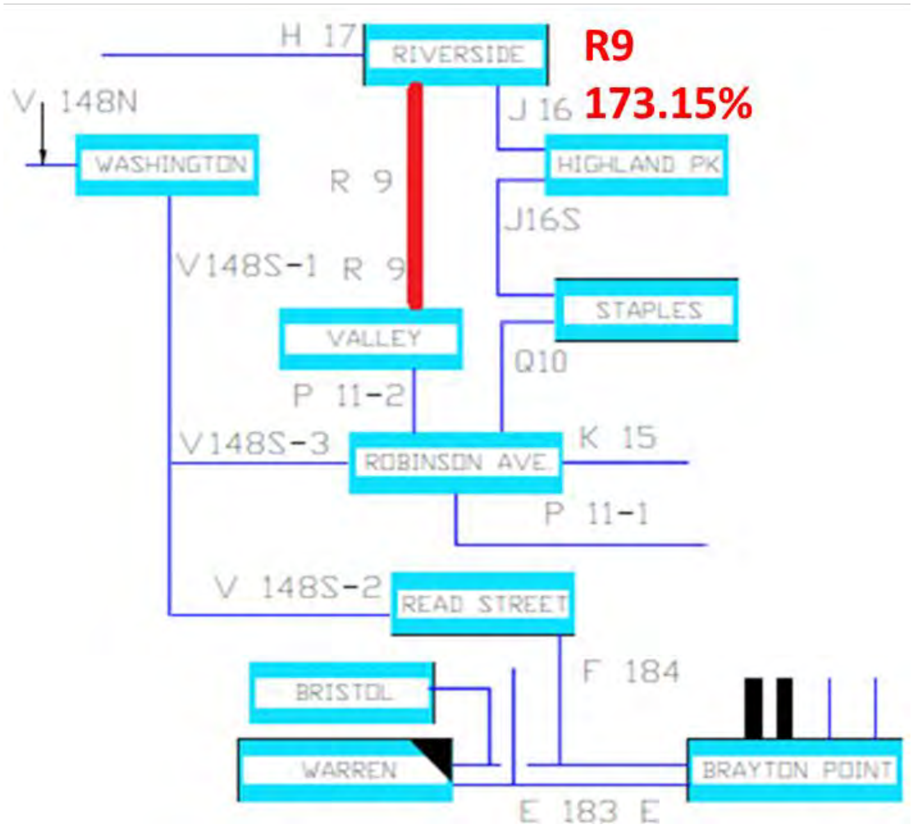

Figure 5-4: R9 N-1 Thermal Overload

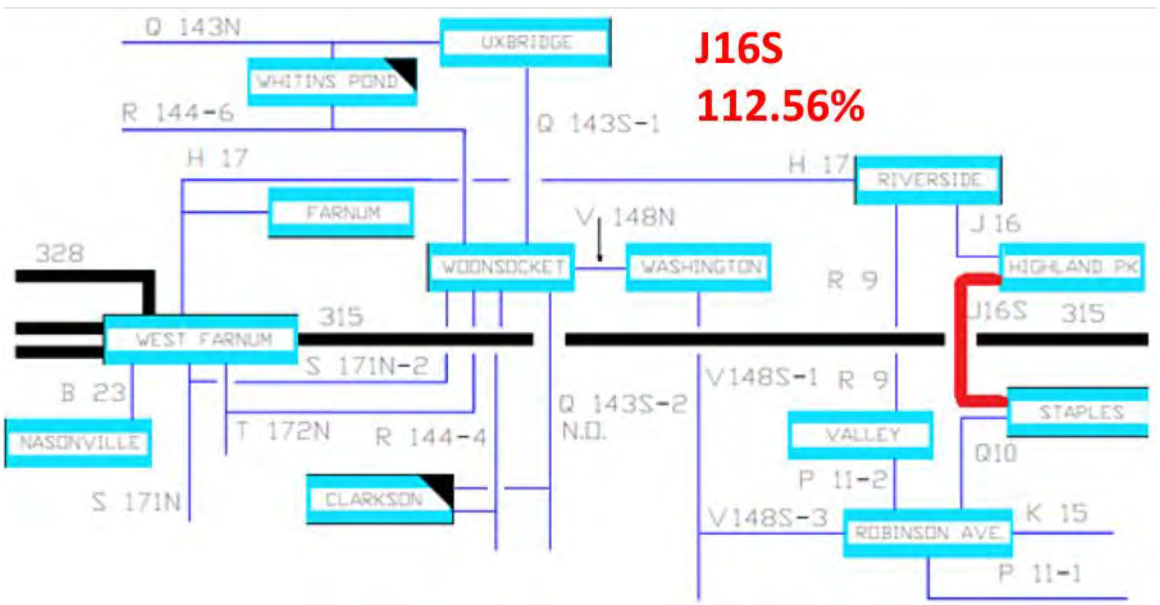

Figure 5-5: J16S N-1 Thermal Overload

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Table 5-3: P11 Line Section N-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MW)	Contingency	Worst-Case Thermal Loading (% LTE)
P11-1	Pawtucket kV to P11 Tap 115 kV Line Section	172	[redacted]	119.40
P11-2	Valley to P11 Tap 115 kV Line Section	127	[redacted]	110.09
P11-3	Robinson Ave to P11 Tap 115 kV Line Section	193	[redacted]	104.40
Worst case overloads occur [redacted], [redacted]. With much of the major generation in the [redacted], additional stress is placed on the 115 kV paths leading into and out of the area.				

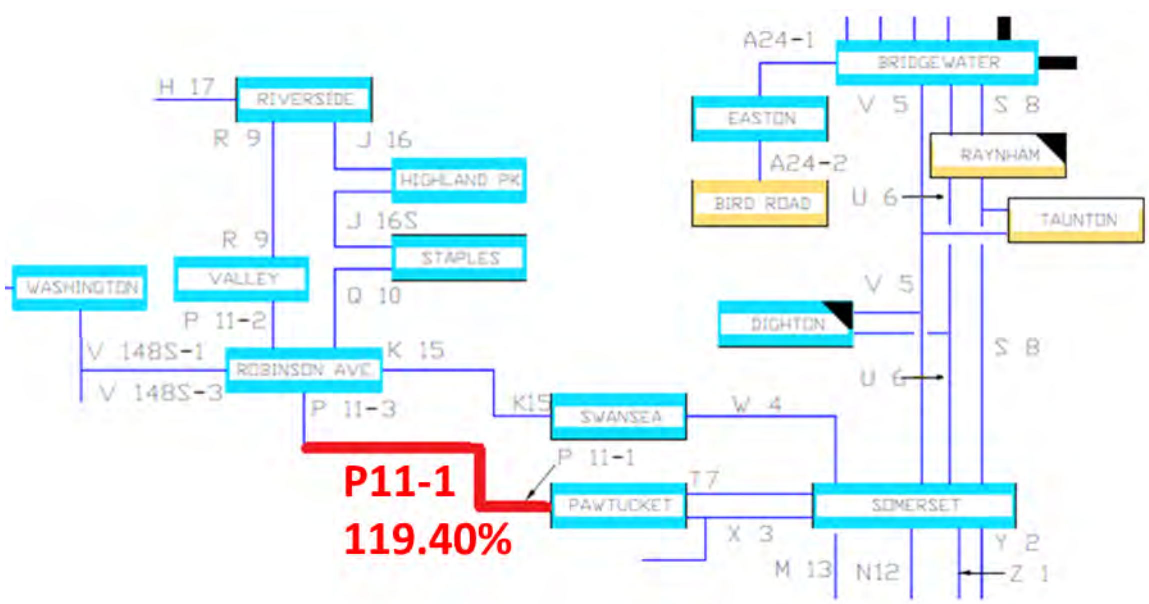

Figure 5-6: P11-1 N-1 Thermal Overload

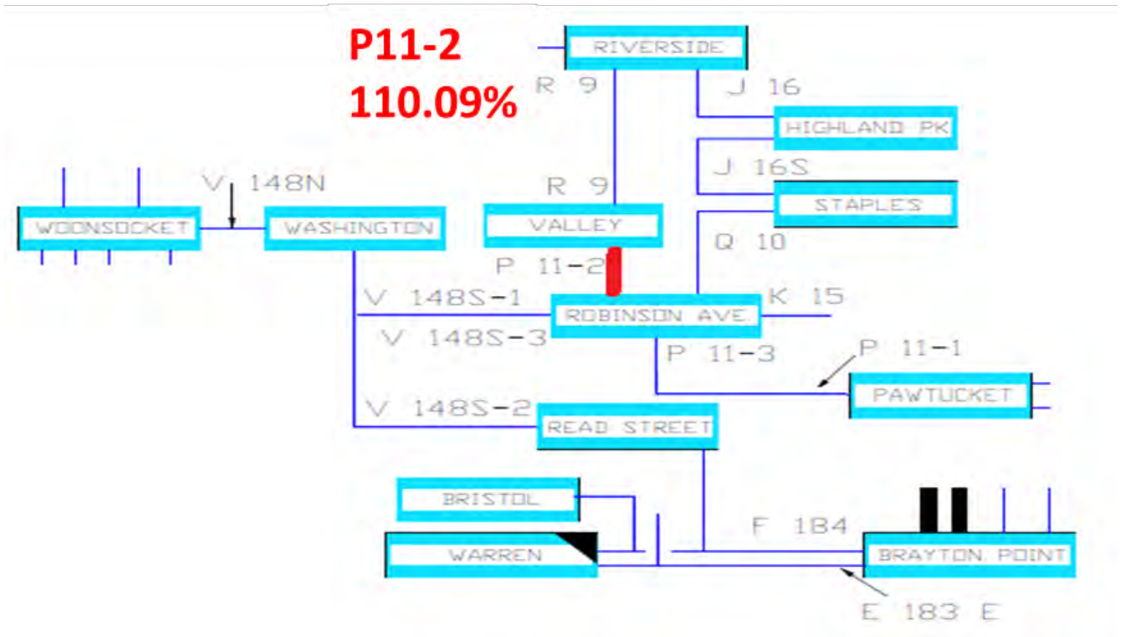

Figure 5-7: P11-2 N-1 Thermal Overload

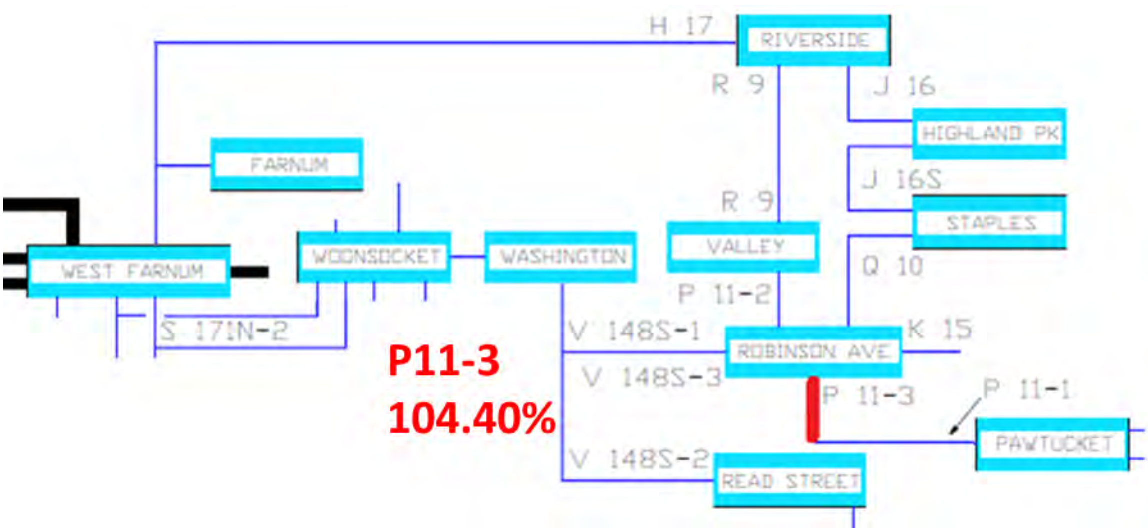

Figure 5-8: P11-3 N-1 Thermal Overload

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Table 5-4: Valley P11/R9 Bus Tie **and H17 Line Sections N-1 Thermal Overloads**

Element ID	Element Description	LTE Rating (MW)	Contingency	Worst-Case Thermal Loading (% LTE)
Valley P11/R9 Bus Tie	Valley 205 115 kV Bus Equipment	128	[redacted]	129.20
H17-1	West Farnum to Farnum Tap 115 kV Line Section	284	[redacted]	112.03
H17-2	Riverside to Farnum Tap 115 kV Line Section	245	[redacted]	129.28
Worst case overloads occur with [redacted].				

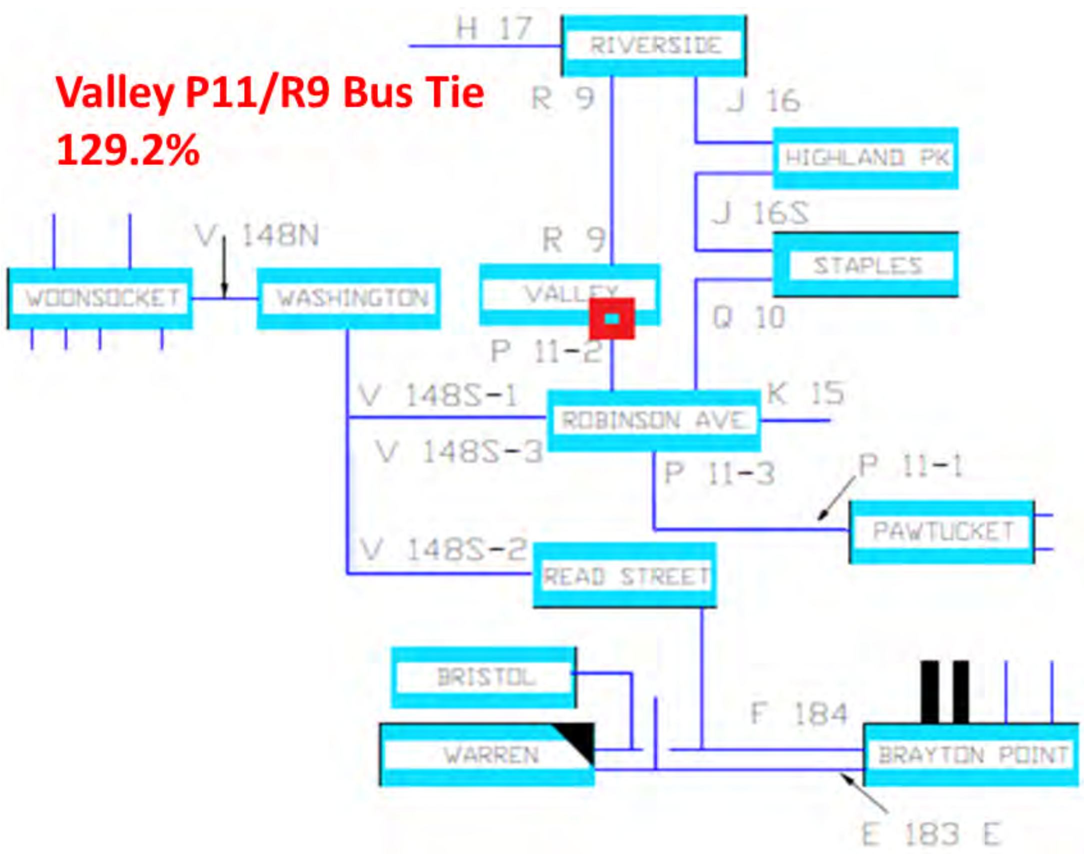

Figure 5-9: Valley P11/R9 Bus Tie**N-1 Thermal Overload**

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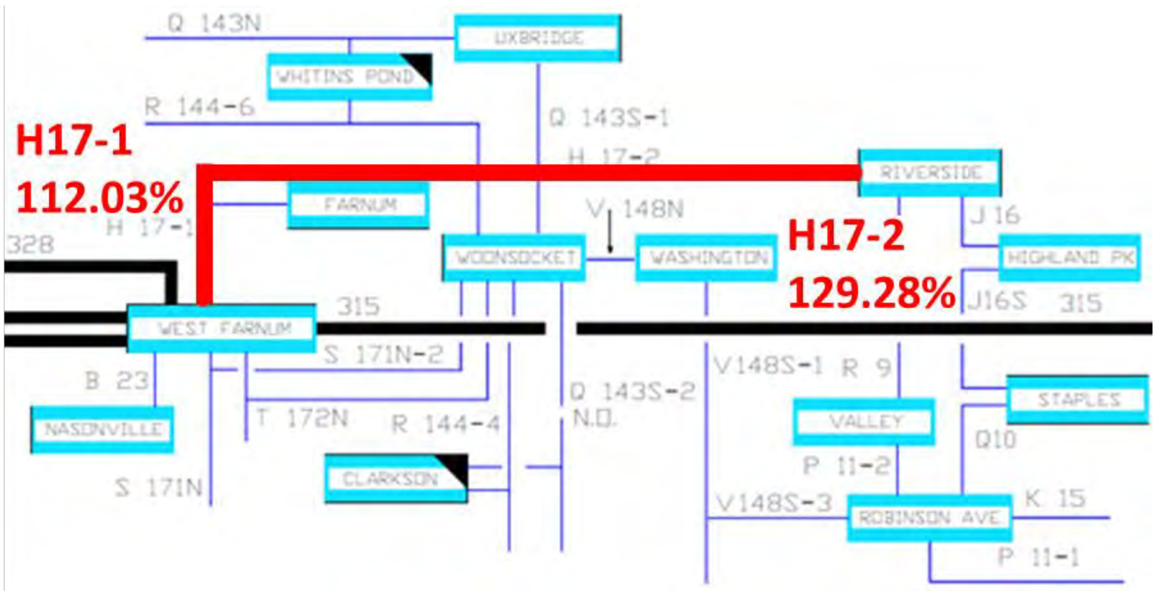

Figure 5-10: H17-1 N-1 Thermal Overload

Table 5-5: West Farnum 175T N-1 Thermal Overload

Element ID	Element Description	LTE Rating (MW)	Contingency	Worst-Case Thermal Loading (% LTE)
West Farnum 175T	West Farnum 345/115 kV Autotransformer	389	[redacted]	100.56
Worst case overload occurs with [redacted]. Loss of major generation in the Farnum area causes much of this subarea to be served [redacted].				

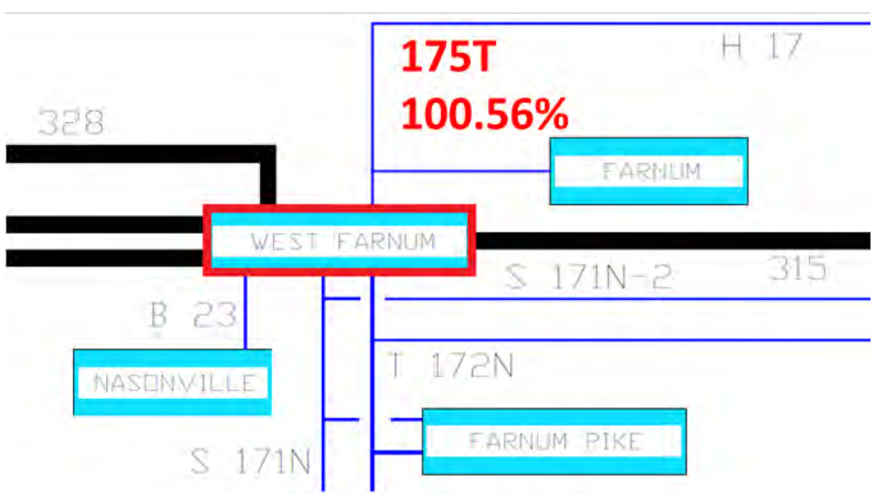

Figure 5-11: West Farnum 175T N-1 Thermal Overload

5.2.2.2 *West Medway – West Walpole Subarea N-1 Thermal Overloads and Voltage Violations Results*

No N-1 voltage violations or thermal overloads were observed for the West Medway – West Walpole subarea.

5.2.2.3 *South Shore Subarea N-1 Thermal Overloads and Voltage Violations Results*

The elements listed in the following table and shown on the one-line diagrams following the table were overloaded for the contingency and generation dispatch conditions noted in the results tables for the South Shore subarea.

No N-1 voltage violations were observed in this subarea.

Table 5-6: South Shore Subarea N-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MW)	Contingency	Worst-Case Thermal Loading (% LTE)
L1[28]	East Bridgewater to East Bridgewater Tap 115 kV Line	166	[redacted]	120.47
E1-2	Middleboro to Bridgewater 115 kV Line Section	197	[redacted]	109.49[29]
Worst case overloads occur for loss of some combination of the [redacted].				

[28] Planned National Grid upgrades to this line (with an in-service date of 2017) may alleviate or eliminate this overload, but final updated ratings were not available as of the time of completion of this Needs Assessment.

[29] This overload only occurs on the portion of the line owned by Middleboro Gas and Electric.

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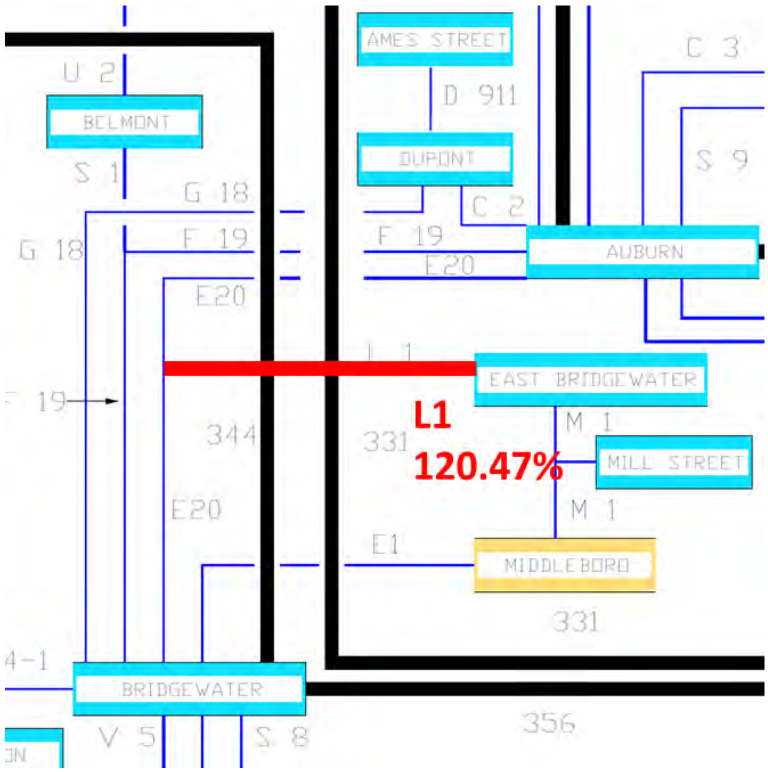

Figure 5-12: L1 N-1 Thermal Overload

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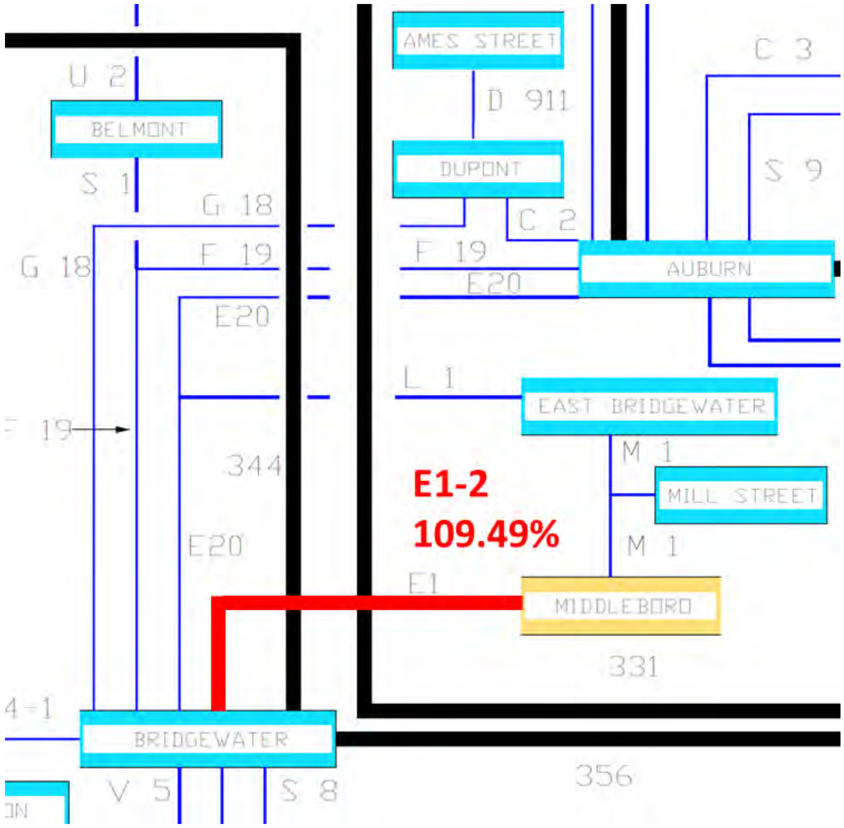

Figure 5-13: E1-2 N-1 Thermal Overload

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5.2.2.4 *Industrial Park Subarea N-1 Thermal Overloads and Voltage Violations Results*

The elements listed in the following table and shown on the one-line diagrams following the table were overloaded for the contingency and generation dispatch conditions noted in the results tables for the Industrial Park subarea.

Table 5-7: 111 and 122 Line Section Overloads N-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Contingency	Worst-Case Thermal Loading (% LTE)
112-1[30]	Tremont to Rochester 115 kV Line Section	286	[redacted]	119.18
112-2[30]	Rochester to Crystal Spring Tap 115 kV Line Section	281	[redacted]	119.73
112-3[30]	Industrial Park Tap to Crystal Spring Tap 115 kV Line Section	280	[redacted]	120.16
112-4	Industrial Park to Industrial Park Tap 115 kV Line Section	246	[redacted]	184.17
111-1	High Hill to Industrial Park 115 kV Line Section	246	[redacted]	163.71
Loss of the [redacted] leaves a large portion of eastern Rhode Island and southeastern Massachusetts fed radially off of the 112 and 114 lines out of the Tremont substation. Absent generation [redacted], the thermal overloads are exacerbated and low voltages are observed in the pocket.				

[30] The reported worst case thermal overloads on these line sections reflect the inclusion of the FCM-certified transmission upgrades proposed for these line sections associated with [redacted].

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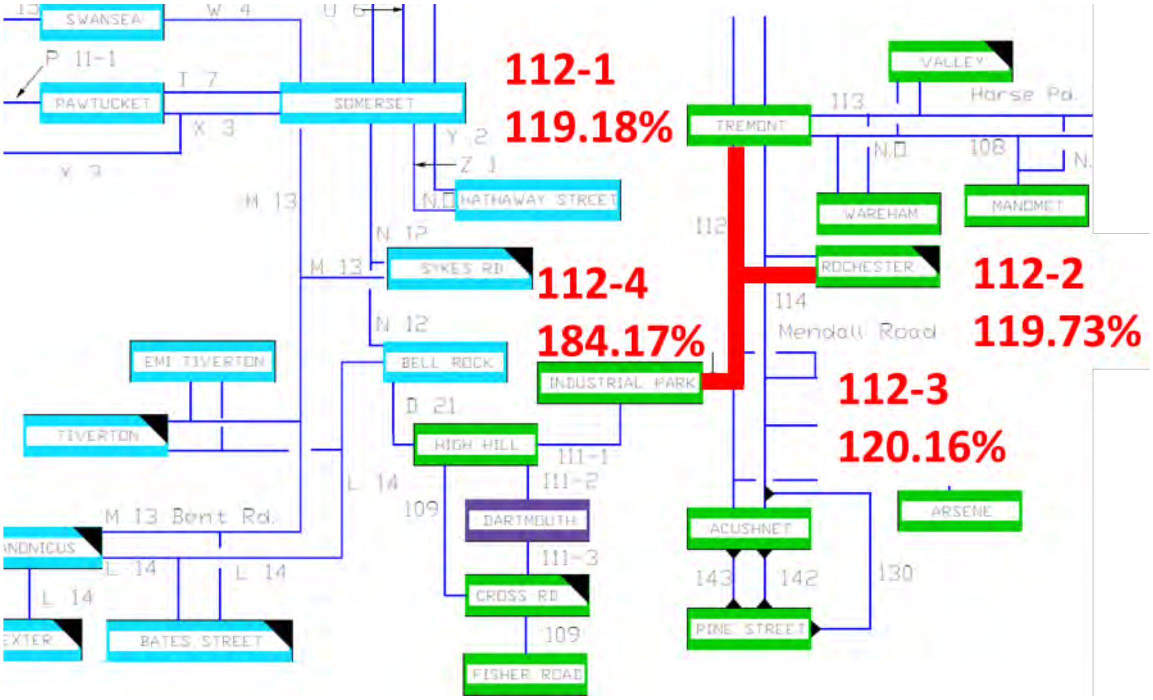

Figure 5-14: 112 Line Sections N-1 Thermal Overloads

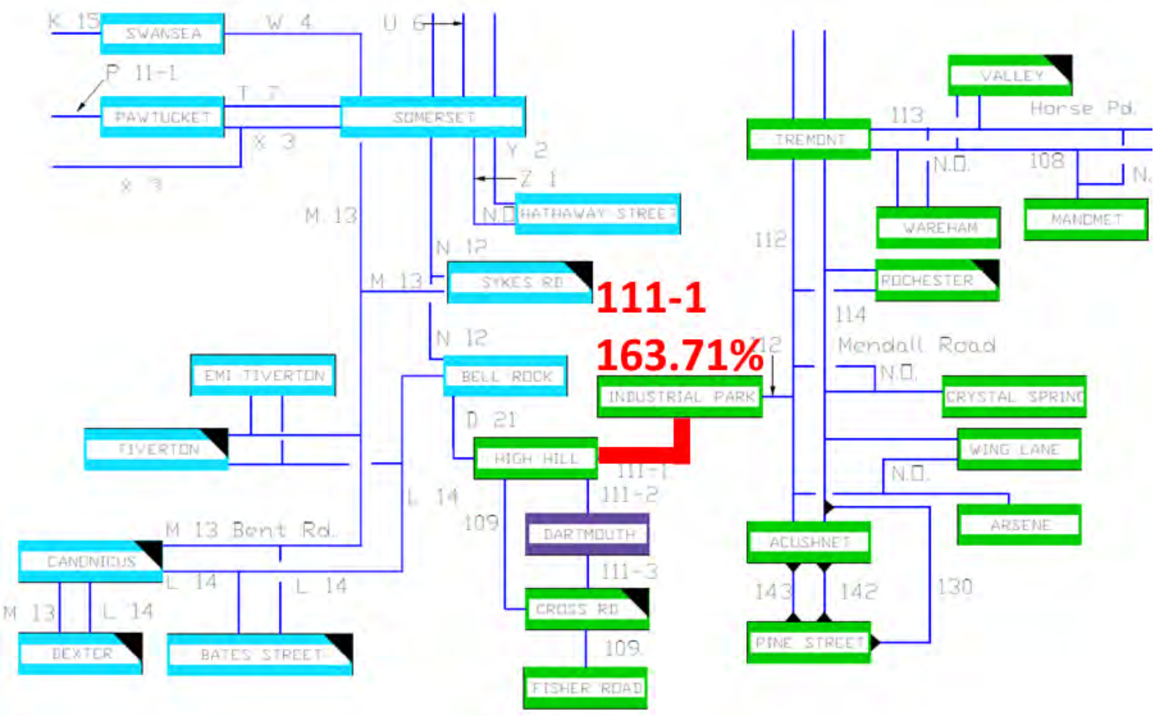

Figure 5-15: 111-1 Thermal N-1 Overload

[redacted] – [redacted]

REDACTED

The buses listed in the following table and shown on the one-line diagrams following the table showed N-1 voltage violations for the contingency and generation dispatch conditions noted in the results tables for the Industrial Park subarea.

Table 5-8: Industrial Park Subarea N-1 Voltage Violations

Bus Name	Base kV	Contingency	Worst-Case Voltage (p.u.)	Comments
Acushnet	115	[redacted]	0.8405	[redacted]
High Hill	115	[redacted]	0.7164	[redacted]
Industrial Park	115	[redacted]	0.7508	[redacted]
Tremont	115	[redacted]	0.9437	[redacted]

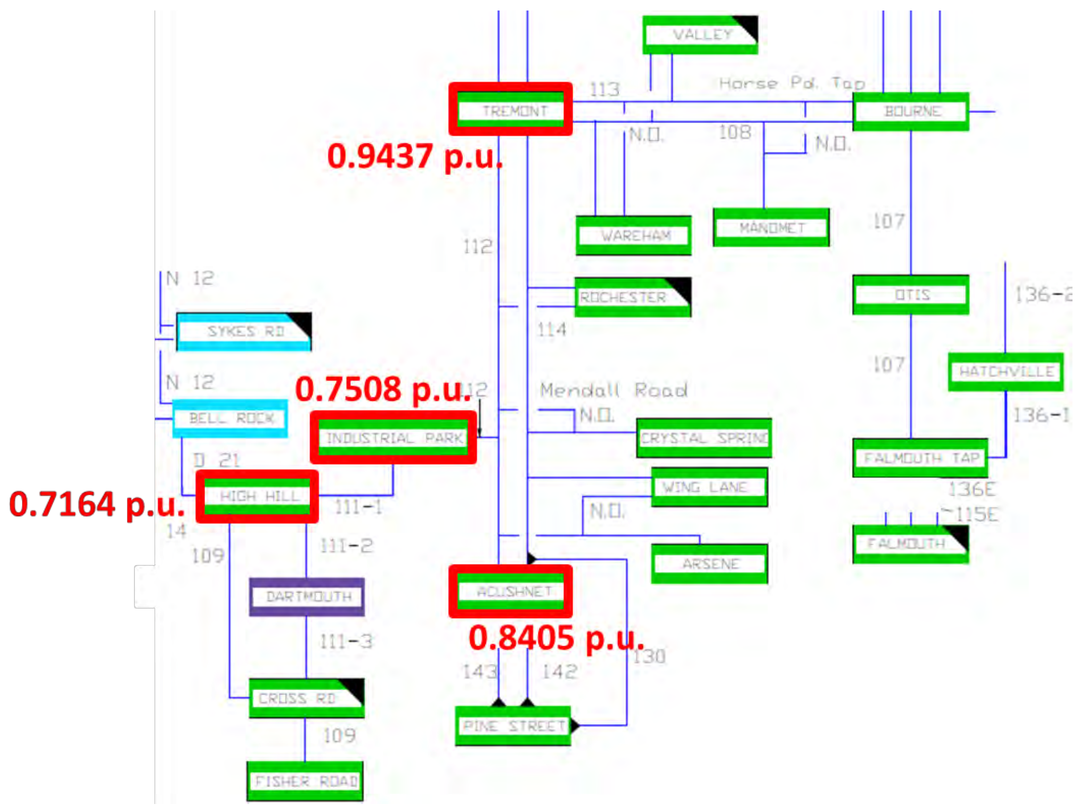

Figure 5-16: Industrial Park Subarea N-1 Voltage Violations

5.2.2.5 *Somerset – Newport Subarea N-1 Thermal Overloads and Voltage Violations Results*

The elements listed in the following tables and shown on the one-line diagrams following the tables were overloaded for the generation dispatch conditions noted under in the results tables for the Somerset-Newport subarea.

The results for this subarea indicate that, absent generation [redacted], N-1 overloads occur on [redacted] the load pocket encompassed by the Woonsocket, Washington, Robinson Ave, Valley, and Riverside substations.

Table 5-9: L14 Line Sections N-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Contingency	Worst-Case Thermal Loading (% LTE)
L14-3	Bent Rd to Tiverton Tap 115 kV Line Section	210	[redacted]	135.25
L14-4	Bell Rock to Tiverton Tap 115 kV Line Section	250	[redacted]	129.16
L14-6	Tiverton to Tiverton Tap 115 kV Line Section	180	[redacted]	103.17
L14-7	Canonicus to Dexter 115 kV Line Section	165	[redacted]	111.50
These overloads occur for various contingencies that take out some or all portions of the [redacted].				

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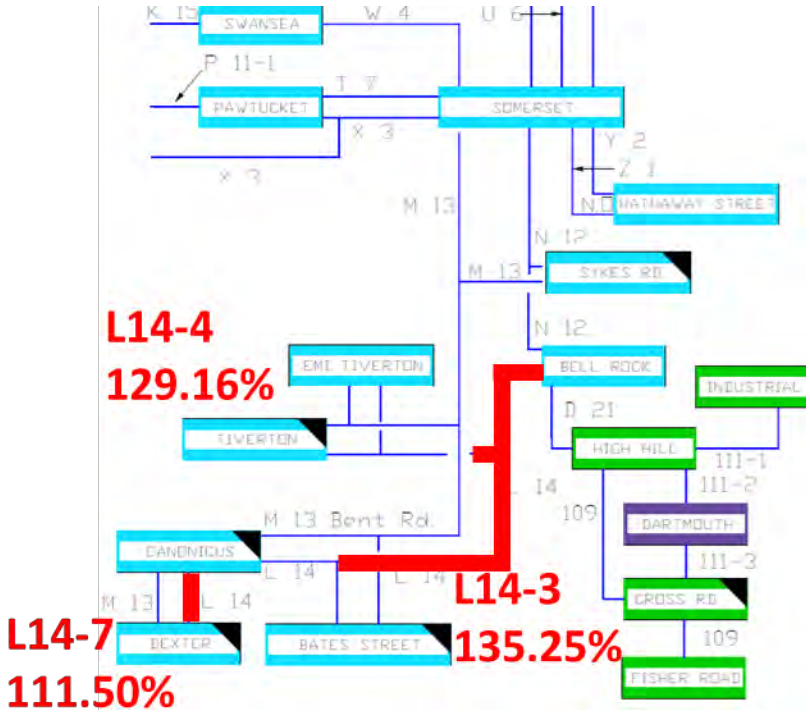

Figure 5-17: L14 Line Sections Thermal Overloads

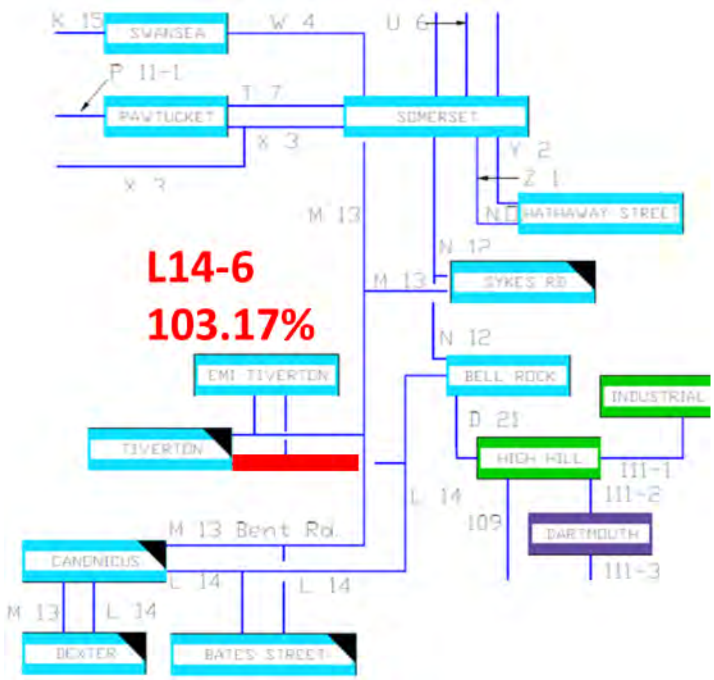

Figure 5-18: L14-6 N-1 Thermal Overload

[redacted] – [redacted]

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Table 5-10: D21, N12 and M13 Line Sections N-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Contingency	Worst-Case Thermal Loading (% LTE)
D21	Bell Rock to High Hill 115 kV Line	330	[redacted]	102.42
N12-1	Somerset to Sykes Rd 115 kV Line Section	284	[redacted]	110.26
N12-2	Sykes Rd to Bell Rock 115 kV Line Section	284	[redacted]	100.05
M13-4	Somerset to Sykes Rd 115 kV Line Section	284	[redacted]	109.38
M13-8	Tiverton Tap to Sykes Rd 115 kV Line Section	250	[redacted]	117.28
With generation at [redacted], loss of [redacted] this load pocket causes overloads on the lines remaining in service.				

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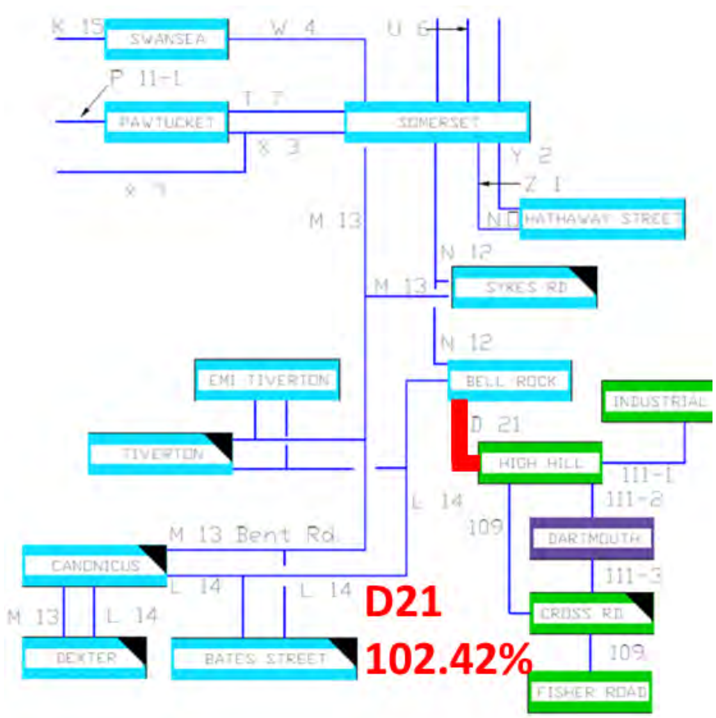

Figure 5-19: D21 N-1 Overload

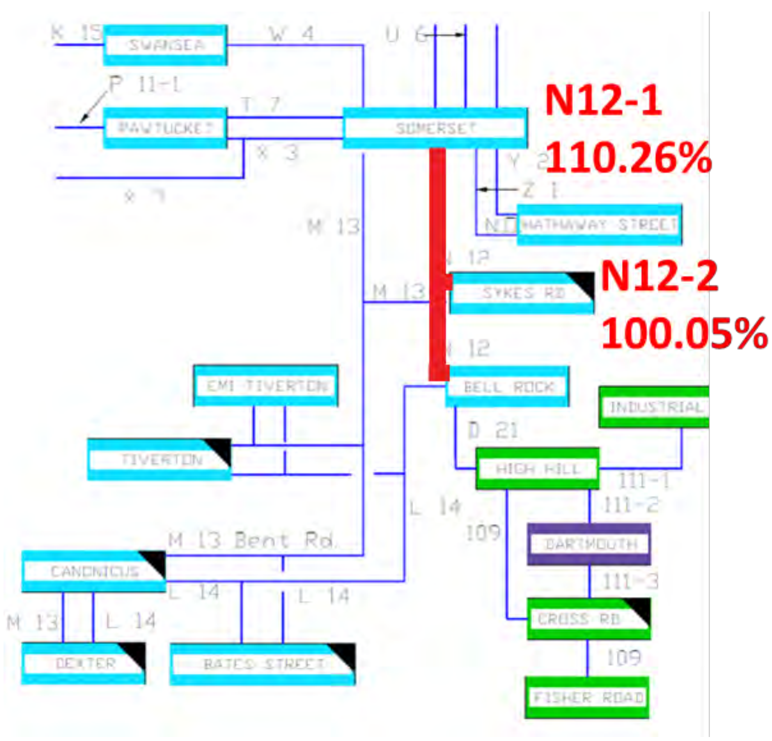

Figure 5-20: N12 Line Sections N-1 Thermal Overloads

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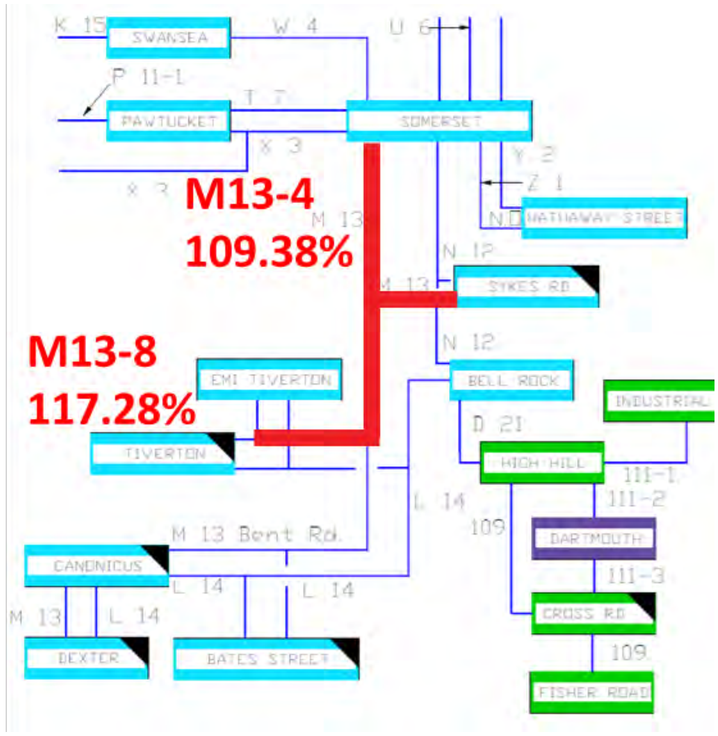

Figure 5-21: M13 Line Sections N-1 Thermal Overloads

REDACTED

Table 5-11: V5, U6 and S8 Line Sections N-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Contingency	Worst-Case Thermal Loading (% LTE)
U6-1	Somerset to Dighton 115 kV Line Section	206	[redacted]	117.38
U6-3	Dighton to Dighton Tap Line Section	206	[redacted]	117.33
V5-3	Bridgewater to V5 Tap 115 kV Line Section	244	[redacted]	100.36
S8-4	Bridgewater to Raynham 115 kV Line Section	244	[redacted]	113.92
Overloads occur [redacted] [redacted] generation with contingencies involving [redacted].				

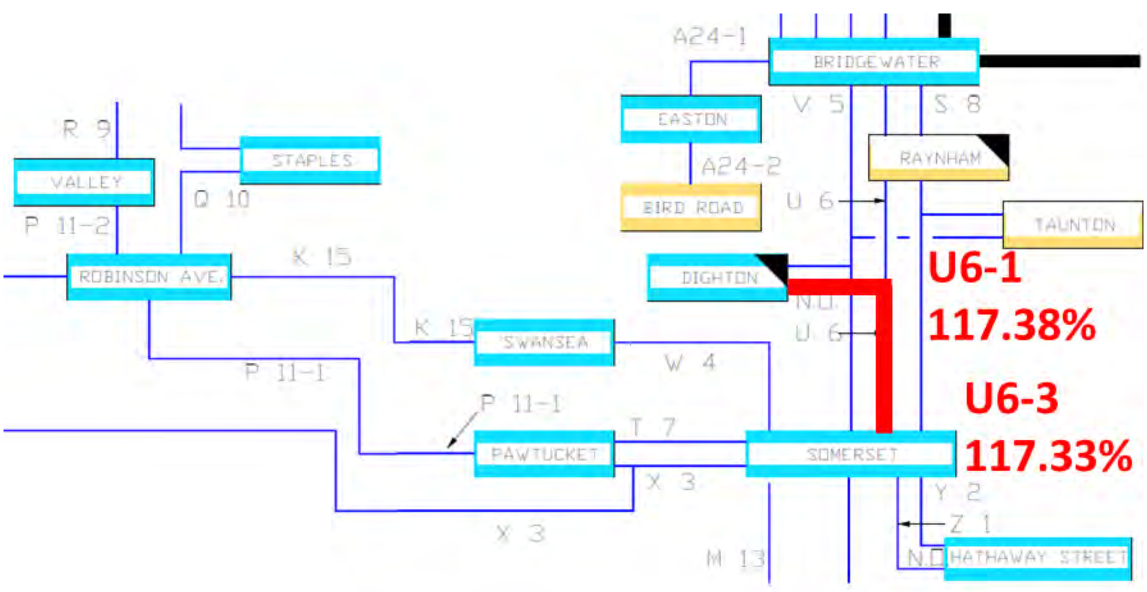

Figure 5-22: U6-1, 3 N-1 Overloads

REDACTED

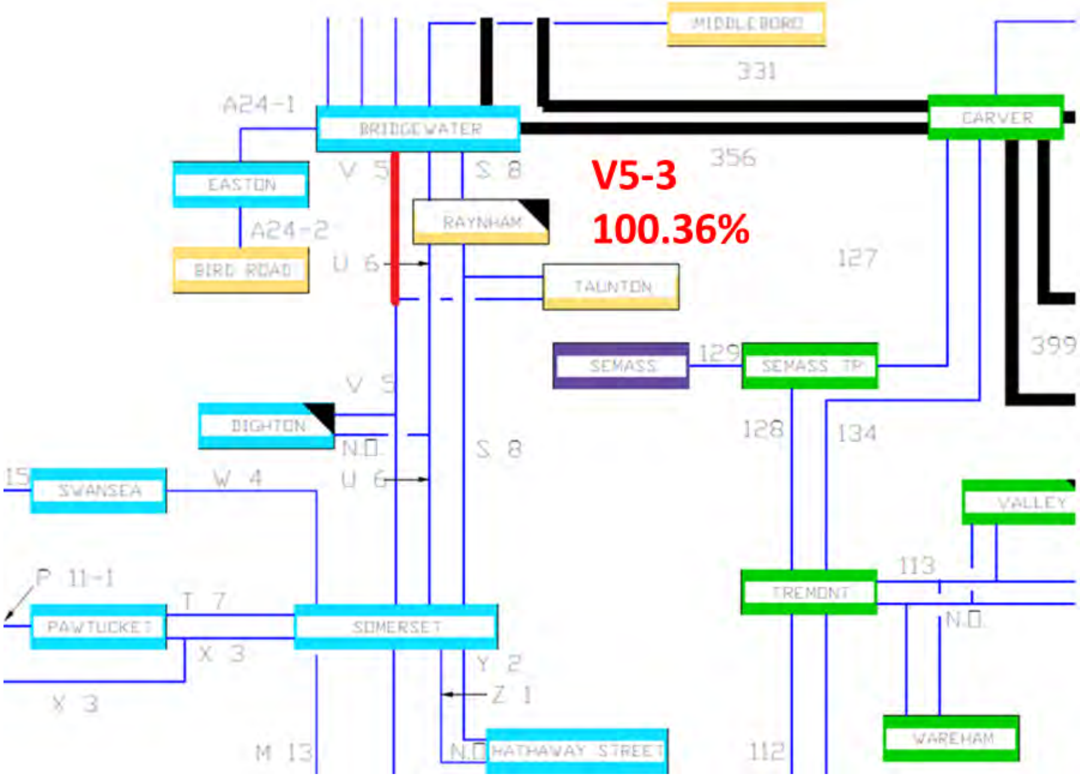

Figure 5-23: V5-3 N-1 Thermal Overload

[redacted] – [redacted]

REDACTED

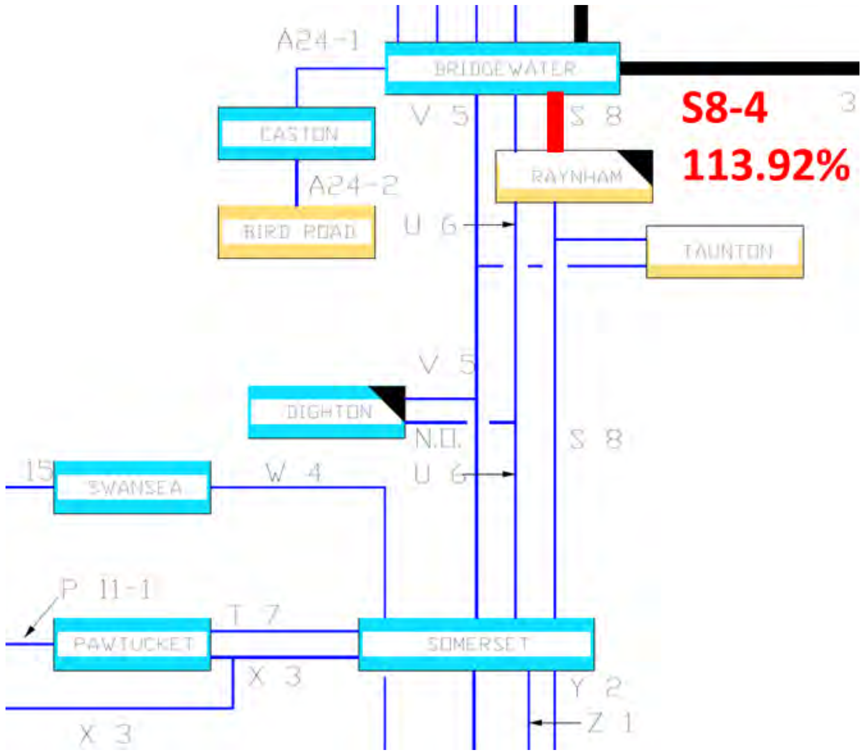

Figure 5-24: S8-4 N-1 Thermal Overload

The buses listed in the following table and shown on the one-line diagram following the table showed N-1 voltage violations for the contingency and generation dispatch conditions noted in the results tables for the Somerset – Newport subarea.

Table 5-12: Somerset – Newport Subarea N-1 Voltage Violations

Bus Name	Base kV	Contingency	Worst-Case Voltage (p.u.)	Comments
Bell Rock	115	[redacted]	0.6702	[redacted]
Canonicus	115	[redacted]	0.5998	[redacted]
Dexter	115	[redacted]	0.5802	[redacted]
Jepson	115	[redacted]	0.5757	[redacted]
Tiverton	115	[redacted]	0.6025	[redacted]

REDACTED

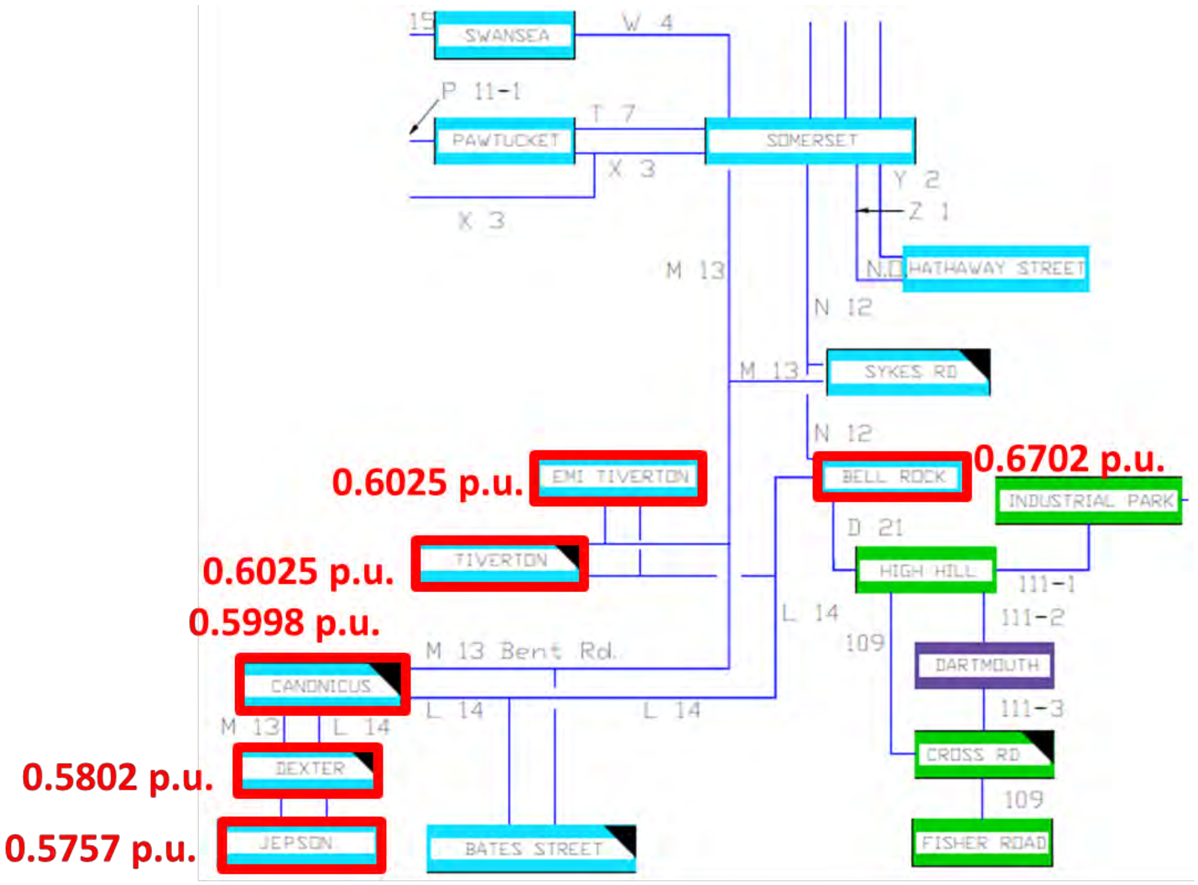

Figure 5-25: N-1 Voltage Violations Somerset - Newport Subarea

5.2.2.6 *Cape Cod Subarea N-1 Thermal Overloads and Voltage Violations Results*

No N-1 voltage violations or thermal overloads were observed for the Cape Cod subarea.

REDACTED

5.2.3 **N-1-1 Thermal and Voltage Violation Summary**

Element-out-of-service (N-1-1) testing included all 115 kV, 230 kV and 345 kV transmission lines as well as 345 kV autotransformers as initial out of service elements in the SEMA-RI area that are considered NERC Bulk Electric System (BES) elements. These element-out-of-service conditions were tested against the full set of contingencies used in the N-1 tests, with noted exceptions made for the treatment of no-fault contingencies as described in Section 4.3.2. Testing of the system included use of an analytical tool that used a re-dispatch of New England generation outside the SEMA-RI area and back-down of SEMA-RI area generation in an attempt to avoid overloads.

The N-1-1 overloaded elements and voltage violations for each subarea listed in Section 5.1 above are shown in this section and are organized by the six subareas. These results shown below include the worst-case result for each element or bus. The dispatch conditions for the overloaded element results have been noted in the comments at the bottom of each table. The full set of results for all contingencies tested can be found in Section 11.

5.2.3.1 *Farnum Subarea N-1-1 Thermal Overloads and Voltage Violation Results*

The tables in this section and the figures following them show the worst case N-1-1 element overloads and unacceptable voltage performance results for the Farnum subarea. Dispatch conditions for each of the overloads and voltage violations are noted in the comments at the bottom of each table.

Table 5-13: Kent County 3X N-1-1 Overload

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
Kent County 3X	Kent County 3X 345/115 kV Autotransformer	587	[redacted]	[redacted]	102.97
Worst case overloads occur with [redacted]. [redacted] leaves the 3X autotransformer (which has the lowest LTE rating of the three) as the only 345 kV source into the area.					

REDACTED

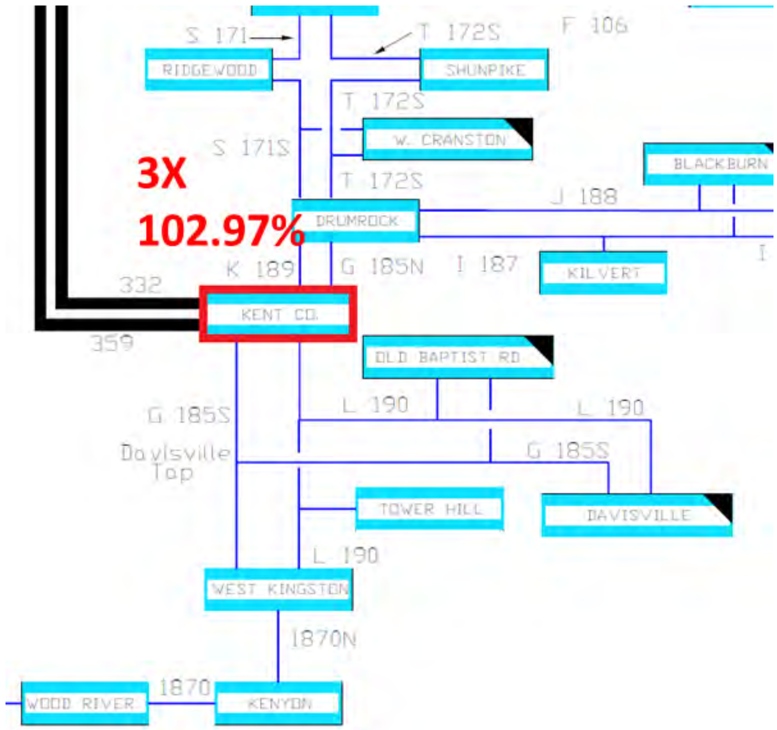

Figure 5-26: Kent County 3X N-1-1 Overload

Table 5-14: L190 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
L190-4	Tower Hill to West Kingston 115 kV Line	251	[redacted]	[redacted]	118.19
L190-5	Tower Hill to Davisville Tap 115 kV Line	251	[redacted]	[redacted]	131.18
Worst-case overloads occurred [redacted]. [redacted], the L190 becomes the sole transmission source into this pocket and also must serve several substations west of the CT-RI border.					

REDACTED

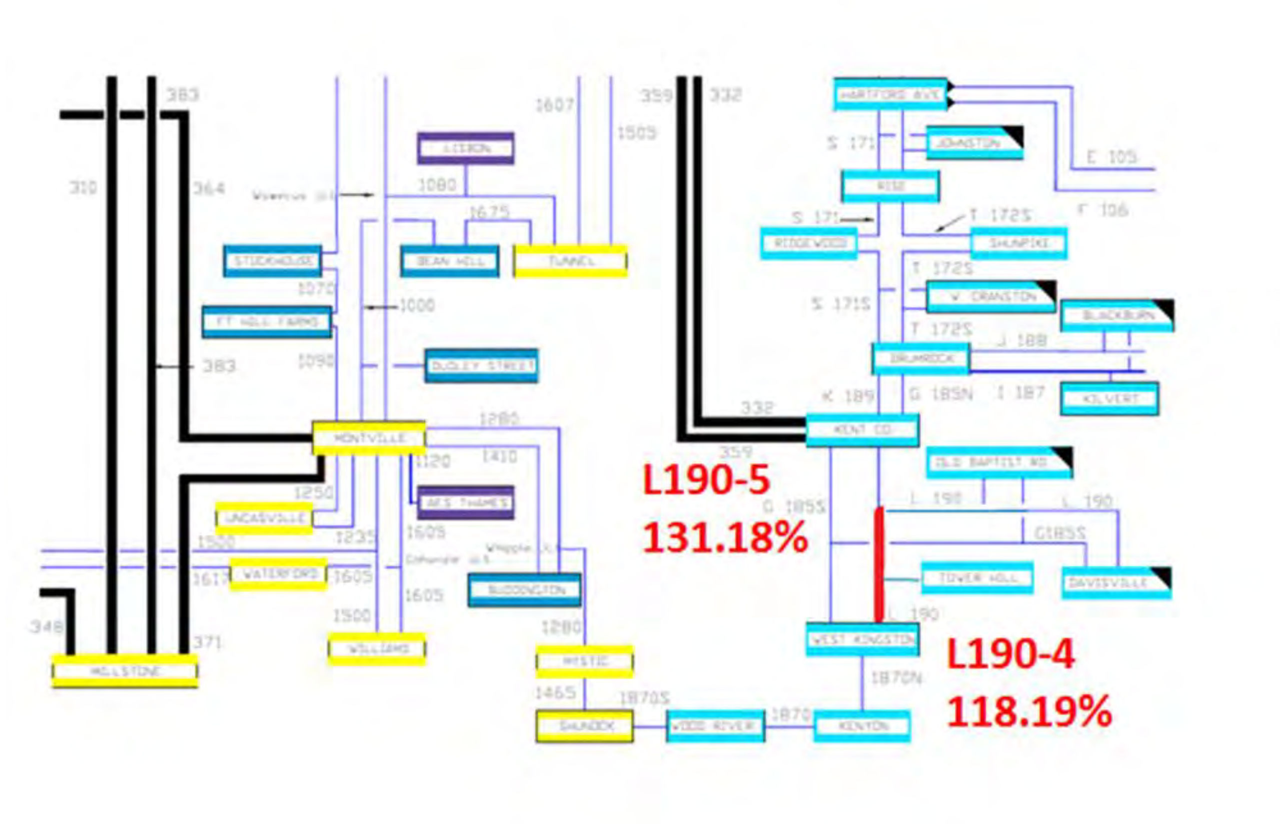

Figure 5-27: L190-4, 5 N-1-1 Overloads

Table 5-15: V148N/S Line Section and H17 Line Section N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
V148S-1	V148 Tap to Washington RI 115 kV Line	218	[redacted]	[redacted]	144.34
V148S-3	Robinson Ave to V148 Tap 115 kV Line	410	[redacted]	[redacted]	104.66
V148N	Washington to Woonsocket 115 kV Line	348	[redacted]	[redacted]	106.84
H17-1	West Farnum to Farnum Tap 115 kV Line	284	[redacted]	[redacted]	144.64
H17-2	Riverside to Farnum Tap 115 kV Line	245	[redacted]	[redacted]	167.18
All of the overloads in this table occur for loss [redacted] and leaves the area with limited support [redacted]. In all cases, the worst violations occurred [redacted].					

REDACTED

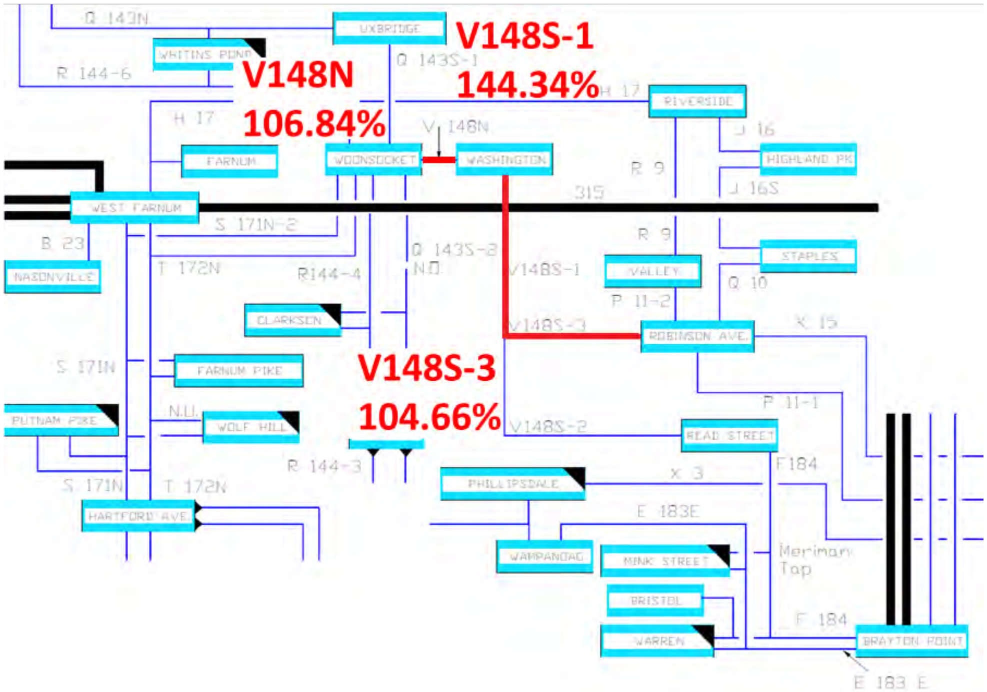

Figure 5-28: V148N and V148S Line Sections N-1-1 Thermal Overloads

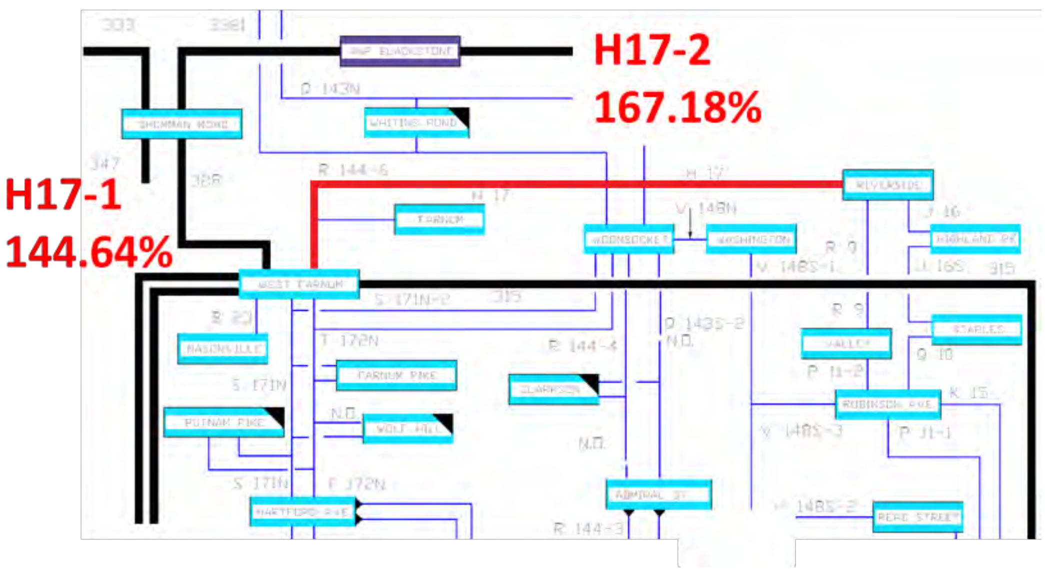

Figure 5-29: H17 Line Sections N-1-1 Overloads

REDACTED

Table 5-16: R9, Valley P11/R9 Bus Tie **and J16 Line Section N-1-1 Thermal Overloads**

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
R9	Riverside to Valley 115 kV Line	110	[redacted]	[redacted]	210.61
Valley P11/R9 Bus Tie	Valley 205 115 kV Bus Equipment	128	[redacted]	[redacted]	160.39
J16S	Staples to Highland Drive 115 kV Line	115	[redacted]	[redacted]	169.36
All of the overloads in this table occur for loss [redacted]. In all cases, the worst violations occurred with [redacted].					

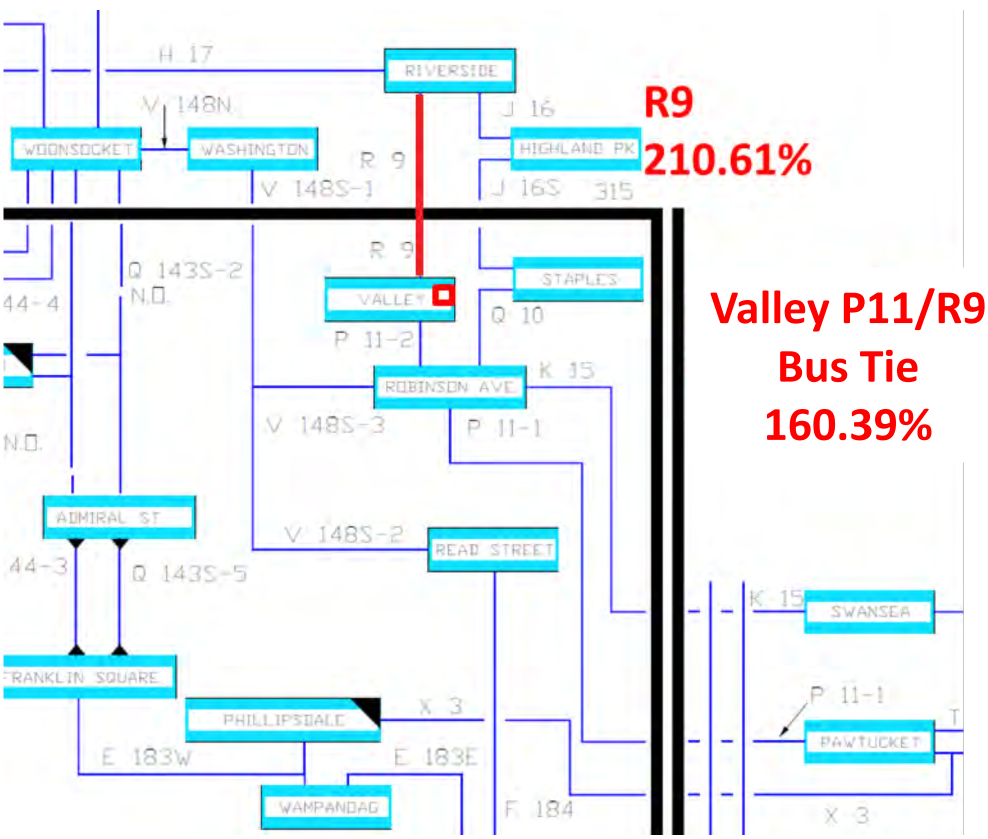

Figure 5-30: R9, Valley P11/R9 Bus Tie **N-1-1 Thermal Overloads**

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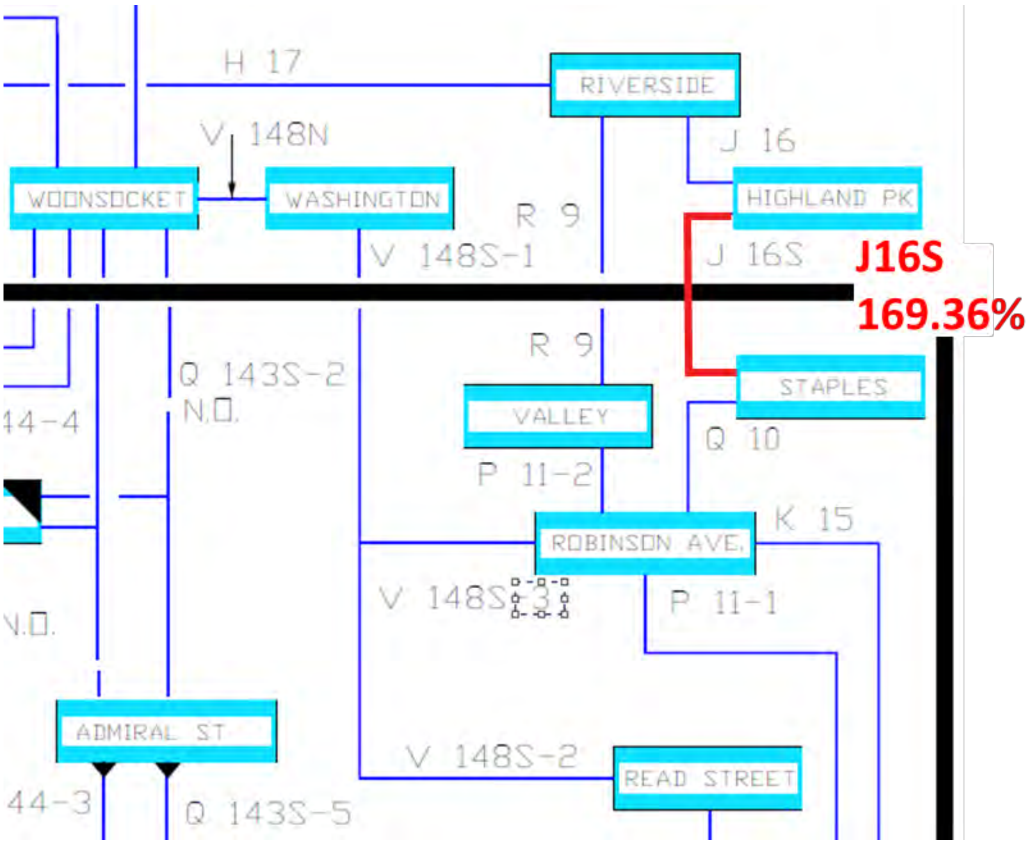

Figure 5-31: J16S N-1-1 Thermal Overloads

REDACTED

Table 5-17: P11 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
P11-1	Pawtucket to P11 Tap 115 kV Line	172	[redacted]	[redacted]	188.96
P11-2	Valley to P11 Tap 115 kV Line	127	[redacted]	[redacted]	140.36
P11-3	Robinson Ave to P11 Tap 115 kV Line	193	[redacted]	[redacted]	136.94
Worst case overloads occur [redacted]. These overloads are primarily driven by loss of [redacted], placing additional stress on the 115 kV network [redacted].					

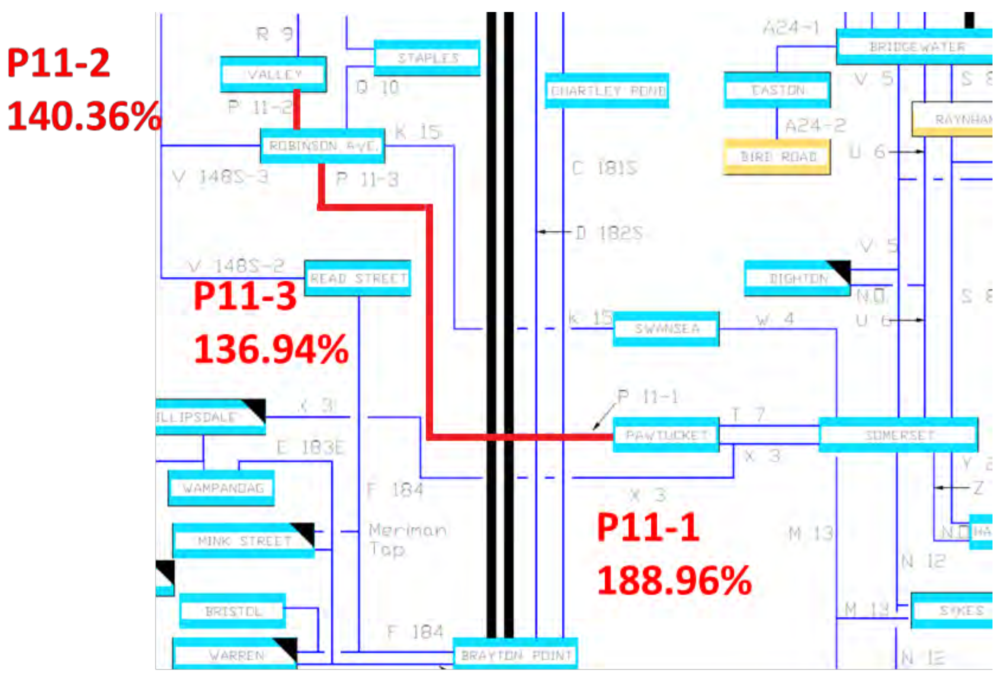

Figure 5-32: P11 Line Sections N-1-1 Thermal Overloads

REDACTED

Table 5-18: Q10 N-1-1 Thermal Overload

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
Q10	Robinson Ave to Staples 115 kV Line	156	[redacted]	[redacted]	119.81
Worst case overloads occur with [redacted]. This combination of contingencies leaves the K15/Q10 path [redacted].					

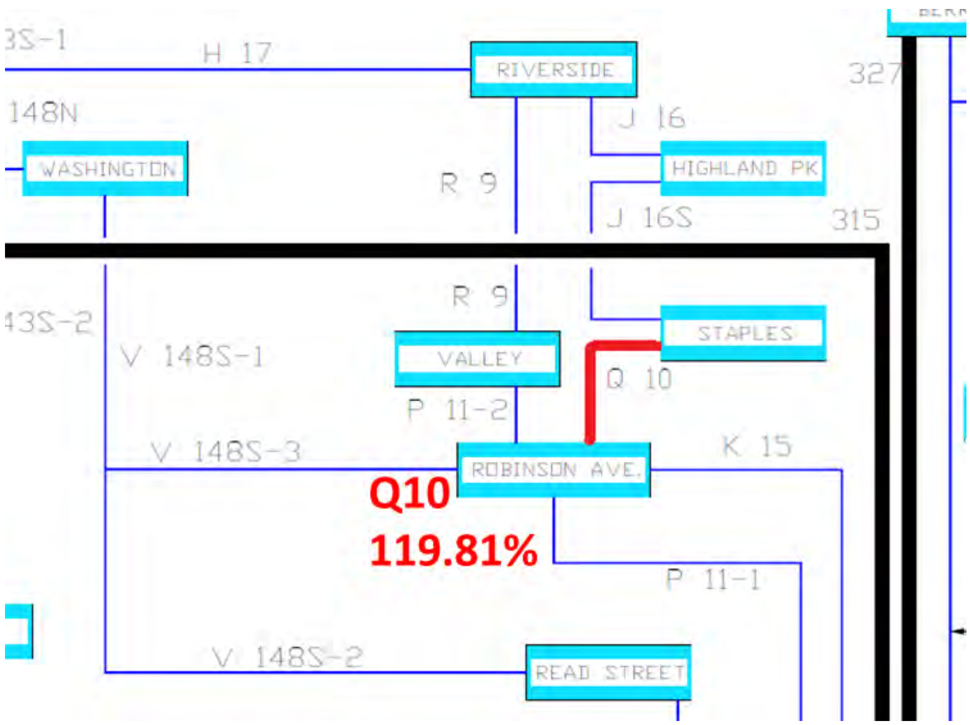

Figure 5-33: Q10 N-1-1 Thermal Overload

REDACTED

Table 5-19: West Farnum 175T and S171 Line Section N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
West Farnum 175T[31]	West Farnum 345/115 kV Autotransformer	389	[redacted]	[redacted]	118.28
Worst case overloads occur [redacted]. Loss of [redacted] makes the remaining autotransformer the main source of 345 kV support into the region between these two 345 kV substations.					

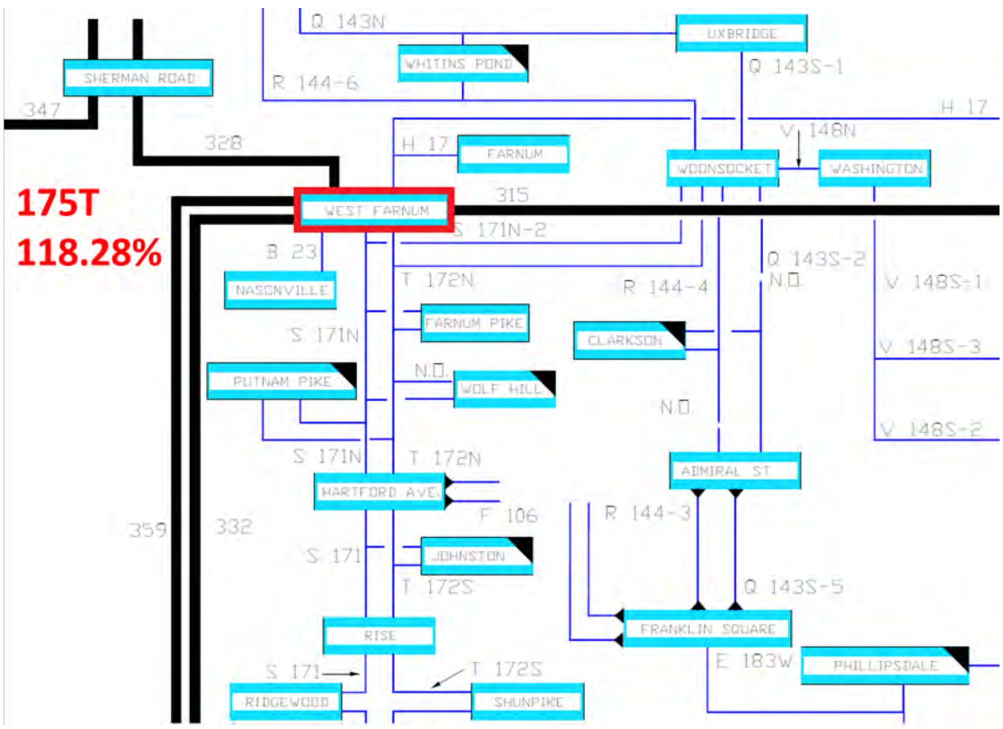

Figure 5-34: West Farnum 175T N-1-1 Thermal Overload

[31] The West Farnum 175T autotransformer has rating of 389 MVA; the parallel 174T transformer has a higher rating of 592 MVA.

Table 5-20: 1870, 1870S N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
1870[32]	Kenyon to Wood River 115 kV Line	290	[redacted]	[redacted]	114.25
1870S[32]	Wood River to Chase Hill 115 kV Line	218	[redacted]	[redacted]	124.02
1870S-1[32]	Chase Hill to Shunock 115 kV Line	218	[redacted]	[redacted]	111.66
With loss of [redacted], Kent County becomes the nearest source of 345 kV support for a large portion of eastern Connecticut, placing stress on the single 115 kV corridor between Connecticut and Rhode Island.					

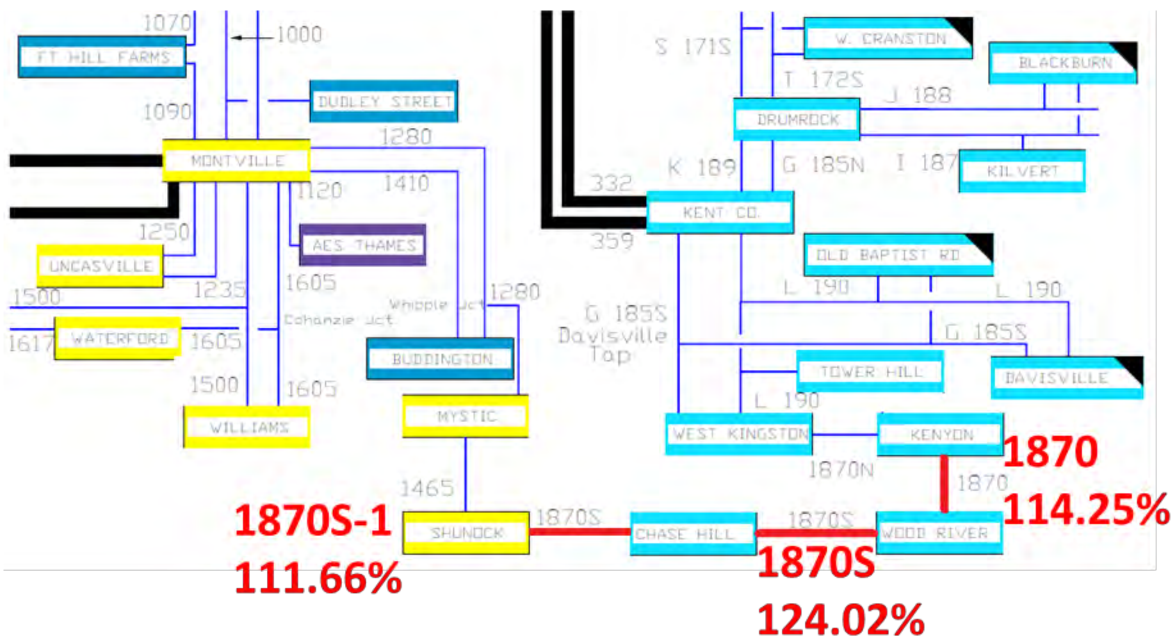

Figure 5-35: 1870N, 1870, 1870S N-1-1 Thermal Overloads

[32] These overloads occur due to contingencies in the eastern portion of Connecticut. Transmission solutions to address these needs will be developed in cooperation with the ongoing Eastern Connecticut study group.

Table 5-21: Drumrock G185N, K189 N-1-1 Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
G185N Line	Drumrock to Kent County 115 kV Line	446	[redacted]	[redacted]	100.97
K189 Line	Drumrock to Kent County 115 kV Line	449	[redacted]	[redacted]	100.78
This combination of contingencies leaves the transmission corridor between West Farnum and Kent County served by only two 115 kV lines. Worst-case overloads occurred [redacted]					

REDACTED

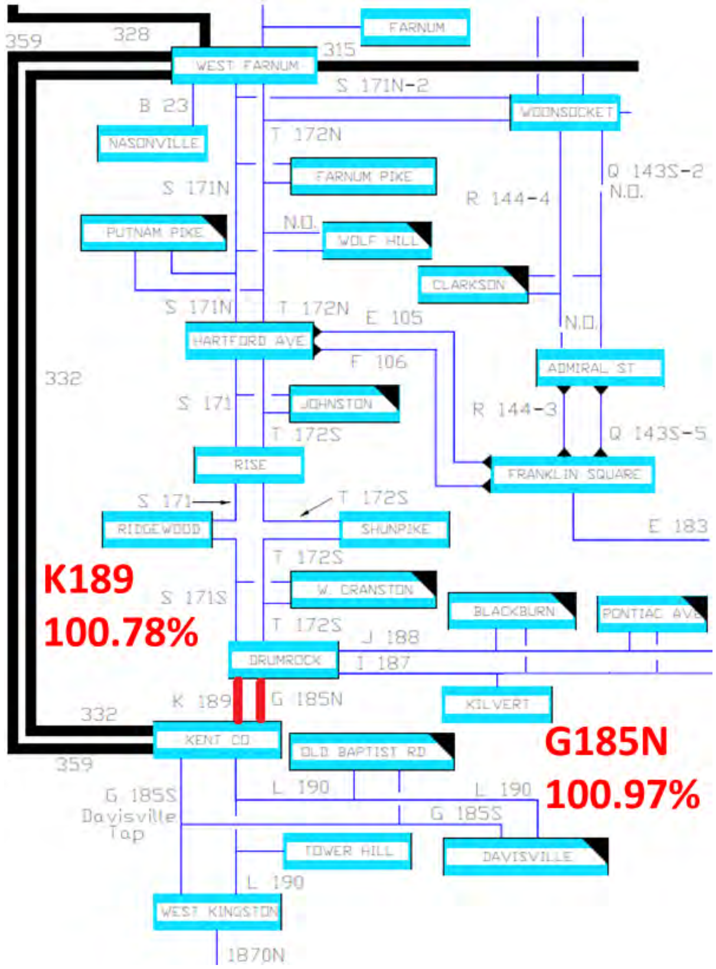

Figure 5-36: G185N, K189 N-1-1 Thermal Overloads

[redacted] – [redacted]

REDACTED

Table 5-22: Farnum Subarea N-1-1 Voltage Violations

Bus Name	Base kV	Element OOS	Contingency	Worst-Case Voltage (p.u.)	Comments
Highland Drive	115	[redacted]	[redacted]	0.7221	[redacted]
Riverside	115	[redacted]	[redacted]	0.7150	[redacted]
Robinson Avenue	115	[redacted]	[redacted]	0.7603	[redacted]
Staples	115	[redacted]	[redacted]	0.7291	[redacted]
Valley	115	[redacted]	[redacted]	0.6917	[redacted]
Drumrock	115	[redacted]	[redacted]	0.9355	[redacted]
Kenyon[33]	115	[redacted]	[redacted]	0.8494	[redacted]
Wood River[33]	115	[redacted]	[redacted]	0.8175	[redacted]
West Kingston[33]	115	[redacted]	[redacted]	0.8897	[redacted]

[33] These voltage violations occur due to contingencies in the eastern portion of Connecticut. Transmission solutions to address these needs will be developed in cooperation with the ongoing Eastern Connecticut study group.

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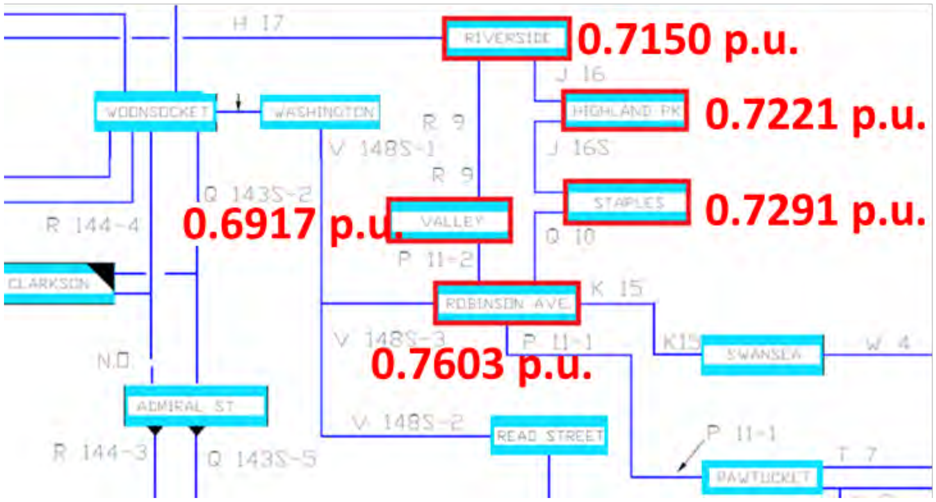

Figure 5-37: Farnum Subarea N-1-1 Voltage Violations

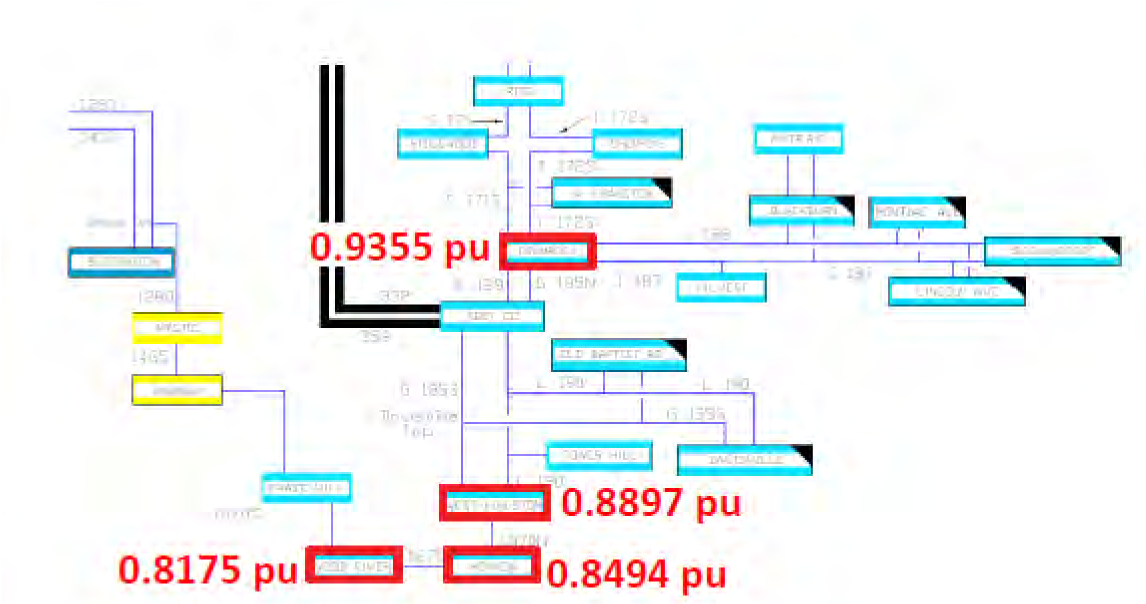

Figure 5-38: Farnum Subarea N-1-1 Voltage Violations

5.2.3.2 *West Medway – West Walpole Subarea N-1-1 Thermal Overloads and Voltage Violation Results*

The tables in this section and the figures following them show the worst case N-1-1 element overloads and unacceptable voltage performance results for the West Medway – West Walpole subarea. Dispatch conditions for each of the overloads and voltage violations are noted in the comments at the bottom of each table.

Table 5-23: West Medway 345 kV Lines N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	2026 Loading % LTE
323 (Eversource)	West Medway to Millbury 345 kV Line	1319	[redacted]	[redacted]	126.40
323 (National Grid)	West Medway to Millbury 345 kV Line	1416	[redacted]	[redacted]	117.77
325	West Medway to West Walpole 345 kV Line	1520	[redacted]	[redacted]	113.67
357 (Eversource)	West Medway to Millbury 345 kV Line	1319	[redacted]	[redacted]	110.67
389	West Medway to West Walpole 345 kV Line	1972	[redacted]	[redacted]	110.51
Worst case overloads for all of these noted violations occur with [redacted], [redacted].					

REDACTED

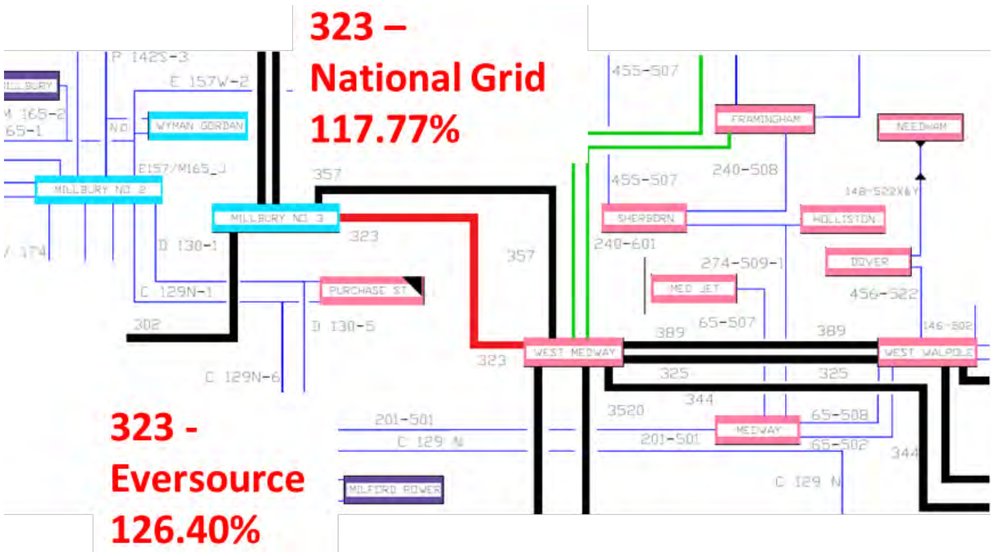

Figure 5-39: 323 N-1-1 Thermal Overload

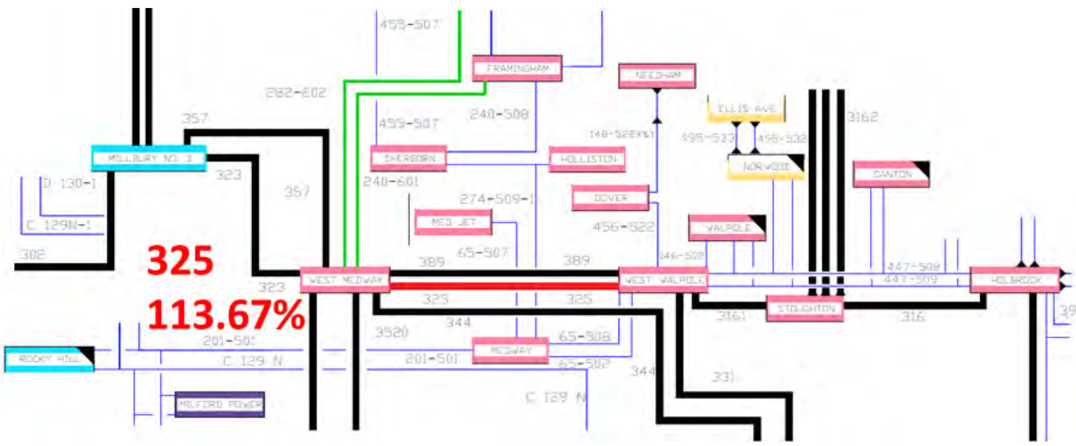

Figure 5-40: 325 N-1-1 Thermal Overload

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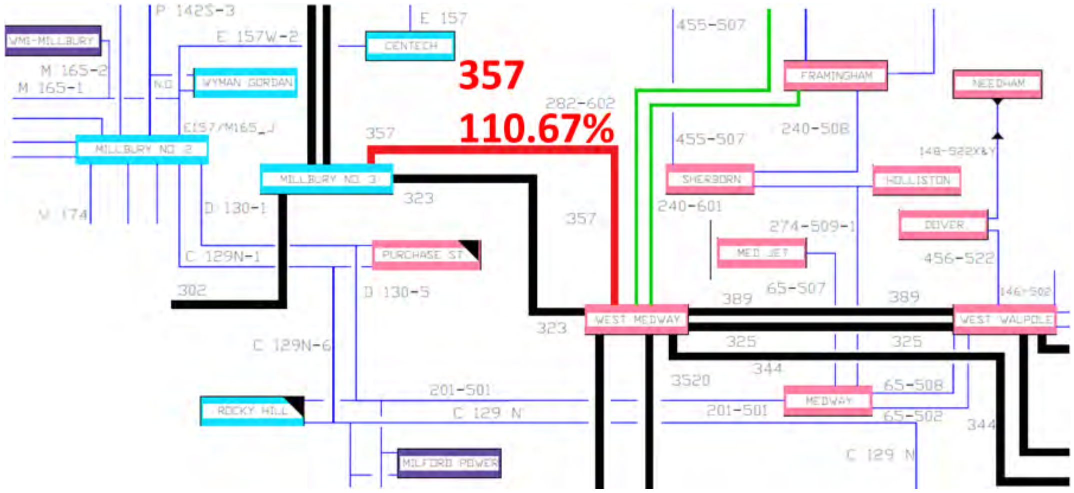

Figure 5-41: 357 N-1-1 Thermal Overload

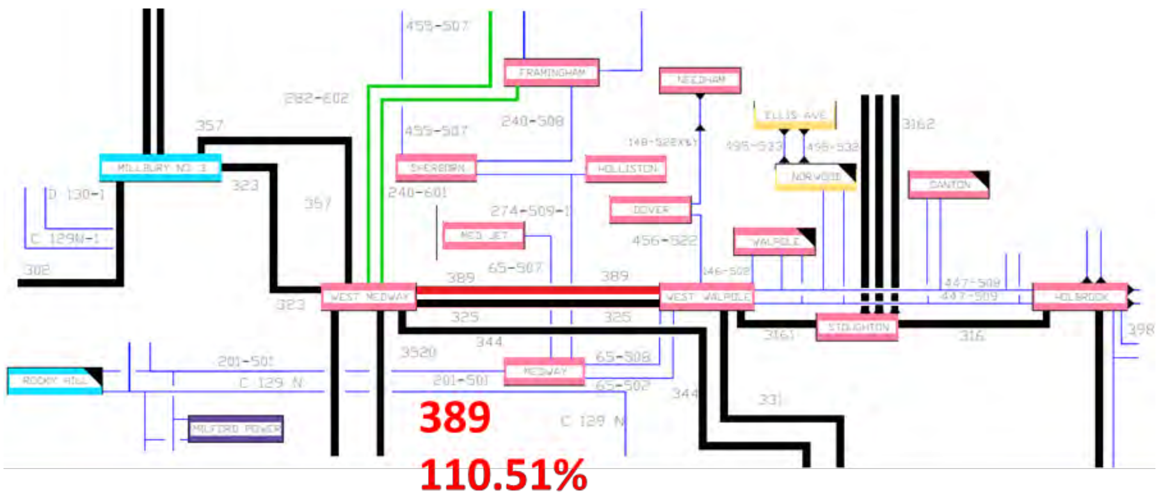

Figure 5-42: 389 N-1-1 Thermal Overload

[redacted] – [redacted]

REDACTED

Table 5-24: 331 N-1-1 Thermal Overload

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	2026 Loading % LTE
331[34]	West Walpole to Carver 345 kV Line	1156	[redacted]	[redacted]	113.16
Worst case overloads for this violation occur with [redacted]. Loss of [redacted] the South Shore/Cape Cod areas causes the remaining 345 kV line to become overloaded.					

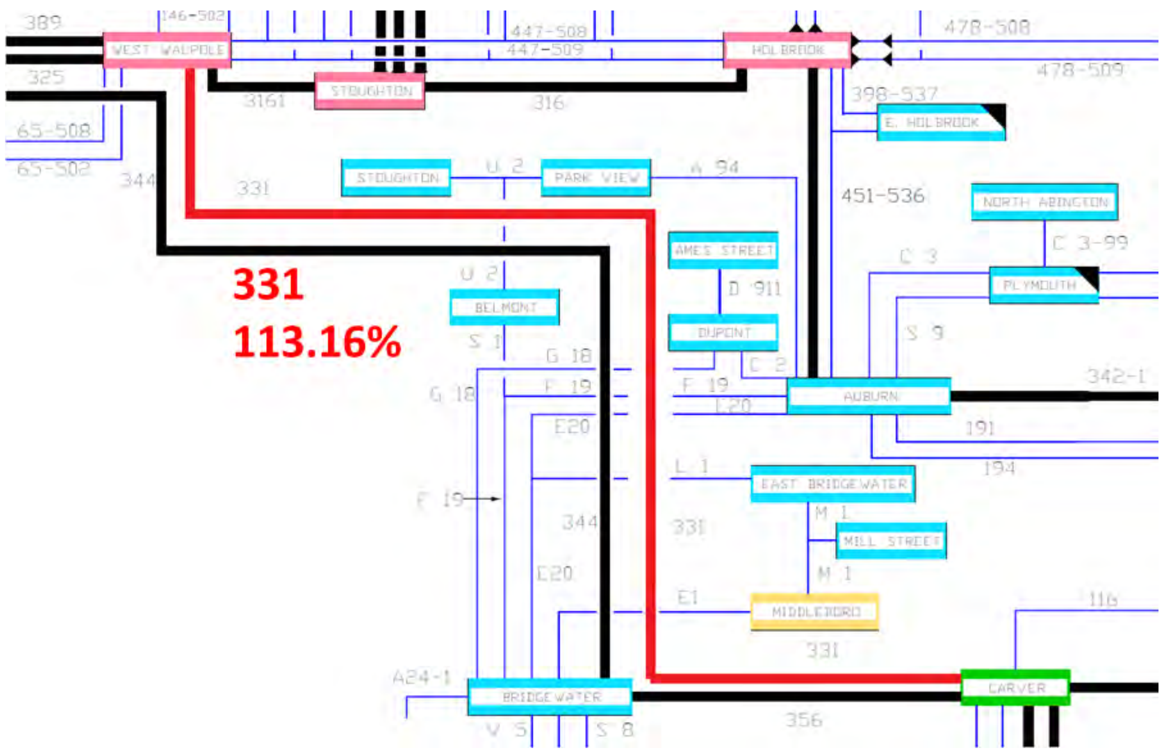

Figure 5-43: 331 N-1-1 Thermal Overload

[34] Both ends of the 331 line are owned by Eversource, but the middle portion of the line is owned by National Grid and has a higher rating (1466 MVA); thus, this overload only occurs on the Eversource portions of the line.

Table 5-25: C-129 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	2026 Loading % LTE
C-129N-1	Millbury to Purchase Tap 115 kV Line Section	218	[redacted]	[redacted]	136.36
C-129N-6	Rocky Hill to Purchase Tap 115 kV Line Section	218	[redacted]	[redacted]	112.90
Worst case overloads for all of these noted violations occur with [redacted]. Loss [redacted] leaves several substations (Purchase Street down to Union Street) served radially from the C-129N out of Millbury.					

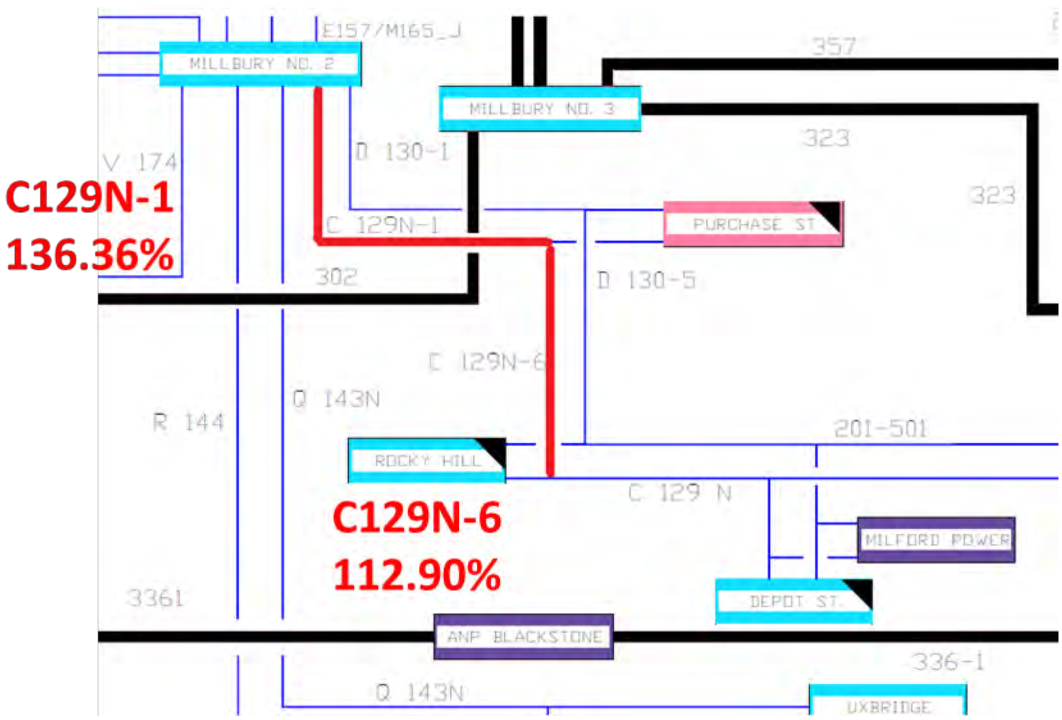

Figure 5-44: C-129N Line Sections N-1-1 Thermal Overloads

REDACTED

Table 5-26: West Medway – West Walpole Subarea N-1-1 Voltage Violations

Bus Name	Base kV	Element OOS	Contingency	Worst-Case Voltage (p.u.)	Comments
Beaver Pond	115	[redacted]	[redacted]	0.8219	[redacted]
Depot Street	115	[redacted]	[redacted]	0.8320	[redacted]
Purchase Street	115	[redacted]	[redacted]	0.8589	[redacted]
Rocky Hill	115	[redacted]	[redacted]	0.8427	[redacted]
Union Street	115	[redacted]	[redacted]	0.8200	[redacted]

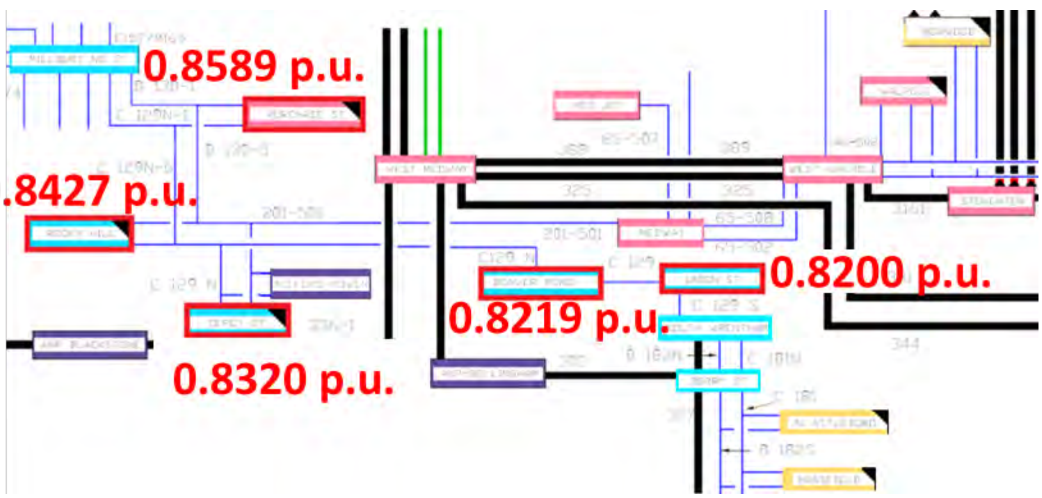

Figure 5-45: West Medway - West Walpole Subarea N-1-1 Voltage Violations

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5.2.3.3 *South Shore Subarea N-1-1 Thermal Overloads and Voltage Violation Results*

The tables in this section and the figures following them show the worst case N-1-1 element overloads and unacceptable voltage performance results for the South Shore subarea. Dispatch conditions for each of the overloads and voltage violations are noted in the comments at the bottom of each table.

Table 5-27: 451-536 N-1-1 Thermal Overload

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
451-536	Holbrook to East Holbrook Tap 115 kV Line	548	[redacted]	[redacted]	104.01
Worst case overloads for this violation occur with [redacted]. With the loss [redacted], the 451-536 line (which runs parallel to the 335 line) becomes a primary feed into the 115 kV network served off of the Auburn and Bridgewater substations.					

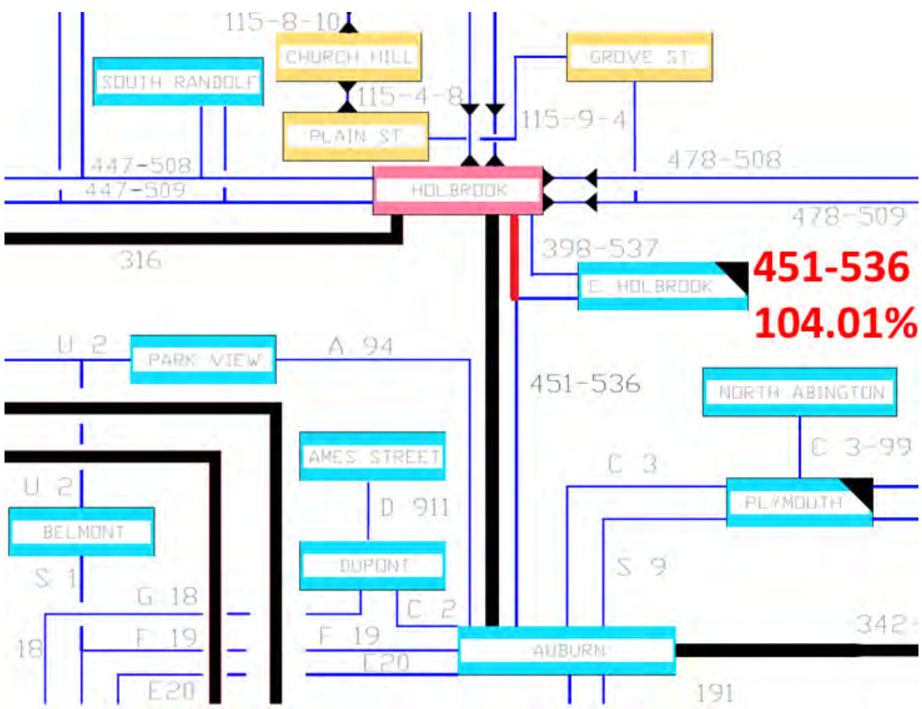

Figure 5-46: 451-536 N-1-1 Thermal Overload

REDACTED

Table 5-28: Bridgewater 162X N-1-1 Thermal Overload

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
Bridgewater 162X	Bridgewater 345/115 kV Autotransformer	472	[redacted]	[redacted]	101.12
Worst case overloads for this violation occur [redacted].					

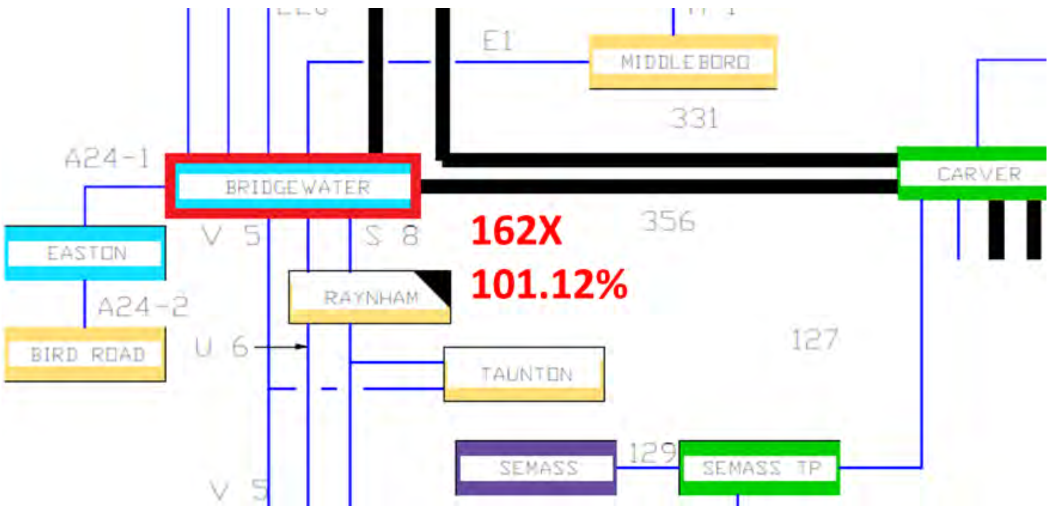

Figure 5-47: Bridgewater 162X N-1-1 Overload

REDACTED

Table 5-29: 191 and 117 Lines N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
191	Kingston to Auburn 115 kV Line	165	[redacted]	[redacted]	121.66
117	Kingston to Brook St 115 kV Line	142	[redacted]	[redacted]	122.86
Worst case overloads occur [redacted]. Loss of [redacted] causes overloads on the 115 kV path between the Auburn and Carver substations, [redacted].					

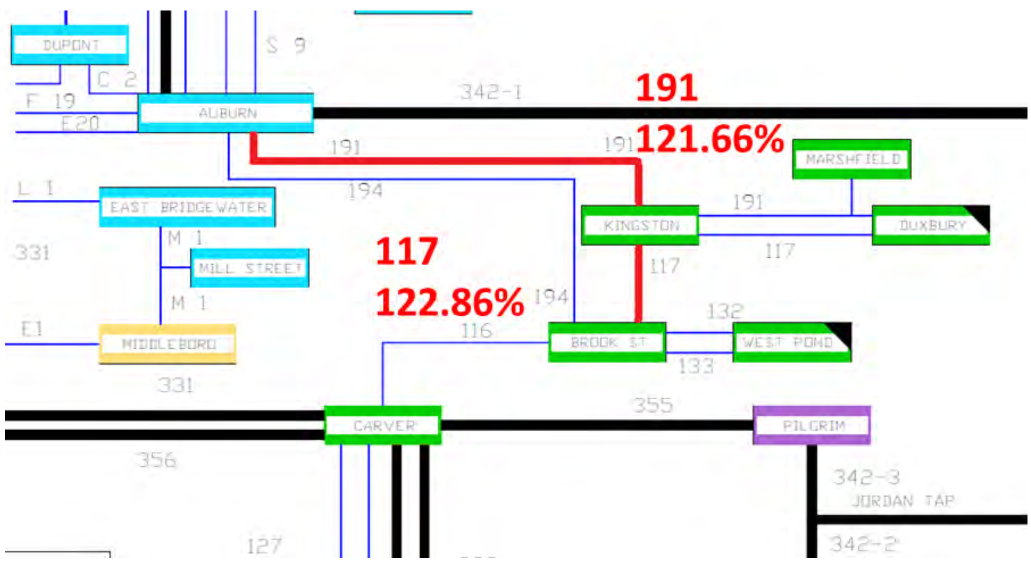

Figure 5-48: 191 and 117 Lines N-1-1 Overloads

REDACTED

Table 5-30: F19, E1, C2, and E20 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
F19-2	Auburn St to Belmont Tap 115 kV Line Section	206	[redacted]	[redacted]	114.63
E1[35]	Bridgewater to Middleboro 115 kV Line	197	[redacted]	[redacted]	118.46
C2	Dupont to Auburn St 115 kV Line	232	[redacted]	[redacted]	117.14
L1[36]	East Bridgewater to East Bridgewater Tap 115 kV Line Section	166	[redacted]	[redacted]	122.57
E20-2	Auburn St to East Bridgewater Tap 115 kV Line Section	244	[redacted]	[redacted]	103.33
Worst case overloads occur [redacted]. [redacted] causes overloads on the remaining 115 kV lines serving the pocket.					

[35] This overload only occurs on the portion of the line owned by Middleboro Gas and Electric.
[36] Planned National Grid upgrades to this line (with an in-service date of 2017) may alleviate or eliminate this overload, but final updated ratings were not available as of the time of completion of this Needs Assessment.

REDACTED

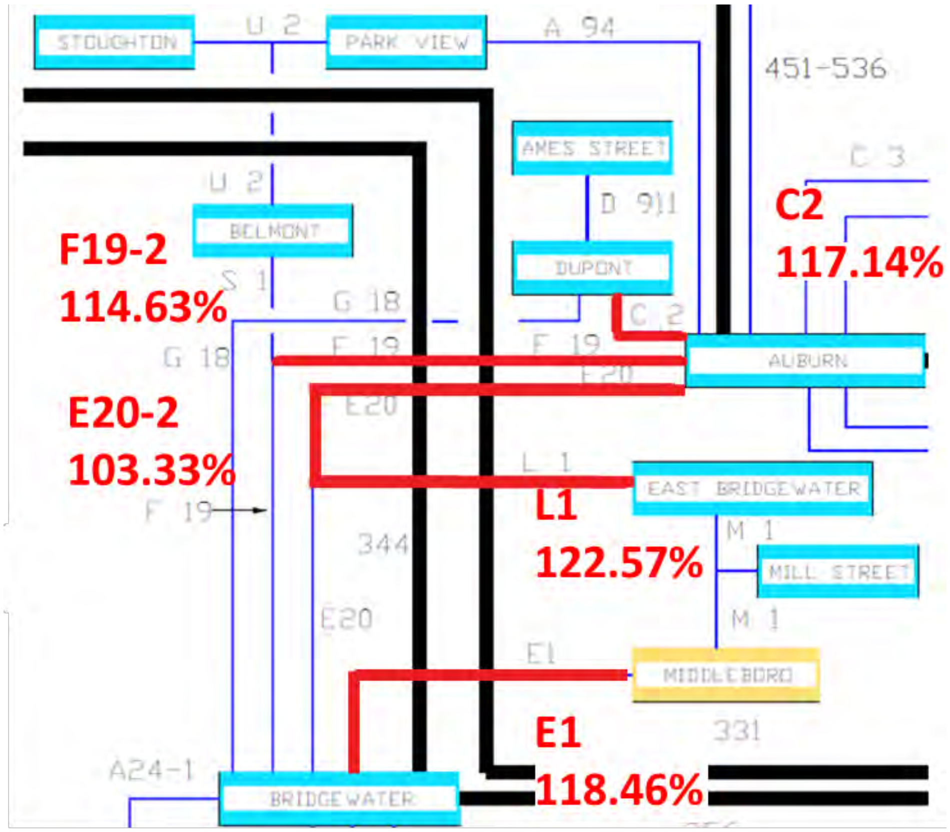

Figure 5-49: F19, E1, C2, L1 and E20 Line Sections N-1-1 Thermal Overloads

REDACTED

Table 5-31: South Shore Subarea N-1-1 Voltage Violations

Bus Name	Base kV	Element OOS	Contingency	Worst-Case Voltage (p.u.)	Comments
Brook Street	115	[redacted]	[redacted]	0.8931	[redacted]
Kingston	115	[redacted]	[redacted]	0.9023	[redacted]
Middleboro	115	[redacted]	[redacted]	0.8952	[redacted]
East Bridgewater	115	[redacted]	[redacted]	0.8539	[redacted]
Mill Street	115	[redacted]	[redacted]	0.8620	[redacted]
Church Hill	115	[redacted]	[redacted]	0.9140	[redacted]
Edgar	115	[redacted]	[redacted]	0.9095	[redacted]
Grove Street	115	[redacted]	[redacted]	0.9170	[redacted]
Holbrook	115	[redacted]	[redacted]	0.9225	[redacted]
Middle Street	115	[redacted]	[redacted]	0.9135	[redacted]
Potter	115	[redacted]	[redacted]	0.9138	[redacted]
Plain Street	115	[redacted]	[redacted]	0.9157	[redacted]

REDACTED

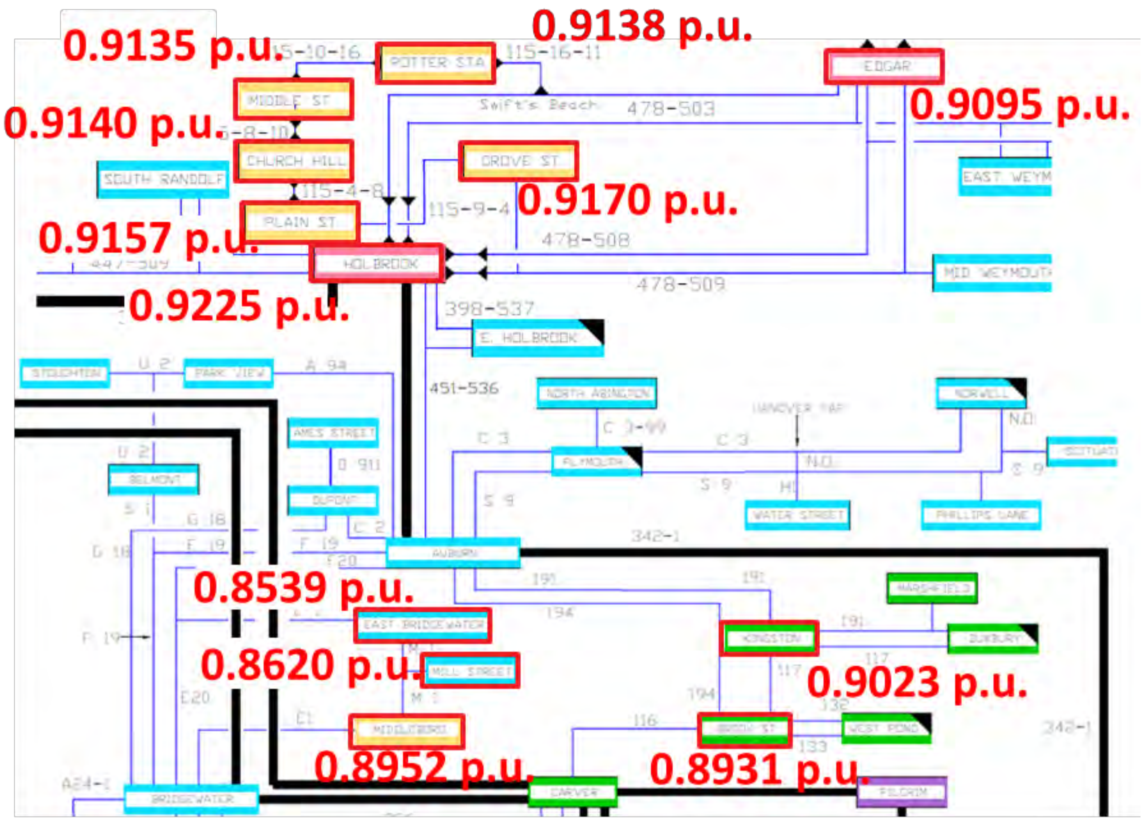

Figure 5-50: South Shore Subarea N-1-1 Voltage Violations

REDACTED

5.2.3.4 *Industrial Park Subarea N-1-1 Thermal Overload and Voltage Violation Results*

The tables in this section and the figures following them show the worst case N-1-1 element overloads and unacceptable voltage performance results for the Industrial Park subarea. Dispatch conditions for each of the overloads and voltage violations are noted in the comments at the bottom of each table.

Table 5-32: 111 Line Section N-1-1 Thermal Overload

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
111-1	High Hill to Industrial Park 115 kV Line Section	246	[redacted]	[redacted]	164.10
Worst case overloads occur [redacted]. Loss of [redacted] leaves the 115 kV path out of Tremont as the sole transmission or generation source into this pocket and into stations normally served by Somerset.					

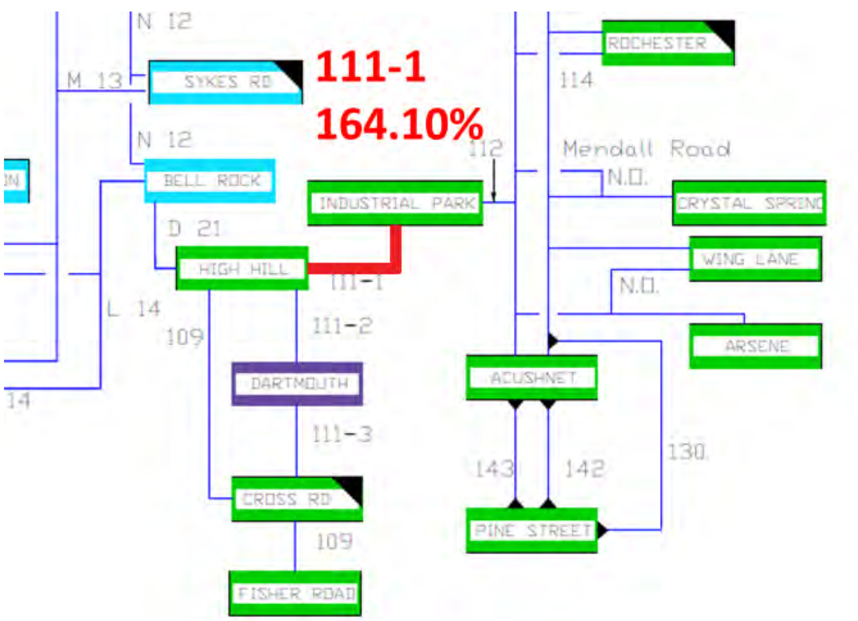

Figure 5-51: 111 Line Section N-1-1 Thermal Overload

REDACTED

Table 5-33: 112 and 114 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
112-1	Tremont to Rochester 115 kV Line Section	229	[redacted]	[redacted]	194.17
112-2	Rochester to Crystal Spring Tap 115 kV Line Section	246	[redacted]	[redacted]	196.00
112-3	Industrial Park to Crystal Spring Tap 115 kV Line Section	246	[redacted]	[redacted]	196.70
112-4	Industrial Park to Industrial Park Tap 115 kV Line Section	246	[redacted]	[redacted]	184.61
114-1	Tremont to Rochester 115 kV Line Section	289	[redacted]	[redacted]	105.93
Worst case overloads occur [redacted]. [redacted] leaves the 115 kV path out of Tremont as the sole transmission or generation source into this pocket and into stations normally served by Somerset.					

[redacted]

REDACTED

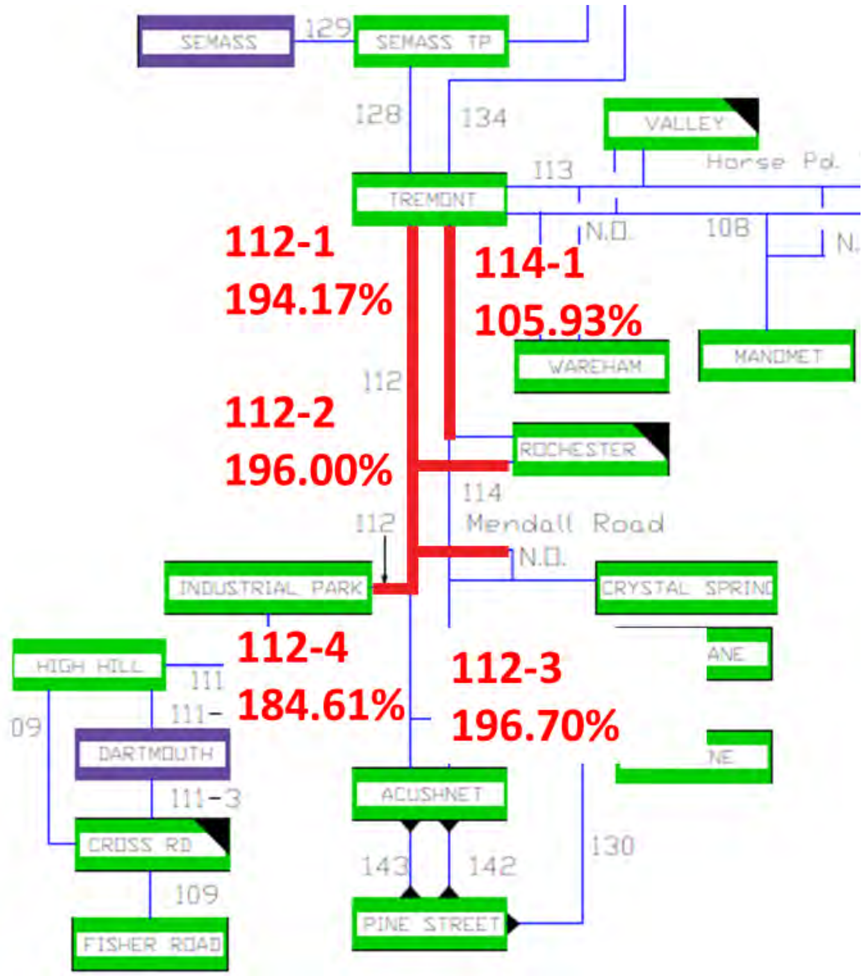

Figure 5-52: 112 and 114 Line Sections N-1-1 Thermal Overloads

REDACTED

Table 5-34: Southeastern MA – Industrial Park Subarea N-1-1 Voltage Violations

Bus Name	Base kV	Element OOS	Contingency	Worst-Case Voltage (p.u.)	Comments
High Hill	115	[redacted]	[redacted]	0.6174	[redacted]
Industrial Park	115	[redacted]	[redacted]	0.6139	[redacted]
Tremont	115	[redacted]	[redacted]	0.8864	[redacted]
Acushnet	115	[redacted]	[redacted]	0.7072	[redacted]
SEMASS	115	[redacted]	[redacted]	0.8951	[redacted]

REDACTED

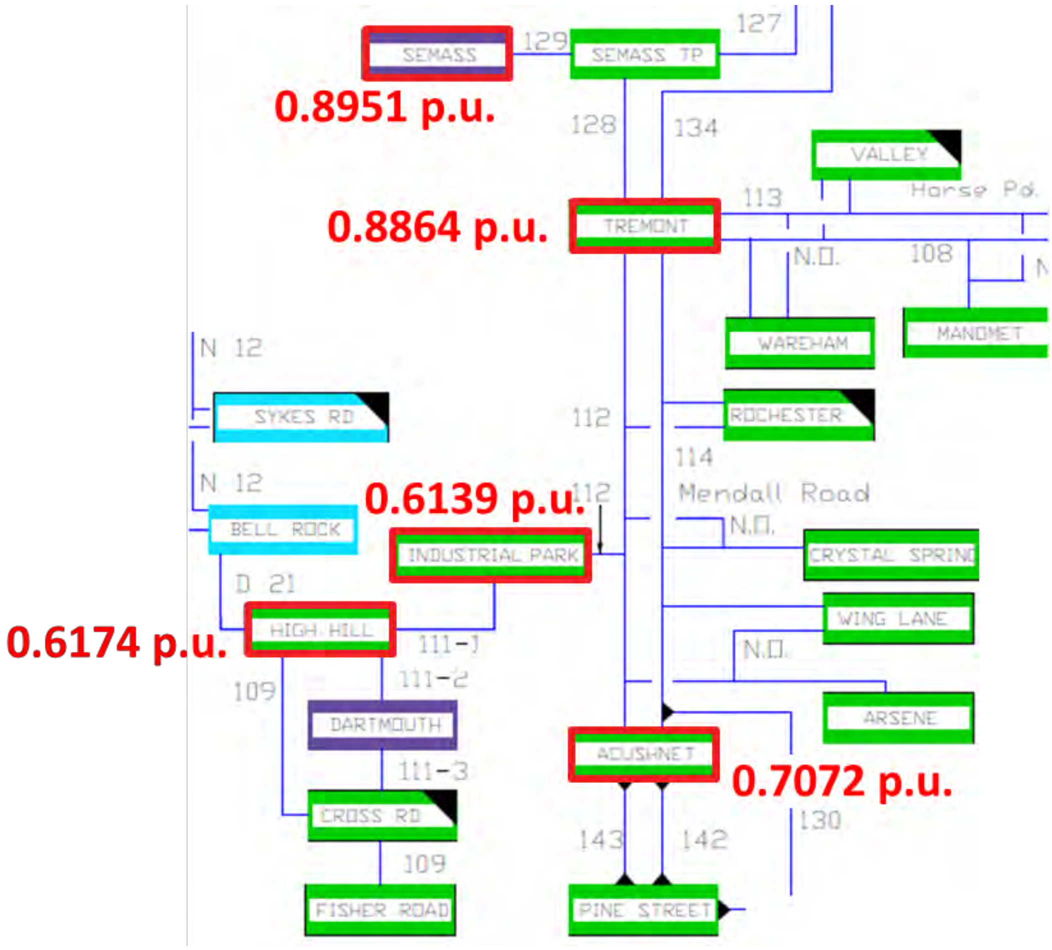

Figure 5-53: Southeastern MA – Industrial Park Subarea N-1-1 Voltage Violations

5.2.3.5 *Somerset – Newport Subarea N-1-1 Thermal Overload and Voltage Violation Results*

The tables in this section and the figures following them show the worst case N-1-1 element overloads and unacceptable voltage performance results for the Somerset-Newport subarea. Dispatch conditions for each of the overloads and voltage violations are noted in the comments at the bottom of each table.

Table 5-35: W4 N-1-1 Thermal Overload

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
W4	Somerset to Swansea 115 kV Line	165	[redacted]	[redacted]	147.11
Worst case overloads occur [redacted]. Loss of the [redacted] leaves the W4/K15 path out of Somerset as the sole transmission source into the load pocket consisting of the Robinson Avenue, Riverside, Valley, Staples and Highland Park substations.					

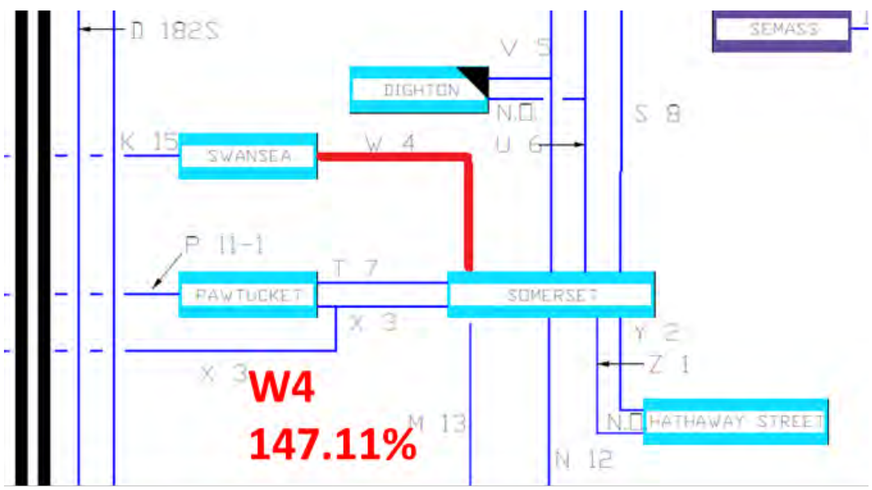

Figure 5-54: W4 N-1-1 Overload

[redacted] – [redacted]

REDACTED

Table 5-36: S8 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
S8-1	Somerset to S8 Tap 115 kV Line Section	244	[redacted]	[redacted]	133.82
S8-2	Raynham to S8 Tap 115 kV Line Section	244	[redacted]	[redacted]	154.64
S8-4	Bridgewater to Raynham 115 kV Line Section	244	[redacted]	[redacted]	171.23
Worst case overloads occur for these violations occur with [redacted]. Loss of [redacted] causes overloads on the only remaining line.					

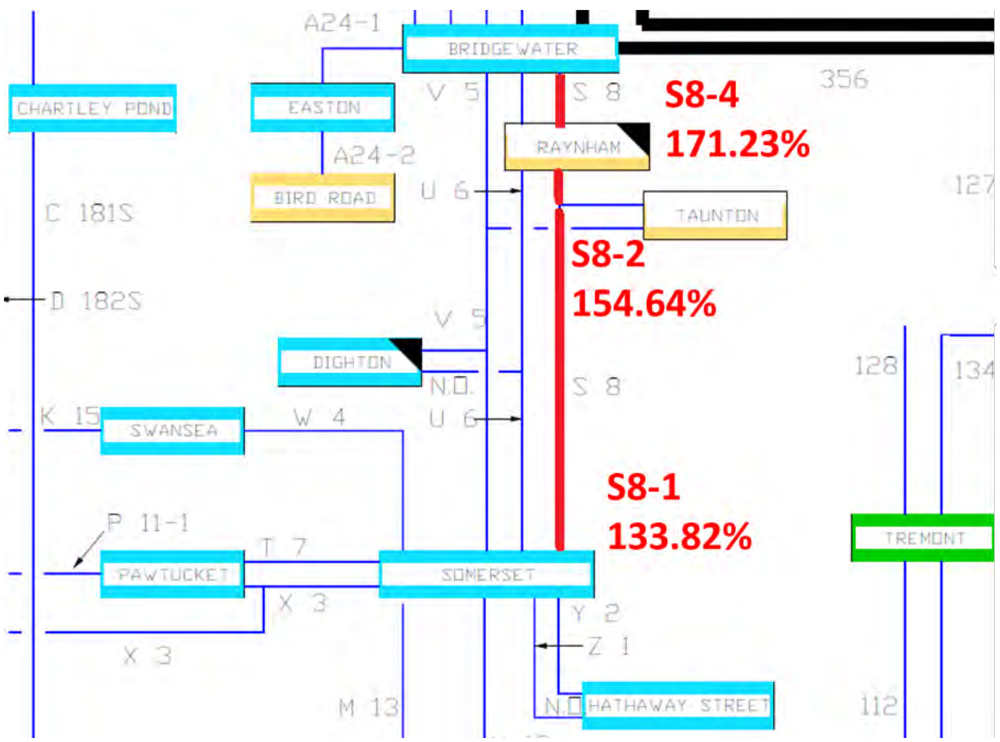

Figure 5-55: S8 Line Sections N-1-1 Thermal Overloads

REDACTED

Table 5-37: V5 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
V5-1	Somerset to Dighton 115 kV Line Section	206	[redacted]	[redacted]	115.35
V5-2	Dighton to V5 Tap 115 kV Line Section	206	[redacted]	[redacted]	129.71
V5-3	Bridgewater to V5 Tap 115 kV Line Section	206	[redacted]	[redacted]	146.54
Worst case overloads occur with [redacted]. Loss of [redacted] places additional stress on the remaining 115 kV lines serving the pocket.					

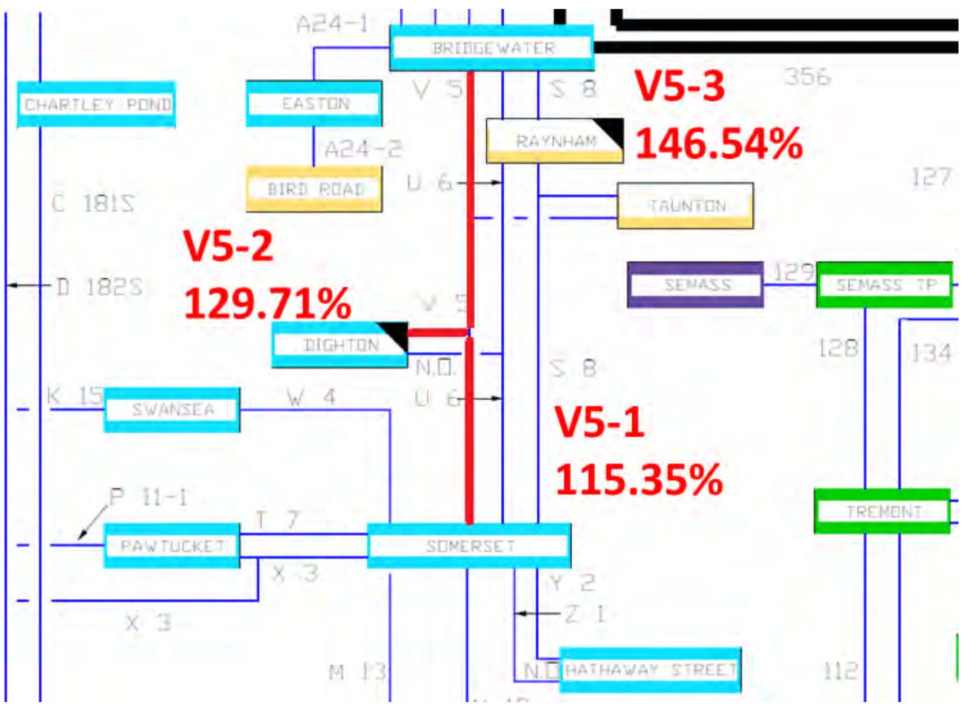

Figure 5-56: V5 Line Sections N-1-1 Thermal Overloads

REDACTED

Table 5-38: N12, D12 and U6 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
N12-1	Somerset to Sykes Rd 115 kV Line Section	284	[redacted]	[redacted]	192.33
N12-2	Sykes Rd to Bell Rock 115 kV Line Section	284	[redacted]	[redacted]	181.30
D21	Bell Rock to High Hill 115 kV Line	330	[redacted]	[redacted]	102.73
U6-1	Somerset to Dighton 115 kV Line Section	206	[redacted]	[redacted]	166.14
U6-3	Dighton to Dighton Tap 115 kV Line Section	206	[redacted]	[redacted]	166.08
Worst case overloads occur with [redacted]. Observed N-1 overloads in this area [redacted] are exacerbated with additional loss of [redacted]					

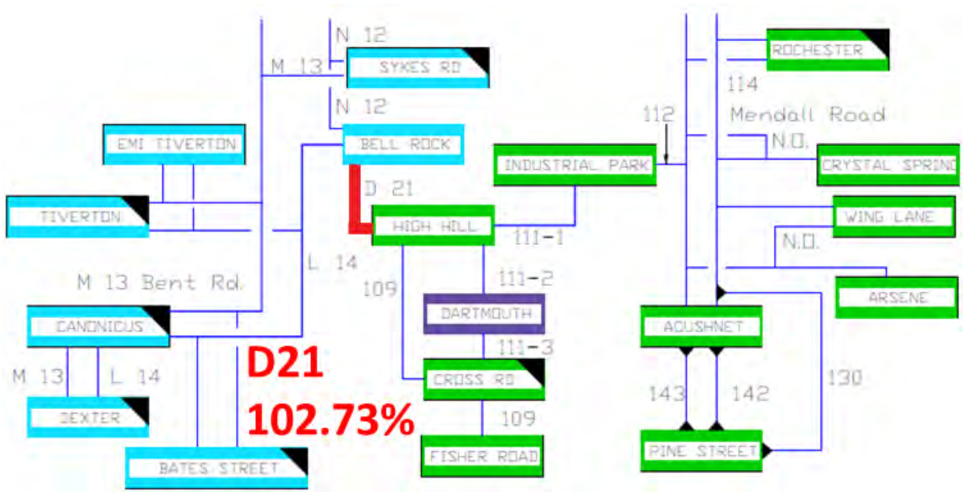

Figure 5-57: D21 N-1-1 Thermal Overload

REDACTED

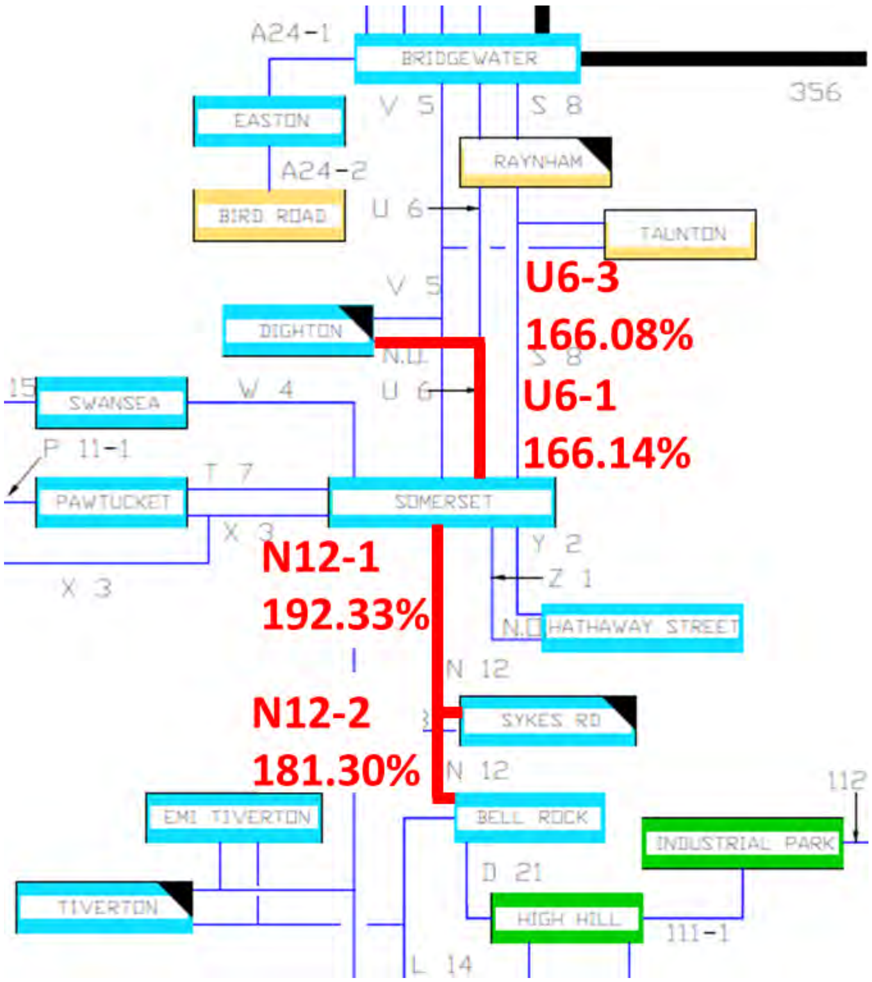

Figure 5-58: N12 and U6 Line Sections N-1-1 Thermal Overloads

REDACTED

Table 5-39: K15 N-1-1 Thermal Overload

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
K15	Swansea to Robinson Ave 115 kV Line	165	[redacted]	[redacted]	142.44
Worst case overloads occur with [redacted]. Loss of [redacted] places additional stress on the remaining 115 kV path between Robinson Avenue and Somerset.					

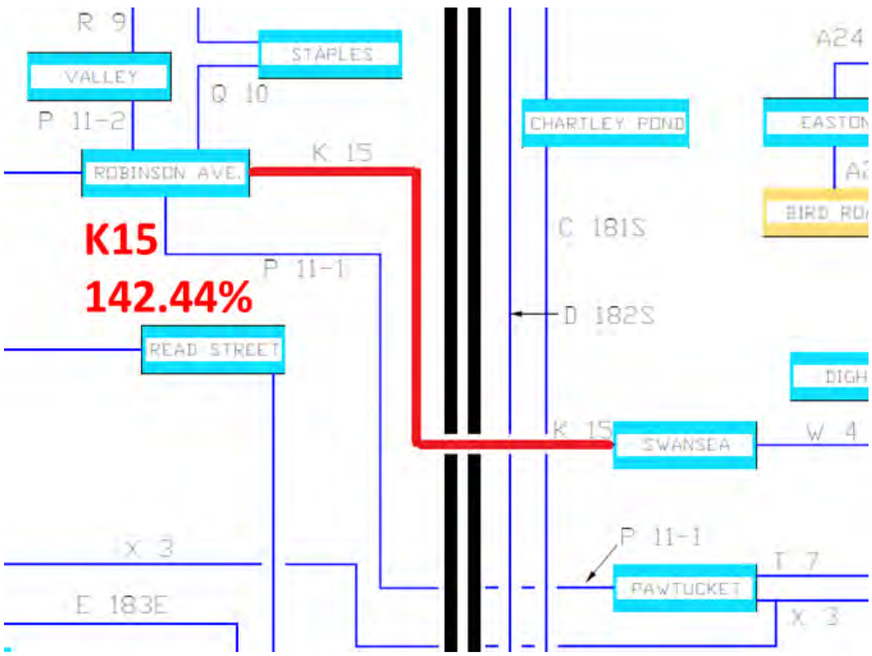

Figure 5-59: K15 N-1-1 Thermal Overload

REDACTED

Table 5-40: M13 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
M13-3	Bent Rd to Tiverton Tap 115 kV Line Section	244	[redacted]	[redacted]	115.36
M13-4	Somerset to Sykes Rd 115 kV Line Section	284	[redacted]	[redacted]	181.74
M13-5	Tiverton Tap to EMI Tiverton Tap 115 kV Line Section	180	[redacted]	[redacted]	157.65
M13-6	EMI Tiverton Tap to EMI Tiverton 115 kV Line Section	180	[redacted]	[redacted]	146.59
M13-7	Canonicus to Dexter 115 kV Line Section	165	[redacted]	[redacted]	109.65
M13-8	Sykes Rd to Tiverton Tap 115 kV Line Section	250	[redacted]	[redacted]	193.58
Worst case overloads occur with [redacted]. Loss of [redacted] places additional stress on the remaining transmission lines serving the load pocket.					

REDACTED

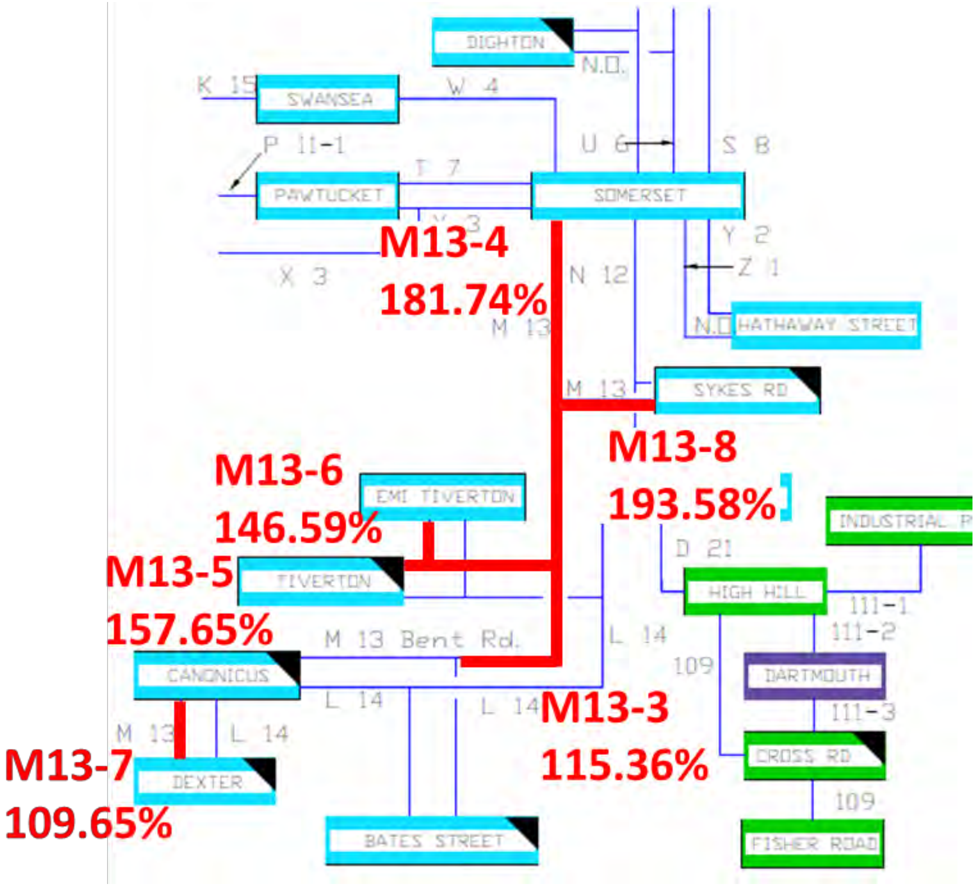

Figure 5-60: M13 Line Sections N-1-1 Thermal Overloads

REDACTED

Table 5-41: L14 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
L14-1	Bent Rd to Canonicus 115 kV Line Section	210	[redacted]	[redacted]	102.68
L14-3	Bent Rd to Tiverton Tap 115 kV Line Section	210	[redacted]	[redacted]	151.00
L14-4	Bell Rock to Tiverton Tap 115 kV Line Section	250	[redacted]	[redacted]	144.83
L14-5	Tiverton Tap to EMI Tiverton Tap 115 kV Line Section	180	[redacted]	[redacted]	133.08
L14-6	EMI Tiverton Tap to EMI Tiverton 115 kV Line Section	180	[redacted]	[redacted]	142.26
L14-7	Canonicus to Dexter 115 kV Line Section	165	[redacted]	[redacted]	130.67
Worst case overloads occur [redacted]. Loss of [redacted] places additional stress on the remaining transmission lines serving the load pocket.					

REDACTED

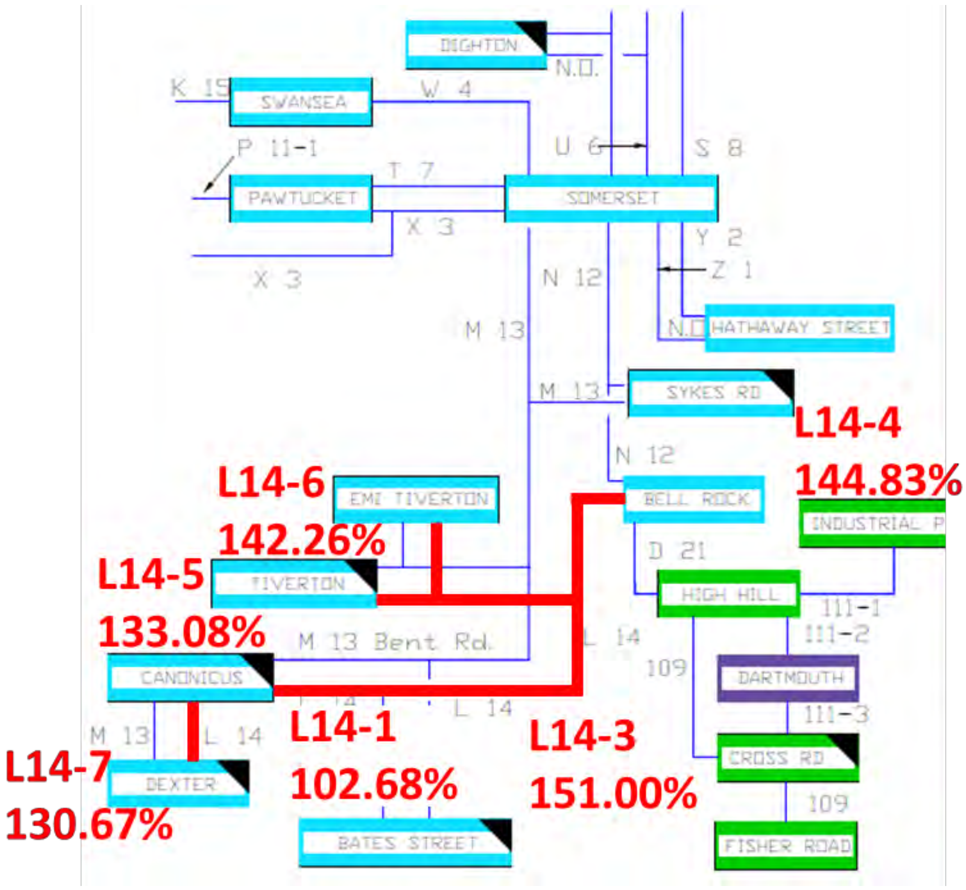

Figure 5-61: L14 Line Sections N-1-1 Thermal Overloads

REDACTED

Table 5-42: Somerset – Newport Subarea Worst Case N-1-1 Voltage Violations

Bus Name	Base kV	Element OOS	Contingency	Worst-Case Voltage (p.u.)	Comments
Bell Rock	115	[redacted]	[redacted]	0.5823	[redacted]
Canonicus	115	[redacted]	[redacted]	0.5212	[redacted]
Dexter	115	[redacted]	[redacted]	0.5042	[redacted]
Jepson	115	[redacted]	[redacted]	0.5003	[redacted]
Tiverton	115	[redacted]	[redacted]	0.5235	[redacted]
Mink Street	115	[redacted]	[redacted]	0.8682	[redacted]
Dighton	115	[redacted]	[redacted]	0.8692	[redacted]
Somerset	115	[redacted]	[redacted]	0.7880	[redacted]
Sykes Road	115	[redacted]	[redacted]	0.7725	[redacted]
Swansea	115	[redacted]	[redacted]	0.8071	[redacted]
Pawtucket	115	[redacted]	[redacted]	0.7926	[redacted]
Phillipdale	115	[redacted]	[redacted]	0.7935	[redacted]
Wampanoag	115	[redacted]	[redacted]	0.8663	[redacted]

REDACTED

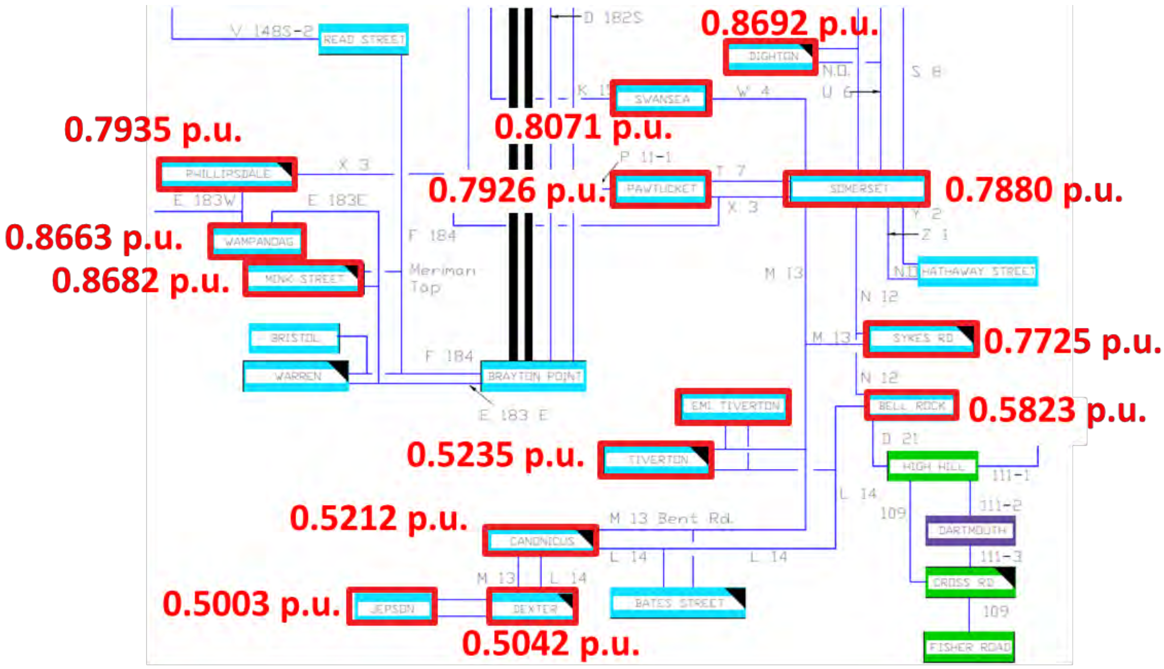

Figure 5-62: Somerset - Newport Subarea N-1-1 Voltage Violations.

Subarea 6: Cape Cod N-1-1 Thermal Overloads and Voltage Violation Results

The tables below and the figures following them show the worst case N-1-1 element overloads and unacceptable voltage performance results for the Cape Cod subarea. Dispatch conditions for each of the overloads and voltage violations are noted in the comments at the bottom of each table.

Table 5-43: 108 Line Sections N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
108-4	Bourne to Horse Pond Tap 115 kV Line	246	[redacted]	[redacted]	111.68
Worst case overloads occur [redacted]. [redacted], causes overloads on portions of the remaining path between Tremont and Bourne.					

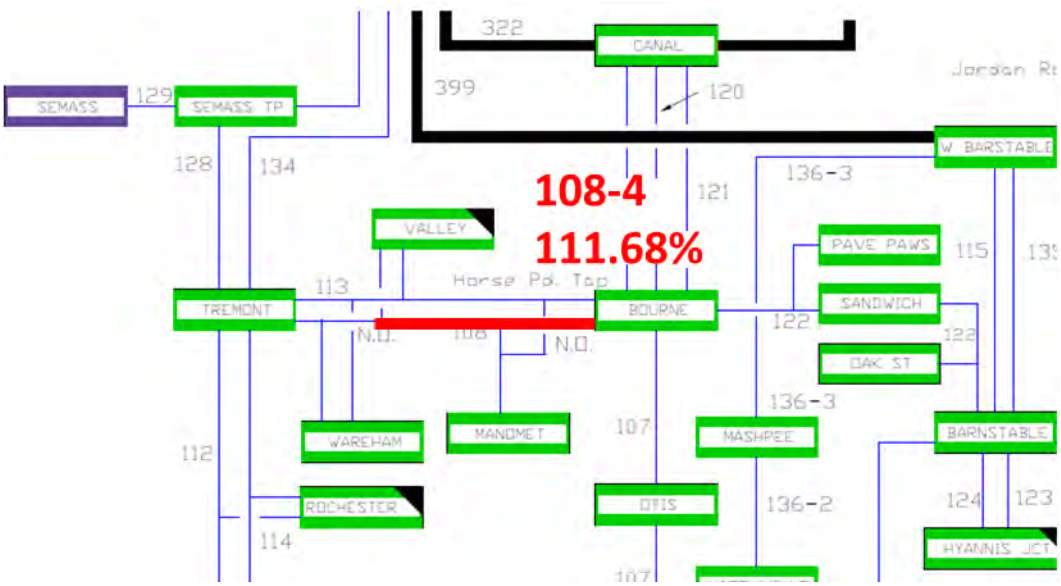

Figure 5-63: 108 Line Sections N-1-1 Thermal Overloads

REDACTED

Table 5-44: 120W N-1-1 Thermal Overload

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
120W	Bourne to Canal 115 kV Line	467	[redacted]	[redacted]	100.97
Worst case overloads occur [redacted], leaves Canal as the strongest 345 kV source of power into the Cape area.					

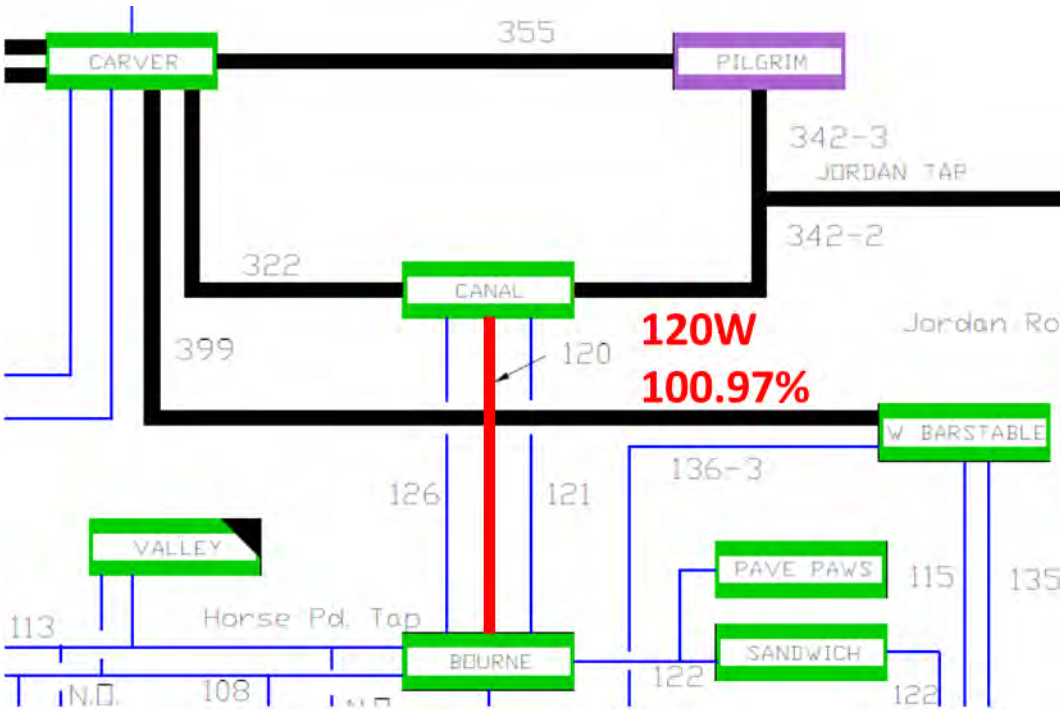

Figure 5-64: 120W N-1-1 Thermal Overload

REDACTED

Table 5-45: Cape Cod Subarea N-1-1 Voltage Violations

Substation Name	Base kV	Element OOS	Contingency	Worst-Case Voltage (p.u.)	Comments
Bourne	115	[redacted]	[redacted]	0.9222	[redacted]
Canal	345	[redacted]	[redacted]	0.9337	[redacted]
Valley_NB	115	[redacted]	[redacted]	0.9143	[redacted]
Wareham	115	[redacted]	[redacted]	0.8972	[redacted]

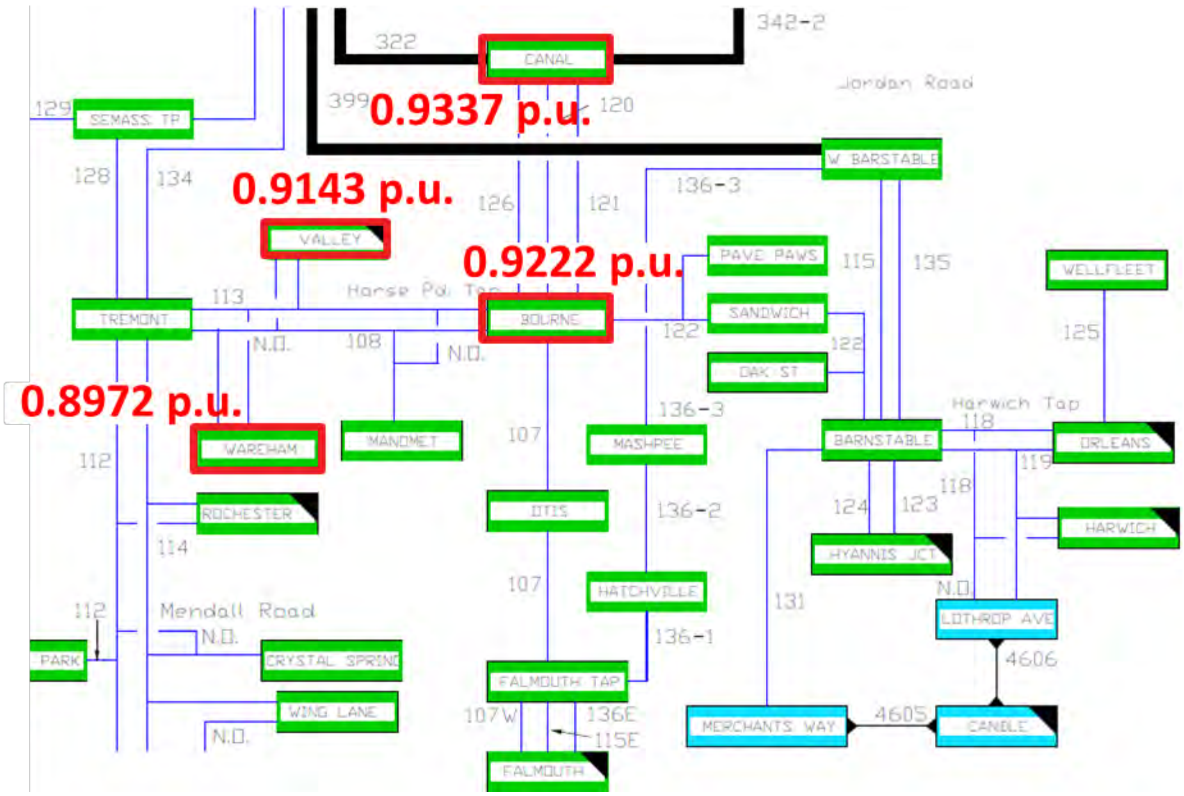

Figure 5-65: Worst Case N-1-1 Voltage Violations Cape Cod Subarea

5.2.3.6 *External Area: Boston N-1-1 Thermal Overload Results*

In addition to the noted thermal overloads and voltage violations in the SEMA-RI study area, several thermal overloads were also observed in the Boston area due to dispatch conditions and contingency scenarios tested in this study.

Table 5-46: Boston Area N-1-1 Thermal Overloads and the figures following it detail the worst case N-1-1 element overloads observed in the Boston area for contingencies modeled in the SEMA-RI study area.

Table 5-46: Boston Area N-1-1 Thermal Overloads

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
324	Mystic to Kingston 345 kV Line	650	[redacted]	[redacted]	108.77
372	Mystic to Kingston 345 kV Line	674	[redacted]	[redacted]	109.56
Kingston 345A	Kingston 345A 345/115 kV Autotransformer	540	[redacted]	[redacted]	135.32
Kingston 345B	Kingston 345B 345/115 kV Autotransformer	540	[redacted]	[redacted]	141.52
329-530	Brighton to Blair Pond 115 kV Line	231	[redacted]	[redacted]	105.73
329-531	Brighton to North Cambridge 115 kV Line	231	[redacted]	[redacted]	145.93
509-530	North Cambridge to Blair Pond 115 kV Line	231	[redacted]	[redacted]	118.84
385-512	Kingston St to K Street 1 115 kV Line	190	[redacted]	[redacted]	166.57
385-513	Kingston St to K Street 1 115 kV Line	190	[redacted]	[redacted]	166.57
385-510-1	High St to K Street 1 115 kV Line Section	190	[redacted]	[redacted]	158.73
385-510-2	Kingston St to High St 115 kV Line Section	190	[redacted]	[redacted]	183.73

REDACTED

Element ID	Element Description	LTE Rating (MVA)	Element OOS	Contingency	Worst-Case Thermal Loading (% LTE)
385-511-1	High St to K Street 2 115 kV Line Section	190	[redacted]	[redacted]	158.73
385-511-2	Kingston St to High St 115 kV Line Section	190	[redacted]	[redacted]	183.73

[redacted] causes flows in the Boston area to re-direct primarily through the low impedance underground cable network in the downtown Boston area. In addition, the area is receiving limited generation support from the SEMA area (worst case overloads occur with two Canal units OOS). These issues were also identified as part of the study work in support of the Greater Boston transmission upgrades but since the facility outages modeled occur in SEMA-RI, it was decided that this study would address them.

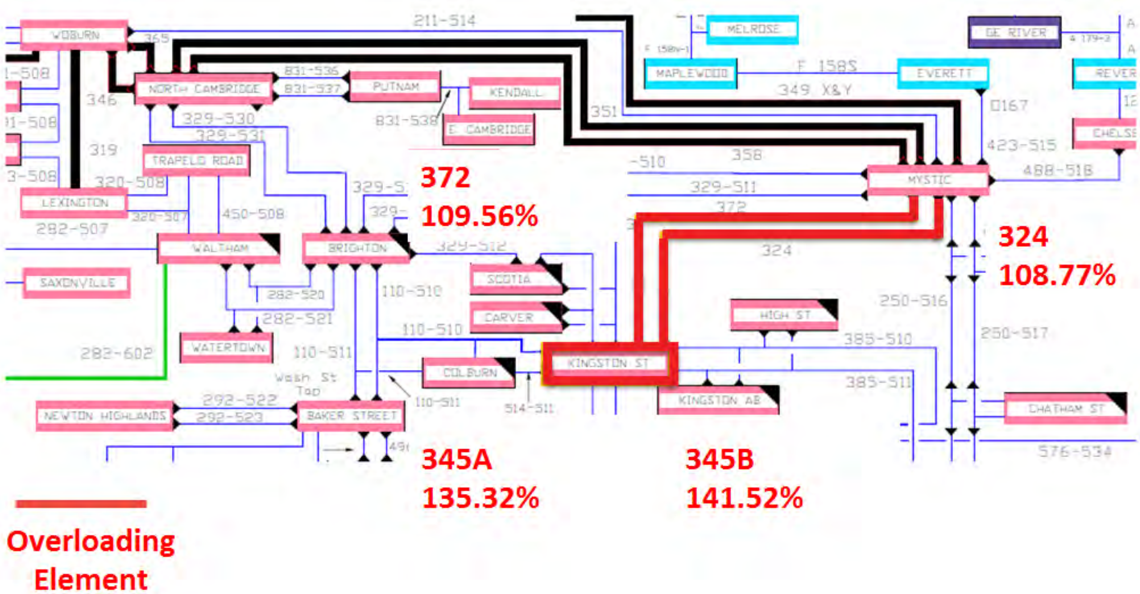

Figure 5-66: Boston Area 345 kV N-1-1 Thermal Overloads

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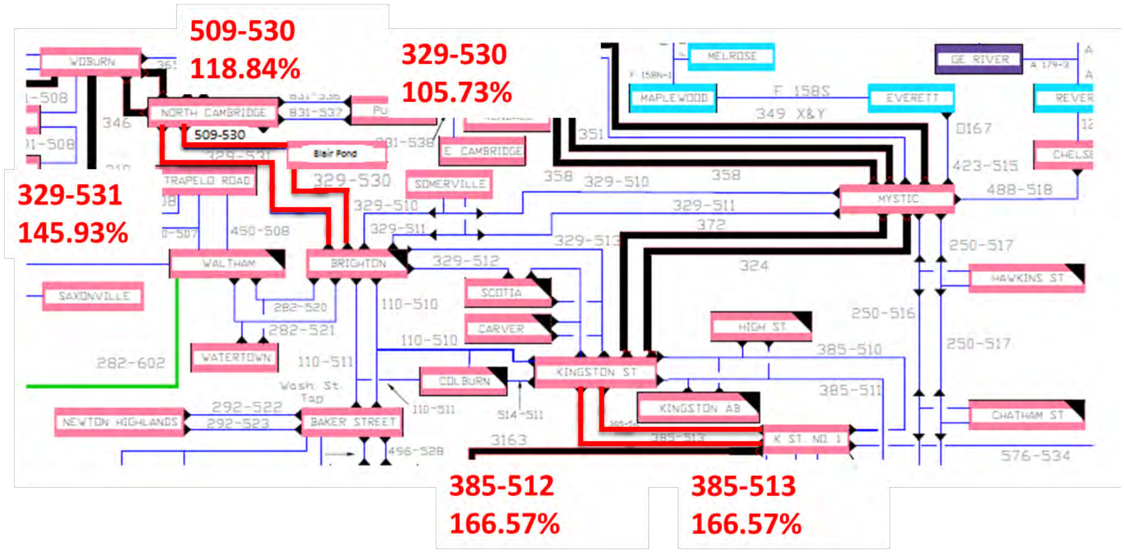

Figure 5-67: Boston Area 115 kV N-1-1 Thermal Overloads

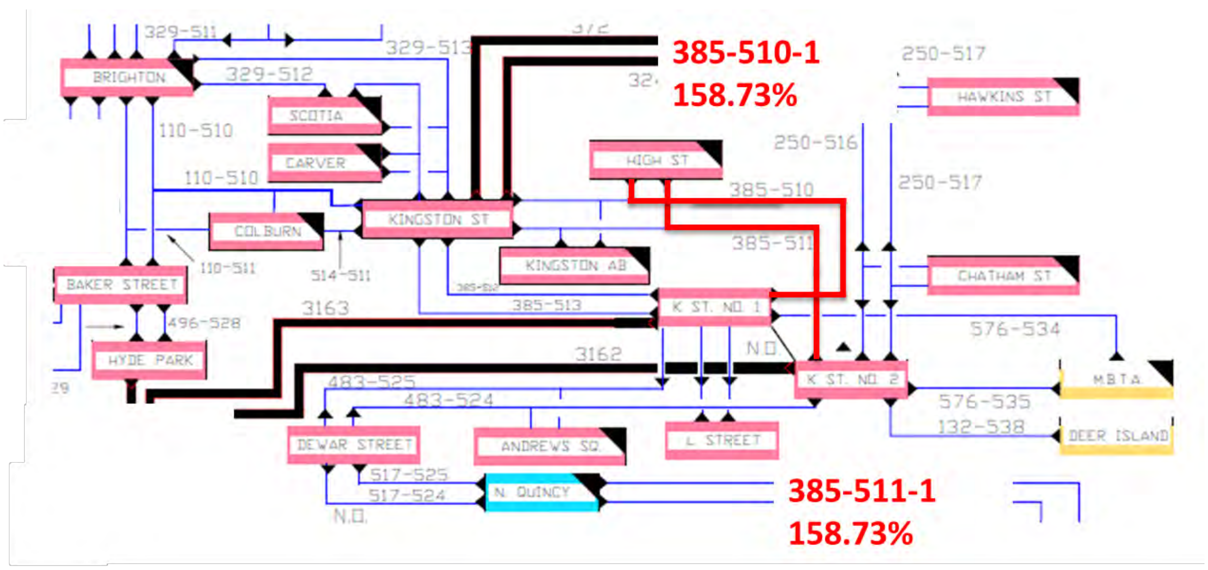

Figure 5-68: Boston Area 115 kV N-1-1 Thermal Overloads

[redacted]

REDACTED

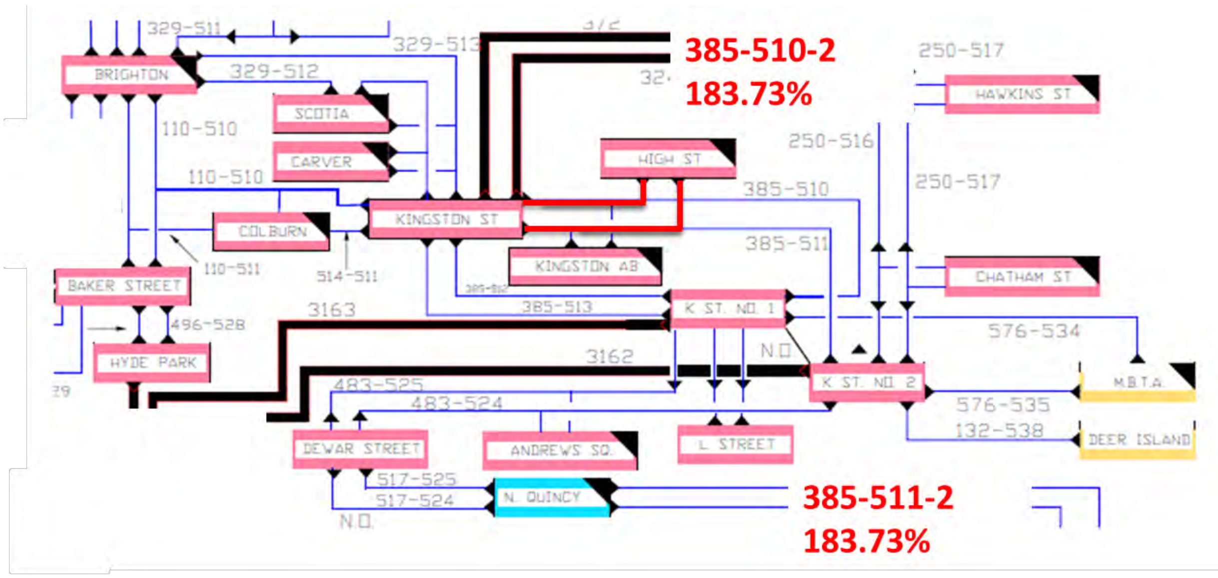

Figure 5-69: Boston Area 115 kV N-1-1 Thermal Overloads

5.2.3.7 *N-1-1 Non-Convergent Contingency Scenario Results*

Non-convergent cases occurred for a number of contingencies associated with [redacted] into the Cape area along [redacted]. [redacted].

Table 5-47 provides details on the contingency pairs that resulted in non-convergent cases and the associated counts for the number of cases where each contingency pair resulted in non-convergence. A contingency pair with a count of 99 indicates that the particular contingency pair did not converge in any case.

Table 5-47: Cape Cod Subarea N-1-1 Non-Convergent Contingency Cases

Element Out of Service	Contingency	Count of Non-Convergent Cases
122-1-2	[redacted]	99
	[redacted]	99
122-3-4	[redacted]	11
	[redacted]	7
399	[redacted]	99
	[redacted]	99
	[redacted]	99
	[redacted]	99
	[redacted]	99
	[redacted]	64
	[redacted]	99
	[redacted]	99
	[redacted]	99
	[redacted]	99

REDACTED

Element Out of Service	Contingency	Count of Non-Convergent Cases
	[redacted]	
	[redacted]	99
	[redacted]	66
	[redacted]	67
345A West Barnstable 345/115 kV	[redacted]	99
	[redacted]	99
	[redacted]	99
	[redacted]	99
	[redacted]	99
	[redacted]	53
	[redacted]	99
	[redacted]	99
	[redacted]	99
	[redacted]	99
	[redacted]	99
	[redacted]	59

REDACTED

5.3 Stability Performance Criteria Compliance

Not applicable for this study.

5.4 Short Circuit Performance Criteria Compliance

Overall results of short circuit testing with respect to over-dutied circuit breakers indicated that there were a total of three 345 kV circuit breakers that could see fault current levels over 95% of their interrupting capability in 2026.

5.4.1 Short Circuit Test Results

Short circuit testing for the SEMA-RI study area was performed for all 345 kV, 115 kV and 69 kV buses within the study area and included assessment of all fault type conditions. The analysis assessed breaker duties for worst-case fault conditions and the results of this analysis are summarized in Table 5-48.

Table 5-48 SEMA-RI Short Circuit Analysis Results

Study Subarea	Substation	Base kV	Number of Circuit Breakers (Breaker Ratings)	
			Over Duty (Above 100%)	High Duty (95% to 100%)
West Medway – West Walpole	West Medway	345	-	3 (50 kA)

REDACTED

5.5 Critical Load Level and Year of Need Assessment Testing Results

An assessment was performed for all thermal overloads, voltage violations under 2026 model year conditions to determine the net New England load level and approximate study year in which these criteria violations would first be seen. This assessment was carried out using the method described in Section 4.3.4 of this report. Only the worst case contingency scenario and dispatch were tested for each transmission element and substation with a criteria violation. Violations with a reported critical load level in-between two respective study years' net peak loads will be reported with the year of need of the higher load level. For all CLLs below 28,198 MW (net New England peak load for the 2016 study year from

Table 4-6), the year of need is reported as "Prior to 2016".

Table 5-49: Farnum Subarea Thermal Critical Load Level Analysis Results

Element ID	Element Description	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
Kent County 3X	Kent County 3X 345/115 kV Autotransformer	[redacted]	[redacted]	26,158	Prior to 2016
L190-4	Tower Hill to West Kingston 115 kV Line	[redacted]	[redacted]	27,280	Prior to 2016
L190-5	Tower Hill to Davisville Tap 115 kV Line	[redacted]	[redacted]	25,537	Prior to 2016
V148S-1	V148 Tap to Washington RI 115 kV Line	[redacted]	[redacted]	16,388	Prior to 2016
V148S-3	Robinson Ave to V148 Tap 115 kV Line	[redacted]	[redacted]	29,568	2021
V148N	Washington to Woonsocket 115 kV Line	[redacted]	[redacted]	29,346	2019
H17-1	West Farnum to Farnum Tap 115 kV Line	[redacted]	[redacted]	24,960	Prior to 2016
H17-2	Riverside to Farnum Tap 115 kV Line	[redacted]	[redacted]	23,141	Prior to 2016
R9	Riverside to Valley 115 kV Line	[redacted]	[redacted]	16,130	Prior to 2016
Valley P11/R9 Bus Tie	Valley 205 115 kV Bus Equipment	[redacted]	[redacted]	19,682	Prior to 2016
J16S	Staples to Highland Drive 115 kV Line	[redacted]	[redacted]	23,792	Prior to 2016

REDACTED

Element ID	Element Description	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
P11-1	Pawtucket to P11 Tap 115 kV Line	[redacted]	[redacted]	24,791	Prior to 2016
P11-2	Valley to P11 Tap 115 kV Line	[redacted]	[redacted]	19,527	Prior to 2016
P11-3	Robinson Ave to P11 Tap 115 kV Line	[redacted]	[redacted]	23,922	Prior to 2016
Q10	Robinson Ave to Staples 115 kV Line	[redacted]	[redacted]	27,990	2016
West Farnum 175T	West Farnum 345/115 kV Transformer	[redacted]	[redacted]	28,083	2016
1870	Kenyon to Wood River 115 kV Line	[redacted]	[redacted]	20,993	Prior to 2016
1870S	Wood River to Chase Hill 115 kV Line	[redacted]	[redacted]	24,871	Prior to 2016
1870S-1	Chase Hill to Shunock 115 kV Line	[redacted]	[redacted]	28,740	2018
G185N Line	Drumrock to Kent County 115 kV Line	[redacted]	[redacted]	29,750	2023
K189 Line	Drumrock to Kent County 115 kV Line	[redacted]	[redacted]	29,723	2022

REDACTED

Table 5-50: Farnum Subarea Voltage Critical Load Level Analysis Results

Bus Name	Base kV	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
Highland Drive	115	[redacted]	[redacted]	27,243	Prior to 2016
Riverside	115	[redacted]	[redacted]	27,192	Prior to 2016
Robinson Avenue	115	[redacted]	[redacted]	27,628	Prior to 2016
Staples	115	[redacted]	[redacted]	27,327	Prior to 2016
Valley	115	[redacted]	[redacted]	27,033	Prior to 2016
Drumrock	115	[redacted]	[redacted]	28,647	2017
Kenyon	115	[redacted]	[redacted]	25,264	Prior to 2016
Wood River	115	[redacted]	[redacted]	22,901	Prior to 2016
West Kingston	115	[redacted]	[redacted]	28,539	2017

REDACTED

Table 5-51: West Medway – West Walpole Subarea Thermal Critical Load Level Results

Element ID	Element Description	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
323 (Eversource)	West Medway to Millbury 345 kV Line	[redacted]	[redacted]	28,929	2018
323 (National Grid)	West Medway to Millbury 345 kV Line	[redacted]	[redacted]	29,346	2019
325	West Medway to West Walpole 345 kV Line	[redacted]	[redacted]	29,346	2019
357 (Eversource)	West Medway to Millbury 345 kV Line	[redacted]	[redacted]	29,346	2019
389	West Medway to West Walpole 345 kV Line	[redacted]	[redacted]	29,346	2019
331 (Eversource)	West Walpole to Carver 345 kV Line	[redacted]	[redacted]	29,346	2019
C-129N-1	Millbury to Purchase Tap 115 kV Line Section	[redacted]	[redacted]	26,501	Prior to 2016
C-129N-6	Rocky Hill to Purchase Tap 115 kV Line Section	[redacted]	[redacted]	28,669	2017

Table 5-52: West Medway – West Walpole Subarea Voltage Critical Load Level Analysis Results

Bus Name	Base kV	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
Beaver Pond	115	[redacted]	[redacted]	27,947	2016
Depot Street	115	[redacted]	[redacted]	28,047	2016
Purchase Street	115	[redacted]	[redacted]	28,483	2017
Rocky Hill	115	[redacted]	[redacted]	28,199	2017
Union Street	115	[redacted]	[redacted]	27,913	2016

REDACTED

Table 5-53: South Shore Subarea Thermal Critical Load Level Results

Element ID	Element Description	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
451-536	Holbrook to East Holbrook Tap 115 kV Line	[redacted]	[redacted]	29,729	2022
Bridgewater 162X	Bridgewater 345/115 kV Autotransformer	[redacted]	[redacted]	30,021	2024
191	Kingston to Auburn 115 kV Line	[redacted]	[redacted]	27,720	2016
117	Kingston to Brook St 115 kV Line	[redacted]	[redacted]	28,444	2017
F19-2	Auburn St to Belmont Tap 115 kV Line Section	[redacted]	[redacted]	27,913	2016
E1-2	Bridgewater to Middleboro 115 kV Line	[redacted]	[redacted]	28,646	2017
C2	Dupont to Auburn St 115 kV Line	[redacted]	[redacted]	27,433	Prior to 2016
L1	East Bridgewater to East Bridgewater Tap 115 kV Line Section	[redacted]	[redacted]	27,162	Prior to 2016
E20-2	Auburn St to East Bridgewater Tap 115 kV Line Section	[redacted]	[redacted]	29,897	2024

Table 5-54: South Shore Subarea Voltage Critical Load Level Analysis Results

Bus Name	Base kV	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
Brook Street	115	[redacted]	[redacted]	27,546	Prior to 2016
Kingston	115	[redacted]	[redacted]	27,950	2016
Middleboro	115	[redacted]	[redacted]	30,228	2025
East Bridgewater	115	[redacted]	[redacted]	29,215	2019
Mill Street	115	[redacted]	[redacted]	29,346	2019
Church Hill	115	[redacted]	[redacted]	29,346	2019
Edgar	115	[redacted]	[redacted]	29,335	2019
Grove Street	115	[redacted]	[redacted]	29,346	2019
Holbrook	115	[redacted]	[redacted]	29,346	2019
Middle Street	115	[redacted]	[redacted]	29,346	2019
Potter	115	[redacted]	[redacted]	29,346	2019
Plain Street	115	[redacted]	[redacted]	29,346	2019

REDACTED

Table 5-55: Industrial Park Subarea Thermal Critical Load Level Results

Element ID	Element Description	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
111-1	High Hill to Industrial Park 115 kV Line Section	[redacted]	[redacted]	17,961	Prior to 2016
112-1	Tremont to Rochester 115 kV Line Section	[redacted]	[redacted]	14,976	Prior to 2016
112-2	Rochester to Crystal Spring Tap 115 kV Line Section	[redacted]	[redacted]	10,063	Prior to 2016
112-3	Industrial Park to Crystal Spring Tap 115 kV Line Section	[redacted]	[redacted]	10,270	Prior to 2016
112-4	Industrial Park to Industrial Park Tap 115 kV Line Section	[redacted]	[redacted]	17,025	Prior to 2016
114-1	Tremont to Rochester 115 kV Line Section	[redacted]	[redacted]	26,310	Prior to 2016

Table 5-56: Industrial Park Subarea Voltage Critical Load Level Analysis Results

Bus Name	Base kV	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
High Hill	115	[redacted]	[redacted]	28,198	2016
Industrial Park	115	[redacted]	[redacted]	15,279	Prior to 2016
Tremont	115	[redacted]	[redacted]	27,624	Prior to 2016
Acushnet	115	[redacted]	[redacted]	15,415	Prior to 2016
SEMASS	115	[redacted]	[redacted]	27,974	2016

REDACTED

Table 5-57: Somerset - Newport Subarea Thermal Critical Load Level Results

Element ID	Element Description	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
W4	Somerset to Swansea 115 kV Line	[redacted]	[redacted]	25,773	Prior to 2016
S8-1	Somerset to S8 Tap 115 kV Line Section	[redacted]	[redacted]	24,471	Prior to 2016
S8-2	Raynham to S8 Tap 115 kV Line Section	[redacted]	[redacted]	23,572	Prior to 2016
S8-4	Bridgewater to Raynham 115 kV Line Section	[redacted]	[redacted]	22,645	Prior to 2016
V5-1	Somerset to Dighton 115 kV Line Section	[redacted]	[redacted]	29,124	2018
V5-2	Dighton to V5 Tap 115 kV Line Section	[redacted]	[redacted]	27,802	2016
V5-3	Bridgewater to V5 Tap 115 kV Line Section	[redacted]	[redacted]	25,909	Prior to 2016
N12-1	Somerset to Sykes Rd 115 kV Line Section	[redacted]	[redacted]	25,159	Prior to 2016
N12-2	Sykes Rd to Bell Rock 115 kV Line Section	[redacted]	[redacted]	25,524	Prior to 2016
D21	Bell Rock to High Hill 115 kV Line	[redacted]	[redacted]	28,656	2017
U6-1	Somerset to Dighton 115 kV Line Section	[redacted]	[redacted]	23,207	Prior to 2016
U6-3	Dighton to Dighton Tap 115 kV Line Section	[redacted]	[redacted]	23,214	Prior to 2016
K15	Swansea to Robinson Ave 115 kV Line	[redacted]	[redacted]	27,888	2016
M13-3	Bent Rd to Tiverton Tap 115 kV Line Section	[redacted]	[redacted]	25,864	Prior to 2016
M13-4	Somerset to Sykes Rd 115 kV Line Section	[redacted]	[redacted]	15,095	Prior to 2016
M13-5	Tiverton Tap to EMI Tiverton Tap 115 kV Line Section	[redacted]	[redacted]	19,699	Prior to 2016
M13-6	EMI Tiverton Tap to EMI Tiverton 115 kV Line Section	[redacted]	[redacted]	17,812	Prior to 2016

REDACTED

Element ID	Element Description	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
M13-7	Canonicus to Dexter 115 kV Line Section	[redacted]	[redacted]	27,059	Prior to 2016
M13-8	Sykes Rd to Tiverton Tap 115 kV Line Section	[redacted]	[redacted]	16,457	Prior to 2016
L14-1	Bent Rd to Canonicus 115 kV Line Section	[redacted]	[redacted]	30,000	2024
L14-3	Bent Rd to Tiverton Tap 115 kV Line Section	[redacted]	[redacted]	22,277	Prior to 2016
L14-4	Bell Rock to Tiverton Tap 115 kV Line Section	[redacted]	[redacted]	21,799	Prior to 2016
L14-5	Tiverton Tap to EMI Tiverton Tap 115 kV Line Section	[redacted]	[redacted]	15,373	Prior to 2016
L14-6	EMI Tiverton Tap to EMI Tiverton 115 kV Line Section	[redacted]	[redacted]	12,216	Prior to 2016
L14-7	Canonicus to Dexter 115 kV Line Section	[redacted]	[redacted]	19,303	Prior to 2016

Table 5-58: Somerset - Newport Subarea Voltage Critical Load Level Analysis Results

Bus Name	Base kV	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
Bell Rock	115	[redacted]	[redacted]	16,827	Prior to 2016
Canonicus	115	[redacted]	[redacted]	16,713	Prior to 2016
Dexter	115	[redacted]	[redacted]	16,719	Prior to 2016
Jepson	115	[redacted]	[redacted]	17,126	Prior to 2016
Tiverton	115	[redacted]	[redacted]	16,205	Prior to 2016
Mink Street	115	[redacted]	[redacted]	27,637	Prior to 2016
Dighton	115	[redacted]	[redacted]	28,604	2017
Somerset	115	[redacted]	[redacted]	27,579	Prior to 2016
Sykes Road	115	[redacted]	[redacted]	27,380	Prior to 2016

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Swansea	115	[redacted]	[redacted]	26,368	Prior to 2016
Pawtucket	115	[redacted]	[redacted]	25,865	Prior to 2016
Phillipdale	115	[redacted]	[redacted]	25,988	Prior to 2016
Wampanoag	115	[redacted]	[redacted]	27,462	Prior to 2016

Table 5-59: Cape Cod Subarea Thermal Critical Load Level Results

Element ID	Element Description	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
108-4	Bourne to Horse Pond Tap 115 kV Line	[redacted]	[redacted]	28,108	2016
120W	Bourne to Canal 115 kV Line	[redacted]	[redacted]	30,307	2026

Table 5-60: Cape Cod Subarea Voltage Critical Load Level Analysis Results

Bus Name	Base kV	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
Bourne	115	[redacted]	[redacted]	29,539	2021
Canal	345	[redacted]	[redacted]	29,829	2023
Valley_NB	115	[redacted]	[redacted]	29,093	2018
Wareham	115	[redacted]	[redacted]	28,261	2017

REDACTED

Table 5-61: Boston Area Thermal Critical Load Level Results

Element ID	Element Description	Initial Element OOS	Worst Case Contingency	Critical Load Level (MW)	Year of Need
324	Mystic to Kingston 345 kV Line	[redacted]	[redacted]	29,346	2019
372	Mystic to Kingston 345 kV Line	[redacted]	[redacted]	29,346	2019
Kingston 345A	Kingston 345A 345/115 kV Autotransformer	[redacted]	[redacted]	25,464	Prior to 2016
Kingston 345B	Kingston 345B 345/115 kV Autotransformer	[redacted]	[redacted]	24,748	Prior to 2016
329-530	Brighton to Blair Pond 115 kV Line	[redacted]	[redacted]	29,346	2019
329-531	Brighton to North Cambridge 115 kV Line	[redacted]	[redacted]	28,392	2016
509-530	North Cambridge to Blair Pond 115 kV Line	[redacted]	[redacted]	29,346	2019
385-512	Kingston St to K Street 1 115 kV Line	[redacted]	[redacted]	23,292	Prior to 2016
385-513	Kingston St to K Street 1 115 kV Line	[redacted]	[redacted]	23,292	Prior to 2016
385-510-1	High St to K Street 1 115 kV Line Section	[redacted]	[redacted]	24,019	Prior to 2015
385-510-2	Kingston St to High St 115 kV Line Section	[redacted]	[redacted]	21,917	Prior to 2016
385-511-1	High St to K Street 2 115 kV Line Section	[redacted]	[redacted]	24,019	Prior to 2016
385-511-2	Kingston St to High St 115 kV Line Section	[redacted]	[redacted]	21,946	Prior to 2016

REDACTED

Table 5-62 lists the critical load level (CLL) and year of need associated with the non-converged contingency scenarios observed in the Cape Cod subarea. These contingency scenarios were non-convergent in at least one study case for projected 2018 system conditions; as such, their CLL and Year of Need were set to coincide with that study year and respective projected New England net load. Since non-converged solutions are an indication of severe system performance concerns, the actual year of need is likely before 2018.

Table 5-62: Cape Cod Area Non-Convergence Critical Load Level Results

Element OOS	Contingency	Critical Load Level (MW)	Year of Need
122-1-2	[redacted]	29,189	2018
	[redacted]	29,189	2018
122-3-4	[redacted]	29,189	2018
	[redacted]	29,189	2018
399	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
345A West Barnstable 345/115 kV	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018

REDACTED

Element OOS	Contingency	Critical Load Level (MW)	Year of Need
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018
	[redacted]	29,189	2018

REDACTED

Section 6
Conclusions on Needs Analysis

The results of the assessment conducted of the Southeastern Massachusetts and Rhode Island area transmission performance against transmission reliability standards for the projected 2026 system conditions in this study indicate that there are a significant number of thermal and voltage violations across a number of subareas within the Southeastern Massachusetts and Rhode Island system. The Southeastern Massachusetts and Rhode Island area transmission system fails to meet established reliability criteria standards, and measures should be developed to mitigate the problems identified. The study has determined the specific year in which violations first emerge and based on this information system upgrades necessary to mitigate these violations in criteria should be implemented as soon as practical.

The specific set of criteria and standards that the transmission system serving SEMA-RI fails to meet includes the following:

- NERC Reliability Standards TPL-001-4 Category P0, P1, P2, P3, P4, P6 and P7 performance requirements.
- NPCC Regional Reliability Reference Directory # 1 Design and Operation of the Bulk Power System Transmission Design Criteria requirements.
- ISO New England Planning Procedure No. 3 Reliability Standards For The New England Area Bulk Power Supply System Section 3.0 Area Transmission requirements.

6.1 Reliability Determination of Time-Sensitive Needs

Transmission needs identified in this study have been deemed time-sensitive if they have a year of need within three years of the completion of this Needs Assessment. Since the publishing date of this assessment occurs before June 1, 2016, the threshold for determining time-sensitive needs has been determined to be any issues that occur before the 2019 summer peak.

Table 6-1, Table 6-2, and Table 6-3 list the needs in the SEMA-RI study area that have been determined to be time-sensitive as part of this Needs Assessment. To address these needs, ISO-NE proposes to use the Solutions Study process described in Section 4.2 of Attachment K and develop solutions to address them in cooperation with Eversource Energy and National Grid, the two participating Transmission Owners in the study area.

REDACTED

Table 6-1: SEMA-RI Time-Sensitive Thermal Needs

Study Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
Farnum	**Kent County 3X**	Kent County 3X 345/115 kV Autotransformer	26,158	Prior to 2016
Farnum	**L190-4**	Tower Hill to West Kingston 115 kV Line	27,280	Prior to 2016
Farnum	**L190-5**	Tower Hill to Davisville Tap 115 kV Line	25,537	Prior to 2016
Farnum	**V148S-1**	V148 Tap to Washington RI 115 kV Line	16,388	Prior to 2016
Farnum	**H17-1**	West Farnum to Farnum Tap 115 kV Line	24,960	Prior to 2016
Farnum	**H17-2**	Riverside to Farnum Tap 115 kV Line	23,141	Prior to 2016
Farnum	**R9**	Riverside to Valley 115 kV Line	16,130	Prior to 2016
Farnum	**Valley P11/R9 Bus Tie**	Valley 205 115 kV Bus Equipment	19,682	Prior to 2016
Farnum	**J16S**	Staples to Highland Drive 115 kV Line	23,792	Prior to 2016
Farnum	**P11-1**	Pawtucket to P11 Tap 115 kV Line	24,791	Prior to 2016
Farnum	**P11-2**	Valley to P11 Tap 115 kV Line	19,527	Prior to 2016
Farnum	**P11-3**	Robinson Ave to P11 Tap 115 kV Line	23,922	Prior to 2016
Farnum	**Q10**	Robinson Ave to Staples 115 kV Line	27,990	2016
Farnum	**West Farnum 175T**	West Farnum 345/115 kV Transformer	28,083	2016
Farnum	**1870**	Kenyon to Wood River 115 kV Line	20,993	Prior to 2016
Farnum	**1870S**	Wood River to Chase Hill 115 kV Line	24,871	Prior to 2016
Farnum	**1870S-1**	Chase Hill to Shunock 115 kV Line	28,740	2018
West Medway - West Walpole	**323 (Eversource)**	West Medway to Millbury 345 kV Line	28,929	2018

[redacted]

REDACTED

Study Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
West Medway - West Walpole	**C-129N-1**	Millbury to Purchase Tap 115 kV Line Section	26,501	Prior to 2016
West Medway - West Walpole	**C-129N-6**	Rocky Hill to Purchase Tap 115 kV Line Section	28,669	2017
South Shore	**191**	Kingston to Auburn 115 kV Line	27,720	2016
South Shore	**117**	Kingston to Brook St 115 kV Line	28,444	2017
South Shore	**F19-2**	Auburn St to Belmont Tap 115 kV Line Section	27,913	2016
South Shore	**E1**	Bridgewater to Middleboro 115 kV Line	28,646	2017
South Shore	**C2**	Dupont to Auburn St 115 kV Line	27,433	Prior to 2016
South Shore	**L1**	East Bridgewater to East Bridgewater Tap 115 kV Line Section	27,162	Prior to 2016
Industrial Park	**111-1**	High Hill to Industrial Park 115 kV Line Section	17,961	Prior to 2016
Industrial Park	**112-1**	Tremont to Rochester 115 kV Line Section	14,976	Prior to 2016
Industrial Park	**112-2**	Rochester to Crystal Spring Tap 115 kV Line Section	10,063	Prior to 2016
Industrial Park	**112-3**	Industrial Park to Crystal Spring Tap 115 kV Line Section	10,270	Prior to 2016
Industrial Park	**112-4**	Industrial Park to Industrial Park Tap 115 kV Line Section	17,025	Prior to 2016
Industrial Park	**114-1**	Tremont to Rochester 115 kV Line Section	26,310	Prior to 2016
Somerset - Newport	**F184-3**	Mink St to Read St 115 kV Line Section	19,181	Prior to 2016
Somerset – Newport	**S8-1**	Somerset to S8 Tap 115 kV Line Section	24,471	Prior to 2016
Somerset - Newport	**S8-2**	Raynham to S8 Tap 115 kV Line Section	23,572	Prior to 2016
Somerset - Newport	**S8-4**	Bridgewater to Raynham 115 kV Line	22,645	Prior to 2016

REDACTED

Study Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
		Section		
Somerset - Newport	**V5-1**	Somerset to Dighton 115 kV Line Section	29,124	2018
Somerset - Newport	**V5-2**	Dighton to V5 Tap 115 kV Line Section	27,802	2016
Somerset - Newport	**V5-3**	Bridgewater to V5 Tap 115 kV Line Section	25,909	Prior to 2016
Somerset - Newport	**N12-1**	Somerset to Sykes Rd 115 kV Line Section	25,159	Prior to 2016
Somerset - Newport	**N12-2**	Sykes Rd to Bell Rock 115 kV Line Section	25,524	Prior to 2016
Somerset - Newport	**D21**	Bell Rock to High Hill 115 kV Line	28,656	2017
Somerset - Newport	**U6-1**	Somerset to Dighton 115 kV Line Section	23,207	Prior to 2016
Somerset - Newport	**U6-3**	Dighton to Dighton Tap 115 kV Line Section	23,214	Prior to 2016
Somerset - Newport	**K15**	Swansea to Robinson Ave 115 kV Line	27,888	2016
Somerset - Newport	**M13-3**	Bent Rd to Tiverton Tap 115 kV Line Section	25,864	Prior to 2016
Somerset - Newport	**M13-4**	Somerset to Sykes Rd 115 kV Line Section	15,095	Prior to 2016
Somerset - Newport	**M13-5**	Tiverton Tap to EMI Tiverton Tap 115 kV Line Section	19,699	Prior to 2016
Somerset - Newport	**M13-6**	EMI Tiverton Tap to EMI Tiverton 115 kV Line Section	17,812	Prior to 2016
Somerset - Newport	**M13-7**	Canonicus to Dexter 115 kV Line Section	27,059	Prior to 2016
Somerset - Newport	**M13-8**	Sykes Rd to Tiverton Tap 115 kV Line Section	16,457	Prior to 2016
Somerset - Newport	**L14-3**	Bent Rd to Tiverton Tap 115 kV Line Section	22,277	Prior to 2016
Somerset - Newport	**L14-4**	Bell Rock to Tiverton Tap 115 kV Line Section	21,799	Prior to 2016
Somerset - Newport	**L14-5**	Tiverton Tap to EMI Tiverton Tap 115 kV	15,373	Prior to 2016

[redacted] – [redacted]

REDACTED

Study Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
		Line Section		
Somerset - Newport	**L14-6**	EMI Tiverton Tap to EMI Tiverton 115 kV Line Section	12,216	Prior to 2016
Somerset - Newport	**L14-7**	Canonicus to Dexter 115 kV Line Section	19,303	Prior to 2016
Cape Cod	**108-4**	Bourne to Horse Pond Tap 115 kV Line	28,108	2016
Boston (External)	**Kingston 345A**	Kingston 345A 345/115 kV Autotransformer	25,464	Prior to 2016
Boston (External)	**Kingston 345B**	Kingston 345B 345/115 kV Autotransformer	24,748	Prior to 2016
Boston (External)	**329-531**	Brighton to North Cambridge 115 kV Line	28,392	2016
Boston (External)	**385-512**	Kingston St to K Street 1 115 kV Line	23,292	Prior to 2016
Boston (External)	**385-513**	Kingston St to K Street 1 115 kV Line	23,292	Prior to 2016
Boston (External)	**385-510-1**	High St to K Street 1 115 kV Line Section	24,019	Prior to 2016
Boston (External)	**385-510-2**	Kingston St to High St 115 kV Line Section	21,917	Prior to 2016
Boston (External)	**385-511-1**	High St to K Street 2 115 kV Line Section	24,019	Prior to 2016
Boston (External)	**385-511-2**	Kingston St to High St 115 kV Line Section	21,946	Prior to 2016

Table 6-2: SEMA-RI Time-Sensitive Voltage Needs

Study Subarea	Bus Name	Base kV	Critical Load Level (MW)	Year of Need
Farnum	**Highland Drive**	115	27,243	Prior to 2016
Farnum	**Riverside**	115	27,192	Prior to 2016
Farnum	**Robinson Avenue**	115	27,628	Prior to 2016
Farnum	**Staples**	115	27,327	Prior to

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Study Subarea	Bus Name	Base kV	Critical Load Level (MW)	Year of Need
				2016
Farnum	**Valley**	115	27,033	Prior to 2016
Farnum	**Drumrock**	115	28,647	2017
Farnum	**Kenyon**	115	25,264	Prior to 2016
Farnum	**Wood River**	115	22,901	Prior to 2016
Farnum	**West Kingston**	115	28,539	2017
West Medway – West Walpole	**Beaver Pond**	115	27,947	2016
West Medway – West Walpole	**Depot Street**	115	28,047	2016
West Medway – West Walpole	**Purchase Street**	115	28,483	2017
West Medway – West Walpole	**Rocky Hill**	115	28,199	2017
West Medway – West Walpole	**Union Street**	115	27,913	2016
South Shore	**Brook Street**	115	27,546	Prior to 2016
South Shore	**Kingston**	115	27,950	2016
Industrial Park	**High Hill**	115	28,198	2016
Industrial Park	**Industrial Park**	115	15,279	Prior to 2016
Industrial Park	**Tremont**	115	27,624	Prior to 2016
Industrial Park	**Acushnet**	115	15,415	Prior to 2016
Industrial Park	**SEMASS**	115	27,974	2016
Somerset - Newport	**Bell Rock**	115	16,827	Prior to 2016
Somerset – Newport	**Canonicus**	115	16,713	Prior to 2016
Somerset – Newport	**Dexter**	115	16,719	Prior to 2016
Somerset – Newport	**Jepson**	115	17,126	Prior to 2016
Somerset – Newport	**Tiverton**	115	16,205	Prior to 2016
Somerset – Newport	**Mink Street**	115	27,637	Prior to 2016

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Study Subarea	Bus Name	Base kV	Critical Load Level (MW)	Year of Need
Somerset – Newport	**Dighton**	115	28,604	2017
Somerset – Newport	**Somerset**	115	27,579	Prior to 2016
Somerset – Newport	**Sykes Road**	115	27,380	Prior to 2016
Somerset – Newport	**Swansea**	115	26,368	Prior to 2016
Somerset – Newport	**Pawtucket**	115	25,865	Prior to 2016
Somerset – Newport	**Phillipdale**	115	25,988	Prior to 2016
Somerset - Newport	**Wampanoag**	115	27,462	Prior to 2016
Cape Cod	**Valley_NB**	115	29,093	2018
Cape Cod	**Wareham**	115	28,261	2017

Table 6-3: SEMA-RI Time-Sensitive Non-Convergence Needs

Element OOS	Contingency	Critical Load Level (MW)	Year of Need
[redacted]		29,189	2018
		29,189	2018
		29,189	2018
		29,189	2018
		29,189	2018
		29,189	2018
		29,189	2018
		29,189	2018
		29,189	2018
		29,189	2018
		29,189	2018
		29,189	2018

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Element OOS	Contingency	Critical Load Level (MW)	Year of Need
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018
[redacted]	[redacted]	29,189	2018

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Table 6-4 and Table 6-5 list the needs in the SEMA-RI study area that have been determined to be not time-sensitive as part of this Needs Assessment. These needs occur only for projected system conditions in the 2019 study year and beyond. During the Solutions Study phase, specific transmission solutions will not be developed to address these needs. However, due to the nature of transmission solutions, it is quite likely that many of the needs determined to be non-time sensitive will be resolved. Once the solution to address the time-sensitive needs in the SEMA-RI study area has been fully developed, any of these needs that remain will be re-evaluated pursuant to the requirements of Attachment K, Section 4.1(j).

Table 6-4: SEMA-RI Thermal Needs Determined to be Not Time-Sensitive

Study Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
Farnum	**V148S-3**	V148 Tap to Washington RI 115 kV Line Section	29,568	2021
Farnum	**V148N**	Washington to Woonsocket 115 kV Line	29,346	2019
Farnum	**G185N**	Drumrock to Kent County 115 kV Line	29,750	2023
Farnum	**K189**	Drumrock to Kent County 115 kV Line	29,723	2022
West Medway – West Walpole	**323 (NGrid)**	Millbury to West Medway 345 Line kV	29,346	2019
West Medway – West Walpole	**325**	West Medway to West Walpole 345 kV Line	29,346	2019
West Medway – West Walpole	**357 (Eversource)**	West Medway to Millbury 345 kV Line	29,349	2019
West Medway – West Walpole	**389**	West Medway to West Walpole 345 kV Line	29,346	2019
West Medway – West Walpole	**331 (Eversource)**	West Walpole to Carver 345 kV Line	29,346	2019
South Shore	**451-536**	Holbrook to East Holbrook Tap 115 kV Line	29,729	2022
South Shore	**Bridgewater 162X**	Bridgewater 345/115 kV Autotransformer	30,021	2024
South Shore	**E20-2**	Auburn St to East Bridgewater Tap 115 kV Line Section	29,897	2024
Somerset – Newport	**L14-1**	Bent Rd to Canonicus 115 kV Line Section	30,000	2024

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Study Subarea	Element ID	Element Description	Critical Load Level (MW)	Year of Need
Cape Cod	**120W**	Bourne to Canal 115 kV Line	30,307	2026
Boston (External)	**324**	Mystic to Kingston 345 kV Line	29,346	2019
Boston (External)	**372**	Mystic to Kingston 345 kV Line	29,346	2019
Boston (External)	**329-530**	Brighton to Blair Pond 115 kV Line	29,346	2019
Boston (External)	**509-530**	North Cambridge to Blair Pond 115 kV Line	29,346	2019

Table 6-5: SEMA-RI Voltage Needs Determined to be Not Time-Sensitive

Study Subarea	Bus Name	Base kV	Critical Load Level (MW)	Year of Need
South Shore	**Middleboro**	115	30,228	2025
South Shore	**East Bridgewater**	115	29,215	2019
South Shore	**Mill Street**	115	29,346	2019
South Shore	**Church Hill**	115	29,346	2019
South Shore	**Edgar**	115	29,335	2019
South Shore	**Grove Street**	115	29,346	2019
South Shore	**Holbrook**	115	29,346	2019
South Shore	**Middle Street**	115	29,346	2019
South Shore	**Potter**	115	29,346	2019
South Shore	**Plain Street**	115	29,346	2019
Cape Cod	**Bourne**	115	29,539	2021
Cape Cod	**Canal**	115	29,829	2023

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Section 7
Appendix A: Load Forecast

Table 7-1: 2015 CELT Seasonal Peak Load Forecast Distributions

		Peak Load Forecast at Milder Than Expected Weather				Reference Forecast at Expected Weather	Peak Load Forecast at More Extreme Than Expected Weather				
Summer (MW)	2015	27145	27395	27440	27825	28251	28700	29165	29825	30600	31270
	2016	27548	27803	27848	28238	28673	29133	29603	30278	31053	31733
	2017	27921	28181	28226	28626	29066	29531	30011	30696	31481	32171
	2018	28323	28583	28633	29033	29483	29958	30443	31138	31933	32628
	2019	28686	28951	28996	29406	29861	30341	30831	31541	32341	33051
	2020	28992	29262	29307	29722	30182	30667	31167	31877	32697	33417
	2021	29287	29557	29607	30022	30487	30977	31482	32202	33037	33762
	2022	29589	29864	29914	30334	30804	31299	31809	32539	33389	34124
	2023	29901	30181	30231	30656	31131	31631	32146	32886	33746	34491
	2024	30214	30494	30544	30974	31455	31964	32479	33224	34104	34859
WTHI (1)		78.49	78.73	79.00	79.39	79.88	80.30	80.72	81.14	81.96	82.33
Dry-Bulb Temperature (2)		88.50	88.90	89.20	89.90	90.20	91.20	92.20	92.90	94.20	95.40
Probability of Forecast Being Exceeded		90%	80%	70%	60%	50%	40%	30%	20%	10%	5%
Winter (MW)	2015/16	22325	22440	22535	22595	22740	22890	23050	23150	23400	23755
	2016/17	22500	22620	22715	22775	22920	23070	23230	23335	23580	23935
	2017/18	22685	22800	22895	22960	23105	23255	23420	23520	23765	24120
	2018/19	22855	22975	23070	23130	23280	23435	23595	23700	23935	24295
	2019/20	23000	23120	23220	23280	23430	23585	23750	23850	24085	24445
	2020/21	23140	23260	23360	23420	23570	23725	23890	23995	24225	24585
	2021/22	23280	23400	23500	23565	23715	23870	24040	24145	24370	24730
	2022/23	23430	23550	23650	23715	23865	24020	24190	24295	24520	24880
	2023/24	23580	23705	23805	23865	24020	24180	24345	24455	24680	25035
	2024/25	23735	23855	23955	24020	24175	24335	24505	24610	24835	25190
Dry-Bulb Temperature (3)		10.72	9.66	8.84	8.30	7.03	5.77	4.40	3.58	1.61	(1.15)

FOOTNOTES:

(1) WTHI - a three-day weighted temperature-humidity index for eight New England weather stations. It is the weather variable used in producing the summer peak load forecast. For more information on the weather variables see http://www.iso-ne.com/system-planning/system-plans-studies/celt .

(2) Dry-bulb temperature (in degrees Fahrenheit) shown in the summer season is for informational purposes only.

(3) Dry-bulb temperature (in degrees Fahrenheit) shown in the winter season is a weighted value from eight New England weather stations.

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Table 7-2: 2026 Detailed Load Distributions by State and Company

ISO New England Basecase DB - Load File Report by Company

Study Date :	07/01/2026	**Study Name :**	SEMA_RI_Needs_Reassessment		
File Created :	2015-10-19	**CELT Forecast :**	2015	**Forecast Year :**	2026
Season :	Summer Peak	**Weather :**	90/10	**Load Distribution :**	N+10_SUM
ISO-NE CELT :	35305 MW	**% of Peak :**	100.000%	**Tx Losses :**	2.50%

State CELT L&L		2.50% Tx Losses		Non-CELT Load		Station Service		Area 104 NE Load		Area 101 Load
35310 MW	-	817.4 MW	+	367.6 MW	+	933.9 MW	-	0.0MW	=	35794.6 MW

1: State CELT L&L: This represents the sum of the 6 State CELT forecasts. This number can sometimes be 5-10 MW different than the ISO-NE CELT forecast number due to round-off error.
2: Non-CELT Load: This is the sum of all load modeled in the case that is not included in the CELT forecast. An example is the "behind the meter" paper mill load in Maine.
3: Station Service: This is the amount of generator station service modeled. If station service is off-line, the Area 101 report totals will be different since off-line load is not counted in totals.
4: Area 104 NE Load: This load is load modeled in northern VT that is electrically served from Hydro Quebec. To make Area Interchange load independent, this load is assigned Area 104.

Maine State Load = 2525 MW - 2.50% Tx Losses = 2466.55 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
CMP	86.10%	2123.74	689.73	0.951	342.41
EM	13.90%	342.81	122.09	0.942	14.29

New Hampshire State Load = 3350 MW - 2.50% Tx Losses = 3272.45 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
PSNH	78.56%	2570.86	366.33	0.990	5.80
UNITIL	12.08%	395.38	56.35	0.990	
GSE	9.36%	306.23	28.97	0.996	1.85

Vermont State Load = 1265 MW - 2.50% Tx Losses = 1235.72 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
VELCO	100.00%	1235.80	212.90	0.985	92.51

Massachusetts State Load = 16545 MW - 2.50% Tx Losses = 16162.01 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
BECO	28.27%	4568.36	1165.13	0.969	37.79
COMEL	11.47%	1852.98	377.78	0.980	
MA-NGRID	39.09%	6317.83	420.66	0.998	38.49
WMECO	7.03%	1136.36	161.89	0.990	
MUNI:BOST-NGR	3.36%	543.33	96.49	0.985	
MUNI:BOST-NST	1.25%	202.19	31.84	0.988	
MUNI:CNEMA-NGR	2.06%	332.61	42.74	0.992	
MUNI:RI-NGR	0.86%	138.83	16.70	0.993	
MUNI:SEMA-NGR	1.82%	293.82	30.15	0.995	
MUNI:SEMA-NST	1.70%	275.05	50.64	0.983	
MUNI:WMA-NGR	0.94%	151.77	15.37	0.995	
MUNI:WMA-NU	2.16%	349.26	49.73	0.990	

Rhode Island State Load = 2550 MW - 2.50% Tx Losses = 2490.97 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
RI-NGRID	100.00%	2490.94	210.82	0.996	45.44

Connecticut State Load = 9075 MW - 2.50% Tx Losses = 8864.93 MW

Company	State Share	Total P (MW)	Total Q (MVAR)	Overall PF	Non-Scaling (MW)
CLP	76.70%	6799.04	968.86	0.990	107.42
CMEEC	4.58%	406.10	57.87	0.990	
UI	18.72%	1659.78	166.62	0.995	10.00

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Table 7-3: 2026 Detailed Demand Response Distributions by Zone

ISO New England Basecase DB - Demand Resources File Report

Study Date : 07/01/2026 **Study Name :** SEMA_RI_Needs_Reassessment
File Created : 2015-10-19 **CCP :** 2018/2019 **Load Season :** 2026 - Summer Peak
Load Distrb : N+10_SUM **Distrb Losses :** 5.50% **DR Season :** SUM

	Demand Reduction Value (DRV)		Load Dependent Capability Assumption (LDCA)		Performance Assumption (PA)		Distribution Losses Gross-Up		Area 104 DR		Area 101 DR
Passive :	2134.81 MW	x	100.00%	x	100.00%	+	117.41 MW	-	0.00 MW	=	2252.20 MW
Forecast EE :	1506.44 MW		100.00%		100.00%		82.85 MW		0.00 MW		1589.31 MW
Active RTDR :	484.06 MW		100.00%		75.00%		19.97 MW		0.00 MW		383.01 MW
Active RTEG :	N/A		N/A		N/A		N/A		N/A		N/A

Demand Reduction Value (DRV): Amount of DR measured at the customer meter without any gross-up values for transmission or distribution losses.
Load Dependent Capability Assumption (LDCA): De-rate factor applied based on % of CELT load. (i.e. Light load is 45% of 50/50 load, so the LDCA would be 45%.)
Performance Assumption (PA): De-rate factor applied based on expected performance of DR after a dispatch signal from Operations.
Area 104 DR: This load is modeled in northern VT and is electrically served from Hydro Quebec. To make Area Interchange load independent, this load is assigned Area

Passive Demand Resources - (On-Peak and Seasonal Peak)

DR Modeled = (DRV_SUM * 100.00% LDCA * 100.00% PA) + 5.50% Distrb Losses Gross-Up

Zone	ID	Description	DRV (MW)	Total P (MW)	Total Q (MVAR)
DR_P_ME	20	Load Zone - Maine	-167.54	-176.76	-61.87
DR_P_NH	21	Load Zone - New Hampshire	-94.90	-100.12	-13.84
DR_P_VT	22	Load Zone - Vermont	-116.80	-123.22	-21.12
DR_P_NEMABOS	23	Load Zone - Northeast Massachusetts & Boston	-526.86	-555.84	-121.69
DR_P_SEMA	24	Load Zone - Southeast Massachusetts	-284.19	-299.82	-33.16
DR_P_WCMA	25	Load Zone - West Central Massachusetts	-330.58	-348.76	-31.57
DR_P_RI	26	Load Zone - Rhode Island	-188.58	-198.96	-16.84
DR_P_CT	27	Load Zone - Connecticut	-425.34	-448.73	-60.40

Forecasted Energy Efficiency

DR Modeled = (DRV_EE * 100.00% LDCA * 100.00% PA) + 5.50% Distrb Losses Gross-Up

Zone	ID	Description	DRV (MW)	Total P (MW)	Total Q (MVAR)
DR_P_ME	20	Load Zone - Maine	-104.02	-109.74	-38.41
DR_P_NH	21	Load Zone - New Hampshire	-63.89	-67.40	-9.32
DR_P_VT	22	Load Zone - Vermont	-101.86	-107.47	-18.43
DR_P_NEMABOS	23	Load Zone - Northeast Massachusetts & Boston	-363.29	-383.27	-83.90
DR_P_SEMA	24	Load Zone - Southeast Massachusetts	-192.26	-202.83	-22.43
DR_P_WCMA	25	Load Zone - West Central Massachusetts	-224.57	-236.92	-21.44
DR_P_RI	26	Load Zone - Rhode Island	-132.41	-139.69	-11.82
DR_P_CT	27	Load Zone - Connecticut	-324.15	-341.98	-46.03

Active Demand Resources - (Real-Time Demand Resource - RTDR)

DR Modeled = (DRV_SUM * 100.00% LDCA * 75.00% PA) + 5.50% Losses Gross-Up

Zone	ID	Description	DRV (MW)	Total P (MW)	Total Q (MVAR)
DR_A_ME_EME	30	Dispatch Zone - ME - Emerea Maine	-27.25	-21.56	-9.29
DR_A_ME_MAIN	31	Dispatch Zone - ME - Maine	-96.93	-76.70	-26.41
DR_A_ME_PORT	32	Dispatch Zone - ME - Portland Maine	-16.59	-13.13	-4.25
DR_A_NH_NEWH	33	Dispatch Zone - NH - New Hampshire	-13.21	-10.45	-1.43
DR_A_NH_SEAC	34	Dispatch Zone - NH - Seacoast	-1.65	-1.31	-0.19
DR_A_VT_NWVT	35	Dispatch Zone - VT - Northwest Vermont	-24.49	-19.38	-3.24
DR_A_VT_VERM	36	Dispatch Zone - VT - Vermont	-5.04	-3.99	-0.72
DR_A_MA_BOST	37	Dispatch Zone - MA - Boston	-50.30	-39.80	-10.07
DR_A_MA_NSHR	38	Dispatch Zone - MA - North Shore	-17.79	-14.07	-1.70
DR_A_MA_CMA	39	Dispatch Zone - MA - Central Massachusetts	-32.00	-25.32	-2.13
DR_A_MA_SPFD	40	Dispatch Zone - MA - Springfield	-7.79	-6.16	-0.85
DR_A_MA_WMA	41	Dispatch Zone - MA - Western Massachusetts	-15.39	-12.18	-0.79
DR_A_MA_LSM	42	Dispatch Zone - MA - Lower Southeast Massachusetts	-7.11	-5.63	-1.01
DR_A_MA_SEMA	43	Dispatch Zone - MA - Southeast Massachusetts	-41.03	-32.46	-2.60
DR_A_RI_RHOD	44	Dispatch Zone - RI - Rhode Island	-55.90	-44.23	-3.74
DR_A_CT_EAST	45	Dispatch Zone - CT - Eastern Connecticut	-7.90	-6.25	-0.89
DR_A_CT_NRTH	46	Dispatch Zone - CT - Northern Connecticut	-28.37	-22.45	-3.20
DR_A_CT_NRST	47	Dispatch Zone - CT - Norwalk-Stamford	-3.36	-2.66	-0.36
DR_A_CT_WEST	48	Dispatch Zone - CT - Western Connecticut	-31.97	-25.30	-3.30

Section 8
Appendix B: Upgrades Included in Base Case

A summary of the future generation and transmission projects included in the study base cases can be found in the file connected to the link shown below:

Appendix B: 2026 SEMA-RI Needs Assessment Study Case Future Projects Summary

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Section 9
Appendix C: Case Summaries

Study base case summaries can be found in the files connected to the links shown below:

Appendix C1: Stress A Case Summaries

Appendix C2: Stress B Case Summaries

Appendix C3: Stress C Case Summaries

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Section 10
Appendix D: Contingency List

Appendix D: 2026 SEMA-RI Needs Assessment Study Contingency Summary

Table 10-1: N-1-1 Transmission Line Element-Out Scenarios

Line	kV	Description	BPS Element
342	345	Pilgrim to Canal to Auburn	Yes
322	345	Carver to Canal	Yes
327	345	Brayton Point to Berry Street	Yes
355	345	Carver to Pilgrim	Yes
331	345	West Walpole to Carver	Yes
356	345	Bridgewater to Carver	Yes
399	345	Carver to Bourne to Oak Street	Yes
341	345	Lake Road to West Farnum	Yes
359	345	Kent County to West Farnum	Yes
344	345	West Medway to Bridgewater	Yes
335	345	Holbrook to Auburn Street	Yes
316	345	Stoughton to Holbrook	Yes
3161	345	West Walpole to Stoughton	Yes
3162	345	Stoughton to K Street	Yes
3163	345	Stoughton to K Street	Yes
3164	345	Stoughton to Hyde Park	Yes
3348	345	Killingly to Lake Road	Yes
389	345	West Medway to West Walpole	Yes
325	345	West Medway to West Walpole	Yes
303	345	ANP Bellingham to Brayton Point	Yes
315	345	Brayton Point to West Farnum	Yes
3520	345	ANP Bellingham to West Medway	Yes
333	345	Sherman Road to Ocean State	Yes
336	345	ANP Blackstone to NEA Bellingham to West Medway	Yes
3361	345	ANP Blackstone to Sherman Road	Yes
3271	345	Lake Road to Card Street	Yes
330	345	Lake Road to Card Street	Yes
332	345	West Farnum to Kent County	Yes
328	345	Sherman Road to West Farnum	Yes
347	345	Sherman Road to Killingly	Yes
366	345	Millbury to West Farnum	Yes
107	115	Bourne to Otis to Falmouth Tap	Yes
108	115	Tremont to Wareham to Valley to Manomet to Bourne	Yes
109	115	High Hill to Cross Road to Fisher Road	No
111	115	Industrial Park to High Hill to Dartmouth to Cross Road	No
112	115	Tremont to Rochester to Crystal Spring to Industrial Park to Wing Lane to Arsene to Acushnet	Yes
112-8	115	Acushnet to Pine Street	No
113	115	Tremont to Wareham to Valley to Manomet to Bourne	Yes

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Line	kV	Description	BPS Element
114	115	Tremont to Rochester	Yes
114-5	115	Acushnet to Pine Street	No
115-10-16	115	Middle Street to Potter Station	No
115-16-17	115	Potter Station to TA Watson	No
115-4-8	115	Plain Street to Church Hill	No
115-8-10	115	Middle Street to Church Hill	No
115-9-4	115	Plain Street to Grove Street	No
116	115	Carver to Brook Street	Yes
117	115	Kingston to Duxbury	No
118	115	Barnstable to Lothrop Ave. to Harwich to Orleans	No
119	115	Barnstable to Lothrop Ave. to Harwich to Orleans	No
120W	115	Bourne to Canal	Yes
121	115	Bourne to Canal	No
122	115	Bourne to Pave Paws to Sandwich	No
123	115	Barnstable to Hyannis Junction	No
124	115	Barnstable to Hyannis Junction	No
125	115	Wellfleet to Orleans	No
126	115	Bourne to Canal	Yes
126-501	115	Hopkinton Tap to Hopkinton	No
126-502	115	Hopkinton Tap to Hopkinton	No
127	115	SEMass Tap to Carver	Yes
128	115	SEMass Tap to Tremont	Yes
129	115	SEMass Tap to SEMass	Yes
130	115	Acushnet to Pine Street	No
131	115	Barnstable to Merchants Way	No
132	115	Brook Street to West Pond	No
133	115	Brook Street to West Pond	No
134	115	Tremont to Carver	Yes
135	115	West Barnstable to Barnstable	No
136	115	Falmouth Tap to Mashpee	No
137	115	West Barnstable to Mashpee	No
142	115	Acushnet to Pine Street	No
143	115	Acushnet to Pine Street	No
146-502	115	West Walpole to Walpole	Yes
1505	115	Killingly to Brooklyn to Tunnel	No
1607	115	Killingly to Exeter to Fry Brook to Tunnel	No
1621	115	Killingly to Tracy	No
1742	115	Killingly to Tracy	No
1870	115	Kenyon to Wood River	No
1870N	115	Kenyon to West Kingston	No
1870S	115	Wood River to Shunock	No
191	115	Auburn Street to Kingston to Duxbury to Marshfield	Yes
194	115	Auburn Street to Brook Street	Yes
274-509	115	Medway to Sherborn	No
398-537	115	Holbrook to East Holbrook	Yes
447-508	115	West Walpole to Walpole to Canton to South Randolph to Holbrook	Yes

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Line	kV	Description	BPS Element
447-509	115	West Walpole to Walpole to Canton to South Randolph to Holbrook	Yes
451-536	115	Holbrook to East Holbrook to Auburn Street	Yes
456-522	115	Dover to West Walpole	Yes
478-502	115	Edgar to Swift's Beach to Holbrook	Yes
478-503	115	Edgar to East Weymouth to Hobart Street to Holbrook	Yes
478-508	115	Edgar to East Weymouth to Hobart Street to Holbrook	Yes
478-509	115	Edgar to Mid Weymouth to Grove Street to Holbrook	Yes
495-532	115	Ellis Avenue to Norwood	No
495-533	115	Ellis Avenue to Norwood	No
517-524	115	North Quincy to Dewar Street	No
517-525	115	North Quincy to Dewar Street	No
517-532	115	North Quincy to Field Street to Edgar	No
517-533	115	North Quincy to Field Street to Edgar	No
65-502	115	Medway to West Walpole	Yes
65-507	115	Medway Jct to West Medway	No
65-508	115	Medway to West Walpole	Yes
A24	115	Bridgewater to Easton to Bird Road	No
A94	115	Auburn Street to Avon to Park View	Yes
B23	115	West Farnum to Nasonville	Yes
C-129	115	Beaver Pond to Union Street	No
C-129N / 201-502	115	Beaver Pond to Depot Street to Milford Power to Rocky Hill to Hopkinton to Millbury	Yes
C-129S	115	Union Street to South Wrentham	No
C-181N	115	South Wrentham to North Attleboro to Mansfield to Chartley Pond	No
C-181S	115	Brayton Point to Chartley Pond	Yes
C2	115	Dupont to Auburn	Yes
C3	115	Auburn Street to Plymouth to North Abington to Hanover to Norwell	Yes
D-130 / 201-501	115	Medway to Depot Street to Milford Power to Hopkinton to Millbury	Yes
E105	115	Franklin Square to Hartford Avenue	Yes
E183E	115	Brayton Point to Warren to Mink Street to Wampanoag	Yes
E183W	115	Manchester Street to Phillipsdale to Wampanoag	No
E20 / L1	115	Bridgewater to East Bridgewater to Auburn Street	Yes
F106	115	Franklin Square to Hartford Avenue	Yes
F184	115	Brayton Point to Warren to Bristol to Mink Street to Read Street	Yes
F19 / S1	115	Bridgewater to Belmont to Auburn Street	Yes
G18	115	Dupont to Bridgewater	Yes
G185N	115	Drumrock to Kent County	Yes
G185S	115	Kent County to Old Baptist Road to Davisville to West Kingston	Yes
I187	115	Drumrock to Blackburn to Kilvert to Pontiac Avenue to Lincoln Avenue to Sockanosset	Yes
J16	115	Riverside to Staples	No

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Line	kV	Description	BPS Element
J188	115	Drumrock to Blackburn to Pontiac Avenue to Lincoln Avenue to Sockanosset	Y
K15	115	Swansea to Robinson Avenue	No
K189	115	Drumrock to Kent County	Yes
L14	115	Canonicus to Bent Road to Bates Street to Tiverton to Bell Rock	No
L190	115	Kent County to Old Baptist Road to Davisville to West Kingston	Yes
P11	115	Pawtucket to Valley to Robinson Avenue	No
Q10	115	Robinson Avenue to Staples	No
Q143N	115	Millbury to Whitins Pond to Uxbridge	Yes
Q143S	115	Uxbridge to Woonsocket to Clarkson to Admiral Street to Franklin Square	Yes
R144	115	Woonsocket to Clarkson to Admiral Street to Franklin Square	Yes
R9	115	Riverside to Valley	No
S171	115	Hartford to Johnston to Rise to Ridgewood	Yes
S171N	115	Woonsocket to West Farnum to Farnum Pike to Wolf Hill to Putnam Pike to Hartford Avenue	Yes
S171S	115	Drumrock to West Cranston to Rise to Johnston to Hartford Avenue	Yes
S8	115	Bridgewater to Raynham to Taunton Cleary to Somerset	Yes
S9 / H1	115	Auburn Street to Plymouth to Hanover to Water Street	Yes
T172N	115	Woonsocket to West Farnum to Farnum Pike to Wolf Hill to Putnam Pike to Hartford Avenue	Yes
T172S	115	Hartford Avenue to Johnston to Rise to West Cranston to Drumrock	Yes
T7	115	Somerset to Pawtucket	Yes
U2	115	Stoughton to Parkview to Belmont	No
U6	115	Bridgewater to Raynham to Dighton to Somerset	Yes
V148	115	Woonsocket to Washington to Robinson Avenue to Read Street	Yes
V5	115	Bridgewater to Dighton to Somerset	Yes
W4	115	Swansea to Somerset	Yes
X3	115	Pawtucket to Phillipsdale to Somerset	Yes
Y2	115	Somerset to Hathaway Street	Yes
Z1	115	Somerset to Hathaway Street	Yes
H17	115	West Farnum to Farnum to Riverside	Yes
A94	115	Auburn Street to Park View	Yes
M1	115	East Bridgewater to Mill Street to Middleboro	No
L14	115	Bell Rock to Tiverton to Bates Street to Canonicus to Dexter	No
M13	115	Somerset to Sykes Road to Tiverton to Bell Rock to Bates Street to Canonicus to Dexter	No
D21	115	High Hill to Bell Rock	No
N12	115	Somerset to Sykes Road to Bell Rock	Yes
D911	115	Dupont to Ames Street	Yes
D-182N	115	Berry Street to South Wrentham	Yes

Line	kV	Description	BPS Element
D182S	115	Brayton Point to Mansfield to Sherman Street to North Attleboro to Berry Street	Yes
E1	115	Bridgewater to Middleboro	Yes
1505	115	Killingly to Brooklyn to Fry Brook to Plainfield to Tunnel	Yes
Ridgewood Gen Lead	115	Ridgewood	Yes
3763	69	Jepson to Navy Tap to Newport	No
W23W	69	Northboro Road to Mass Water Resources Authority to Woodside to South Marlboro to Marlboro	No

Table 10-2: N-1-1 Autotransformer Element-Out Scenarios

Autotransformer	kV	Description	BPS Element
Auburn 210X	345/115	Auburn Street 210X Autotransformer	Yes
Auburn 220X	345/115	Auburn Street 220X Autotransformer	Yes
Berry 1X	345/115	Berry Street 1X Autotransformer	Yes
Brayton Point 3XA	345/115/20	Brayton Point 3XA Autotransformer	Yes
Bridgewater 161X	345/115	Bridgewater 161X Autotransformer	Yes
Bridgewater 162X	345/115	Bridgewater 162X Autotransformer	Yes
Canal 120X	345/115	Canal 120X Autotransformer	Yes
Canal 121X	345/115	Canal 121X Autotransformer	Yes
Canal 126X	345/115	Canal 126X Autotransformer	Yes
Carver 345A	345/115	Carver 345A Autotransformer	Yes
Carver 345B	345/115	Carver 345B Autotransformer	Yes
Card 5X	345/115	Card Street 5X Autotransformer	Yes
Holbrook 345A	345/115	Holbrook 345A Autotransformer	Yes
Kent County 3X	345/115	Kent County 3X Autotransformer	Yes
Kent County 4X	345/115	Kent County 4X Autotransformer	Yes

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Autotransformer	kV	Description	BPS Element
Kent County 8X	345/115	Kent County 8X Autotransformer	Yes
Killingly 2X	345/115	Killingly 2X Autotransformer	Yes
West Barnstable 345A	345/115	West Barnstable 345A Autotransformer	No
West Farnum 174T	345/115	West Farnum 174T Autotransformer	Yes
West Farnum 175T	345/115	West Farnum 175T Autotransformer	Yes
West Walpole 345A	345/115	West Walpole 345A Autotransformer	Yes

Table 10-3: N-1-1 Generator Element-Out Scenarios

Generator	Station
ANP Bellingham 1	ANP-Bellingham
ANP Bellingham 2	ANP-Bellingham
ANP Blackstone 1	ANP-Blackstone
ANP Blackstone 2	ANP-Blackstone
Canal 1	Canal
Canal 2	Canal
Cleary 8	Cleary
Cleary 9	Cleary
Dartmouth	Dartmouth
Dighton	Dighton
Edgar	Edgar
Lake Road 1	Lake Road
Lake Road 2	Lake Road
Lake Road 3	Lake Road
Manchester 9	Franklin Square
Manchester 10	Franklin Square
Manchester 11	Franklin Square
Milford Power 2	Milford Power
NEA Bellingham	NEA-Bellingham
Oak Bluffs	Falmouth
Ocean State 1	Ocean State
Ocean State 2	Ocean State
Pawtucket Power	Admiral Street
Pilgrim	Pilgrim
Potter 2	Potter Station
Medway Peaker 1	Medway
Medway Peaker 2	Medway

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Generator	Station
Ridgewood	Ridgewood
Rise	Rise
SEMASS 1	SEMASS
SEMASS 2	SEMASS
Tiverton	Tiverton
TA Watson 1	Potter Station
TA Watson 2	Potter Station
West Medway Jet	West Medway
West Tisbury	Falmouth

Table 10-4: N-1-1 Shunt Device Element-Out Scenarios

Reactive Device	Station	MVAR
115 kV Capacitor	Barnstable	35.3
Static VAR Compensator	Barnstable	112.5
115 kV Reactor R1	Edgar	40.0
115 kV Reactor R2	Edgar	40.0
115 kV Capacitor	Falmouth	35.3
115 kV Capacitor	Franklin Square	37.8
115 kV Capacitor	Harwich	21.2
115 kV Capacitor	Hyannis Junction	39.0
115 kV Capacitor C2	Kent County	63.0
115 kV Capacitor C5	Kent County	144.0
115 kV Capacitor	Mashpee	35.3
115 kV Capacitor	Orleans	13.6
115 kV Reactor R1	Pine Street	10.0
115 kV Reactor R2	Pine Street	10.0
345 kV Stoughton R1	Stoughton	110.0
345 kV Stoughton R2	Stoughton	110.0
345 kV Stoughton R3	Stoughton	110.0
345 kV Stoughton R4	Stoughton	70.0
115 kV Wing Lane	Wing Lane	35.3

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Section 11
Appendix E: Steady State Analysis Results

The complete set of steady state thermal and voltage analysis results can be found in the files connected to the links shown below:

Appendix E1: SEMA-RI 2026 Needs N-1 Thermal Results

Appendix E2: SEMA-RI 2026 Needs N-1 Voltage Results

Appendix E3: SEMA-RI 2026 Needs N-1-1 Thermal Results

Appendix E4: SEMA-RI 2026 Needs N-1-1 Voltage Results

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Section 12
Appendix F: Short Circuit Analysis Results

The complete set of short circuit analysis results can be found in the file connected to the link shown below:

Appendix F: 2026 SEMA-RI Needs Short Circuit Results

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Section 13
Appendix G: NERC Compliance Statement

This report is the first part of a two part process used by ISO-NE to assess and address compliance with NERC TPL standards. This Needs Assessment report provides documentation of an evaluation of the performance of the system as contemplated under the TPL standards to determine if the system meets compliance requirements. If necessary, development of transmission solutions to address criteria violations identified in this Needs Assessment will be handled using either the Solutions Study process or Competitive Solicitation process described in Attachment K of the OATT. This Needs Assessment report and any report documentation developed as part of the solution development process provide the necessary evaluations and determinations required under the NERC TPL standards.

This study provides a detailed assessment of SEMA-RI electric system performance for 2026. The results of this study show a substantial number of violations across the study area: 30 elements showing thermal violations & 19 PTF elements showing voltage violations under N-1 conditions, and 84 elements showing thermal violations & 48 PTF elements showing voltage violations under N-1-1 conditions. As shown in Section 5.5, Critical Load Levels have been identified for these thermal violations from 10,063 MW to 30,307 MW and for the voltage violations from 15,279 MW to 30,228 MW in terms of equivalent net New England load level. As shown in Section 3.1.6, the study includes peak load testing. Shoulder and light load testing was unnecessary for this study area. This study uses normal operating procedures as illustrated by transfers, phase shifter settings and normal capacitor settings. Transfer levels used in this study are as described in Section 3.1.10. Note that while firm transfers are not explicitly modeled or used in New England the system conditions used in this study are always sufficiently stressed to ensure transfer capability across interfaces is maintained. As described in Section 3, this study includes the effects of existing and planned Demand Response, transmission and generation facilities. The study also includes the effects of area reactive resources which were found to provide inadequate voltage support for the next five years and beyond. Planned outages are addressed through testing of numerous generator dispatches. The effects of existing and planned protection systems can be found in Section 3.1.14. ISO New England Operations coordinates and approves planned generator and transmission outages looking out one year. Long term planning studies look at 90/10 load, stressed dispatch and line out conditions that historically provide ample margin to perform maintenance.

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APPENDIX 2-4 EXCERPT FROM ANALYSIS OF DOCKET NO. EFSB 21-04/D.P.U. 21-149

This document has been reviewed for Critical Energy Infrastructure Information (CEII) July 2022.

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December 22, 2021

NSTAR ELECTRIC COMPANY d/b/a EVERSOURCE ENERGY

AND NEW ENGLAND POWER COMPANY d/b/a NATIONAL GRID

Acushnet to Fall River Reliability Project

Analysis to Support the Petition before the Energy Facilities Siting Board

Volume I of III

nationalgrid
EVERSOURCE

PROJECT ID	PROJECT DESCRIPTION
1721	Install a 37.5 MVAR capacitor at Bell Rock, reconfigure Bell Rock to breaker-and-a-half station, split the M13 line at Bell Rock substation, and terminate 114 Line at Bell Rock; install a new breaker in series with N12/D21 tie breaker, and upgrade D21 line switch
1731	Install a 35.3 MVAR capacitor at High Hill substation and install a 35.3 MVAR capacitor at Wing Lane substation

[1] The N12/M13 DCT separation and reconductoring project (Project 1720) addresses different contingencies and is geographically distinct from the Project; therefore, it will be presented separately to the Department of Public Utilities pursuant to G.L. c. 164, § 72.

2.7 Additional Needs Analysis Performed by Eversource and National Grid

To address the changing load forecasts and inconsistency with observed actual loads (see Section 2.7.1), and to serve as a basis for an updated alternatives analysis (since ISO-NE did not issue an updated Solutions Study report), Eversource and National Grid analyzed the performance of the transmission system with all required SEMA-RI upgrades in place except for the Project (ID 1722 and 1730) under: (1) two distinct 2031 load forecast scenarios; and (2) two scenarios representing weather-normalized peak loads experienced in 2020 and 2021. Under each of these additional scenarios, the Companies' analyses confirm that the need for the Project remains.

2.7.1 Load Forecast Scenarios

For consistency with the traditional 10-year horizon used for planning purposes, the Companies examined 2031 load projections for two different net peak load forecasts for the Load Pocket -- (1) the 2021 ISO-NE CELT Forecast; and (2) a forecast that combines internal National Grid and Eversource forecasts for substations within the Load Pocket ("Companies' Forecast").

Table 2.9, below, presents the projected 90/10[8] net load level for the year 2031 for each forecast.

TABLE 2-9 LOAD FORECAST SCENARIOS ANALYZED

LOAD SCENARIO	EVERSOURCE	NATIONAL GRID	TOTAL LOAD
2021 CELT 2031 Forecast	186	217	403
Companies' 2031 Forecast	319	236	555

As illustrated above, there are significant differences between the total loads forecasted by ISO-NE and the Companies, which influence the size and scale of the need for the Project. Most of the difference between the ISO-NE CELT Forecast and the Companies' Forecast is attributable to loads projections for the Eversource portion of the Load Pocket. Table 2.10 below presents a more detailed breakdown of the differences between the Eversource and ISO-NE net load forecasts for the Load Pocket. As can be seen in Table 2.10, the ISO-NE forecast assumes substantially higher peak-hour contributions from both energy efficiency and photovoltaic distributed generation than does the Eversource forecast.

[8] 90/10 load forecast specifies a 10% probability that the forecast could be exceeded.

TABLE 2-10 EVERSOURCE AND ISO-NE 90/10 FORECAST COMPARISONS

EVERSOURCE					ISO-NE				
Year	Gross Load	EE	PV	Net Load	Year	Gross Load	EE	PV	Net Load
2022	298.7	-4.2	-3.5	290.9	**2022**	298.0	-30.7	-42.6	224.7
2023	301.3	-4.8	-4.0	292.5	**2023**	299.9	-32.6	-47.8	219.5
2024	303.3	-5.4	-4.1	293.7	**2024**	301.9	-34.4	-51.6	215.9
2025	305.1	-6.0	-4.1	295.0	**2025**	304.6	-37.9	-55.4	211.3
2026	307.1	-6.6	-4.1	296.4	**2026**	290.6	-39.3	-59.1	192.2
2027	309.3	-7.2	-4.1	298.0	**2027**	292.9	-41.9	-62.1	188.9
2028	311.7	-7.8	-4.1	299.8	**2028**	295.2	-44.0	-64.2	187.1
2029	314.2	-8.4	-4.1	301.7	**2029**	299.7	-45.8	-66.2	187.7
2030	316.9	-9.0	-4.1	303.8	**2030**	303.1	-47.1	-68.2	187.8
2031	318.7	-9.0	-4.1	305.6	**2031**	304.1	-47.7	-70.2	186.2

Notes: EE = Energy Efficiency; PV = photovoltaic.

A similar disparity between the ISO-NE and Eversource forecasts was examined extensively by the Department of Public Utilities (the “Department”) in Docket No. D.P.U. 20-67. As explained during that proceeding, two major drivers of this disparity are: (1) the timing of the peak load, which affects the assumed levels of output from photovoltaic distributed generation in the load pocket; and (2) certain simplifying assumptions made by ISO-NE with respect to the physical location of certain photovoltaic resources and energy efficiency measures. These same factors have created a gap between ISO-NE and Eversource forecasts for the Load Pocket.

With respect to the timing of peak load, ISO-NE examines peak load at the hour coincident with the time of the regional system peak load. Since 2017, this coincident peak has occurred at the hour ending 17:00 or 18:00. Based on the timing of this coincident peak, ISO-NE assumes that the output of photovoltaic (“PV”) distributed generation for which it has locational information (1.0 MW and above) is 26% at the time of peak.

In contrast, Eversource forecasts the SEMA region using actual Eversource SEMA coincident peak load values from the prior year as a baseline. This actual coincident peak load falls later in the day than the regional peak, and thus at a time when the PV output is much less significant. In recent years, the Eversource portion of the Load Pocket has peaked at or near the hour ending 19:00, at which time the output of PV distributed generation is approximately 9%. This results in a substantially lower contribution from PV distributed generation on peak.

In D.P.U. 20-67, Eversource also identified assumptions regarding the location of PV and energy efficiency (“EE”) that contribute to the disparity in forecasts. For PV for which ISO-NE does not have locational information (less than 1.0 MW and future PV), ISO-NE allocates the statewide levels on a bus-by-bus basis proportional to the gross load at the buses. ISO-NE similarly allocates statewide projections of EE on a bus-by-bus basis, since locational information is not available. In both cases, this tends to lead to higher levels of PV and EE penetration in the Load Pocket than modeled by Eversource.

For the National Grid portion of the Load Pocket, the difference between the National Grid and the ISO-NE 2031 Load Pocket forecasts is 19 MW, or about 8%. This difference is attributable to similar factors, including more granular forecasts of peaks in specific load zones, and the use of Company-specific information and methodologies for forecasting energy efficiency, solar PV, electric vehicles, electric heat pumps, energy storage, and Company-run demand response programs. Like Eversource, National Grid adjusts the assumed PV contribution based on the anticipated hour of peak load. In 2020, this part of National Grid's service territory peaked in the hour ending at 18:00, when the PV contribution is assumed to be 16% of nameplate). In 2021, this part of the service territory peaked in the hour ending at 19:00.

2.7.2 Comparison with Actual and Weather-Adjusted Loads

A comparison of ISO-NE forecasts with recent load data confirms that, even in the very short term, the CELT Forecast is not a good predictor of peak loads within the Load Pocket. Table 2.11 compares actual and weather-adjusted peak loads for 2020 and 2021 for the Load Pocket to the ISO-NE projected 2021 load from the 2020 CELT Report. As can be seen from Table 2.11, the 2021 CELT Forecast for the Load Pocket (450 MW) is well below the actual net peak loads experienced in the Load Pocket in both 2020 and 2021. It falls even further below the 2020 and 2021 weather-adjusted peak loads, which represent the net peak load that would have been expected had 90/10 weather been experienced in either year.

TABLE 2-11 NET PEAK LOADS (MW)

	2020 CELT	REAL TIME NET LOADS		WEATHER-ADJUSTED NET LOADS	
	2021 Forecast (90/10)	2020 Peak (8/28/2020)	2021 Peak (8/26/2021)	2020 Peak (8/28/2020)	2021 Peak (8/26/2021)
Eversource	230	275	257	300	278
National Grid	220	218	210	228	236
Total Load	450	493	467	528	514

Moreover, ISO-NE's forecasts show declining loads within the Load Pocket over time, resulting in a peak forecast of only 403 MW for the Load Pocket in 2031 – 111 MW, or 22%, lower than the 2021 weather-adjusted peak. This projection appears inconsistent with the Commonwealth's plans for increasing electrification within Massachusetts. The 2020 and 2021 Weather-Adjusted scenarios analyzed below show the anticipated transmission system impacts of 90/10 weather at present-day load levels.

2.7.3 Results of Scenario Analysis

Table 2.12 provides the thermal loading violations identified in the Companies' analyses for: (1) the 2031 ISO-NE forecast load based on the 2021 CELT; (2) the 2020 weather-adjusted peak load; (3) the 2021 weather-adjusted peak load; and (4) the Companies' 2031 internal forecast load. As shown in Table 2.12, large thermal overloads were observed on segments of Eversource's 115-kV Lines 111 and 112 for all instances under N-1-1 contingency conditions. These overloads will be addressed by the Project.

TABLE 2-12 N-1-1 THERMAL OVERLOADS

OVERLOADED ELEMENT	LTE RATING (MVA)	THERMAL LOADINGS (% LTE)			
		2031 ISO-NE Forecast (based on 2021 CELT)	2020 Weather-Adjusted Load	2021 Weather-Adjusted Load	2031 Companies' Forecast
		Load Pocket 403 MW	Load Pocket 528 MW	Load Pocket 514 MW	Load Pocket 555 MW
Industrial Park - Industrial Park Tap 115-kV (Line 112)	246	114%	148%	146%	N/A[1]

OVERLOADED ELEMENT	LTE RATING (MVA)	THERMAL LOADINGS (% LTE)			
		2031 ISO-NE Forecast (based on 2021 CELT)	2020 Weather-Adjusted Load	2021 Weather-Adjusted Load	2031 Companies' Forecast
		Load Pocket 403 MW	Load Pocket 528 MW	Load Pocket 514 MW	Load Pocket 555 MW
Industrial Park – High Hill 115-kV (Line 111)	243	107%	132%	132%	N/A

Notes: LTE = Long-time Emergency; MVA = megavolt ampere; MW = megawatt; kV = kilovolt.
[1]The thermal overloads for the 2031 Companies' Forecast scenario cannot be specified because the voltage collapses in the Load Pocket and the power flow case does not solve in the Companies' modeling.

Table 2.13 provides the voltage results for Companies' analyses for the same four instances shown in Table 2.12. The table shows acceptable voltages for the 2031 ISO-NE forecast load based on the 2021 CELT Report and for the 2020 and 2021 weather-adjusted peak loads. However, under N-1-1 conditions, the Companies' 2031 forecast load reveals that total voltage collapse[9] in the Load Pocket is a substantial risk. The risk of voltage collapse will also be fully addressed by the Project.

TABLE 2-13 N-1-1 VOLTAGE RESULTS

Load Pocket Buses	2031 ISO-NE Forecast (based on 2021 CELT)	2020 Weather-Adjusted Load	2021 Weather-Adjusted Load	2031 Companies' Forecast
	Load Pocket 403 MW	Load Pocket 528 MW	Load Pocket 514 MW	Load Pocket 555 MW
115-kV Bus Voltage	Acceptable	Acceptable, but approaching voltage collapse	Acceptable, but approaching voltage collapse	Voltage Collapse

Additional sensitivity analysis was performed in order to determine the minimum load levels within the Load Pocket that would result in low voltages and voltage collapse. These load levels are known as Critical Load Levels ("CLLs"). The CLLs are determined by scaling (increasing) the load from an initial load level to a level that results in low voltages and then voltage collapse. Using both the 2020 and 2021 weather-adjusted loads as starting points yields two different sets of CLLs. Based on these starting points, the low voltage CLL is in the range of 526-534 MW, while the voltage collapse CLL is in the range of 549-555 MW. The reason the CLLs vary depending on the starting load point is that the load distribution across the Load Pocket substations vary between the 2020 and 2021 weather-adjusted loads.[10]

To summarize, under all forecasts, N-1-1 contingencies could lead to thermal overloads on Eversource's 115-kV Lines 111 and 112; however, load levels just slightly higher than 2021 actual peak loads, adjusted for weather, could lead to low voltages and, at load levels consistent with the Companies' Forecast for 2031, complete voltage collapse. Voltage collapse would lead to the loss of service to as many as 161,000 electric customers across the 16 communities in the Load Pocket.

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[9] Voltage collapse occurs when the power system is not electrically strong enough to support the amount of power that must be transferred into a load pocket to supply its electrical load. It can be thought of as a "breaking point." As the load in the pocket increases, the power transfer must also increase, which causes the voltage to drop. When the voltage drops, the power system becomes weaker. At a certain point, the system becomes so weak that it "breaks," as the voltage collapses and the power transfer ceases. When this happens, the electric load is dropped and the load pocket "blacks out."

[10] The differences in the load distributions are due to differences in load components across the substations or the additions of new "spot loads." The load components include gross load, energy efficiency, solar, and demand reduction. Spot loads are new large loads that could include a large shipping distribution center, a manufacturing facility, a hospital, etc.

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APPENDIX 4-1 NATIONAL GRID ENVIRONMENTAL GUIDANCE DOCUMENT (EG-303NE)

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PURPOSE/OBJECTIVE:
This document provides National Grid personnel, consultants and contractors with Best Management Practices (BMPs) for conducting work on electric and natural gas transmission and distribution rights-of-ways (ROWs) and substations in New England.

WHO:
These BMPs are to be followed by all personnel conducting work on Company electric and gas ROWs and substations in New England. These BMPs do not apply to Company employees and contractors performing routine vegetation management activities that are not a part of construction or re-construction projects. Employees and contractors maintaining vegetation on Company ROWs and substations must follow the National Grid ROW Vegetation and Substation Vegetation Management Plans.

DEFINITIONS:

Refer to **Glossary** in **Appendix 1** and **Acronyms** in **Appendix 2**.

WHAT TO DO:

1.0 Project Planning

Prior to the start of any project (proposed new facilities or maintenance of existing facilities), the Project Engineer or other project planner shall determine whether any environmental permits or approvals are required, per the state-specific EG-301 environmental checklists. Any questions regarding which activities may be conducted in regulated areas or within environmentally sensitive areas shall be referred to the National Grid Environmental Scientist or Project Environmental Consultant.

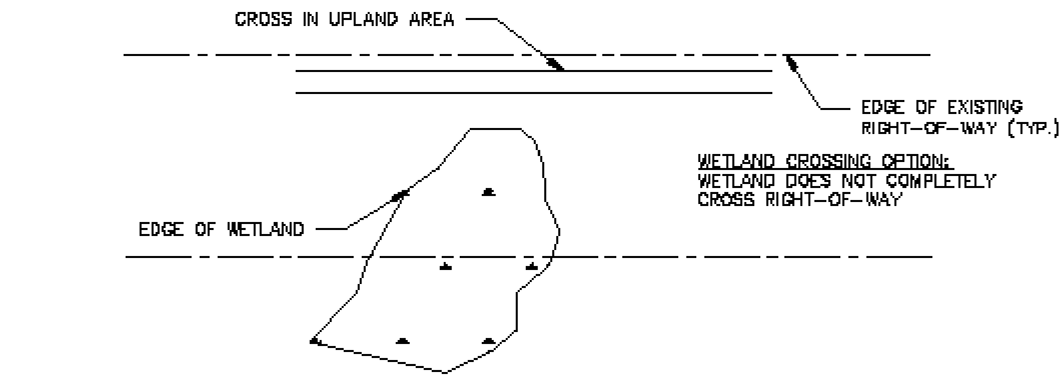
All new construction and maintenance projects shall follow clear and enforceable environmental performance standards, which is the purpose for which these BMPs have been compiled.

1.1 Avoidance and Minimization

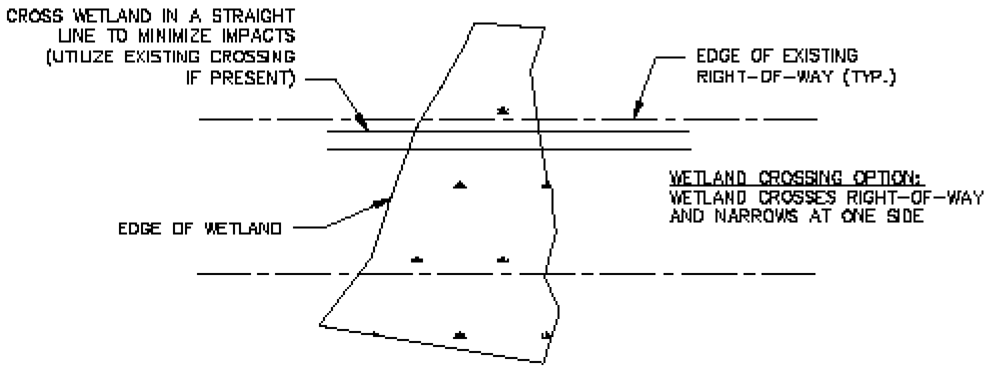
Measures shall always be taken to avoid impacts to wetlands, waterways, rare species habitats, known below and above ground historical/archeological resources and other environmentally sensitive areas. If avoidance is not possible, then measures shall be taken to minimize the extent of impacts. Alternate access routes or staging areas shall always be considered. Below is a list of methods that shall be considered where impacts are unavoidable:

- Use existing ROW access where available. Keep to approved routes and roads without deviating from them or making them wider.
- Off-ROW access shall never be assumed and shall be coordinated through National Grid Real Estate before being implemented.
- Where no existing ROW access is present, avoid wetlands and if a wetland crossing is necessary, cross wetlands at the most narrow point possible or at the location of a previously used crossing (if evident). Figure 1 below illustrates this minimization technique.

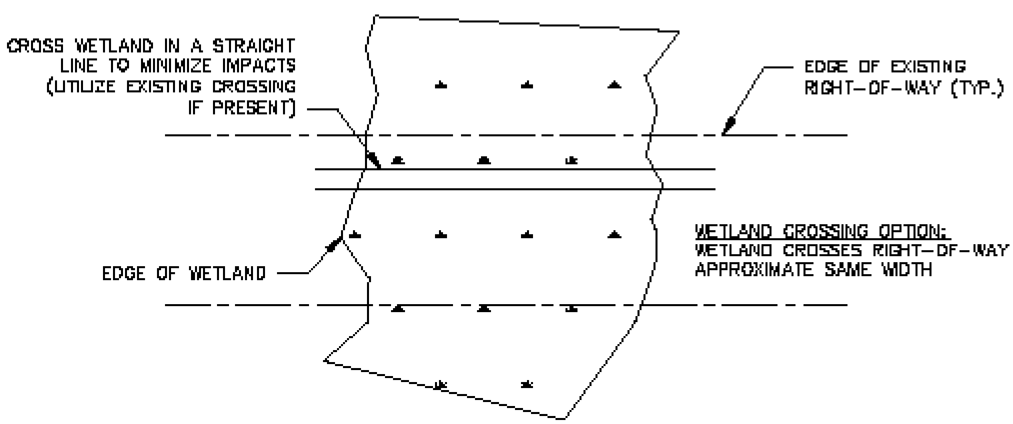
- Avoid and minimize stream crossings.
- Minimize the width of typical access roads through wetlands to a maximum width of 16 feet.
- Conduct work manually (without using motorized equipment) in wetlands, wherever possible.
- Use construction mats in wetlands to minimize soil disturbance and rutting when crossing or working within wetlands. When not using mats for access, standard vehicles shall not be allowed to drive across wetlands without the prior approval of the National Grid Environmental Scientist. Use of a low ground pressure (LGP) vehicle may be a feasible alternative to mats provided that such LGP vehicle use has been reviewed and approved by the National Grid Environmental Scientist. See Section 7.0.
- Coordinate the timing of work to cause the least impacts during the regulatory low-flow period under normal conditions, when water/ground is frozen, after the spring songbird nesting season, and, outside of the anticipated amphibian migration window (mid-February to mid-June). Refer to the United States Army Corps of Engineers (USACE) state-specific General Permit for the definition of the low-flow period in each state at: http://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/. A summary table is provided in Section 7.0.
- Seek alternative routes or work methods to minimize impact.



WETLAND AVOIDANCE
FIGURE 1a – AVOIDANCE



WETLAND AVOIDANCE
FIGURE 1b – MINIMIZATION
(CROSSING AT NARROWEST LOCATION)



WETLAND AVOIDANCE
FIGURE 1c – MINIMIZATION
(CROSSING UNIFORM WIDTH IN A STRAIGHT LINE)

1.2 Historically Significant Areas

Areas that have been identified as historically and/or culturally significant shall be avoided in accordance with site-specific avoidance plans, as applicable. Refer to the project-specific Environmental Field Issue (EFI) for any applicable avoidance plans or consult with the National Grid Environmental Scientist. Demarcation of these areas to be avoided shall use staked orange snow fencing or an equivalent physical barrier (not just ribbon flagging) and signage. Refer to Section 14.0 for signage guidance.

1.3 Rare Species Habitat

Work within areas that have been identified as mapped rare species habitat shall follow site-specific requirements, as applicable. In Massachusetts, maintenance activities within mapped habitat (known as Priority Habitat of Rare Species) shall follow the BMPs outlined in the Natural Heritage Endangered Species Program (NHESP)-approved National Grid Operation and Maintenance Plan. Work in mapped rare species habitat may require, at a minimum, turtle training for crews and sweeps of work areas for turtles, botanist identification of rare plant locations and avoidance of these locations, and protection of vernal pools, all prior to the start of work. Demarcation of these areas to be avoided (e.g., rare plant populations, overwintering turtles, nests) shall use staked orange snow fencing or an equivalent physical barrier (not just ribbon flagging) and signage. Refer to Section 14.0 for signage guidance.

Where new substations are being constructed or existing substations are undergoing a rebuild or expansion, and the substations are located in mapped rare turtle habitat, project team members should consider fenceline improvements or measures needed to prevent/eliminate turtle entrance into the substation or allow multiple points for easy egress such that turtles are not trapped within the substation fenceline.

Other requirements may apply in NH, VT and RI. Refer to the project-specific EFI for any applicable measures or consult with the National Grid Environmental Scientist.

1.4 Meetings

Pre-permitting meetings shall take place early in the project development process to determine what permits are triggered by the proposed work and the timeline required for permitting. During these meetings, the team shall develop access plans and BMPs to be used during construction of the project.

Field / Constructability review meetings shall take place on-site to evaluate construction site access and job site set-up, to ensure that the project can proceed as permitted. It is at this point in time where work areas, pulling locations, laydown areas, parking areas, and equipment storage areas are evaluated and located. Off-ROW areas under consideration should be included in this discussion.

Prior to submitting permit plans to regulatory authorities, the construction group (contractor or National Grid) shall review the plans for final sign off.

Pre-construction meetings are typically held prior to the commencement of all work to appoint responsible parties, discuss timing of work, and further consider options to avoid and/or minimize impacts to sensitive areas. These meetings can occur on- or off-site and shall include all the willing and available stakeholders (i.e., utility employees, contractors, consultants, inspectors, and/or monitors, and regulatory personnel). Training of crews and supervisors of the EFI, Stormwater Pollution Prevention Plan (SWPPP), rare species, and other permit requirements shall be conducted at a pre-construction meeting.

Pre-job briefings shall be conducted daily or otherwise routinely scheduled meetings shall be conducted on-site with the work crew throughout the duration of the work. These meetings are a way of keeping everyone up to date, confirming there is consensus on work methods and responsibilities, and ensuring that tasks are being fulfilled with as little impact to the environment as possible.

The Project Environmental Scientist/Monitor and Construction Project Manager shall communicate regularly (e.g. weekly or bi-weekly meetings or phone conversations) to discuss the work completed since last communication (i.e. work locations, wetland impacts, equipment used, and unexpected delays or work conditions). These meetings or calls shall include the expected schedule of construction for the upcoming week, the long term construction plans, and planned methods for working near/in wetlands. Both the Project Environmental Scientist/Monitor and Construction Project Manager shall work together so the Project complies with all environmental permits and regulations. When changes to the Project scope or agreed work plan are proposed they shall be done so with the final approval of the National Grid Environmental Scientist.

1.5 Communication of Project Specific Environmental Requirements

Project specific environmental concerns, to include sensitive resources, permits, approved access and time-of-year or other restrictions, shall be communicated to the project team and be included as part of the Pre-Bid and Pre-Construction Meetings. Project specific requirements shall be communicated to the project manager/construction manager/engineering group using the following guidelines:

<u>Environmental Field Issue</u> – The EFI will be a full document consisting of narrative, project permits, access and matting plans. A table summarizing pertinent (but not all) permit conditions and the responsible party for those conditions shall be included in the EFI. Copies of all permits should be included as attachments. This will be prepared for most projects with multiple permits or large, complex projects (siting board, Section 404, 401 WQC, SWPPP). There shall be EFI training at the pre-construction meeting. The National Grid EFI template is located in **EI-303NE**.

<u>Simplified Environmental Field Issue</u> – The Simplified EFI is a memorandum containing environmental resources present, project permit(s), access and matting plans and a table summarizing relevant permit conditions and responsible party for those conditions. Copies of all permits should be included as attachments. The Simplified EFI will be prepared for most projects with 1 or 2 permits (Order of Conditions, S404 Cat 1). The Simplified EFI should also be provided for projects that have environmental resources present, but the scope of the project does not trigger environmental permitting (e.g., the scope of work qualifies for maintenance exemption(s)). The resources present

shall be discussed at the Pre-Bid and Pre-Construction meetings and any changes in scope will require additional review by the National Grid project team.

E-mail delivery of Permit and any Sediment/Erosion control or BMP plan – For those projects with only one permit (eg., MA Order of Conditions, RI DEM permit, RI CRMC permit, NH Utility Notification) or projects with a sediment & erosion control plan (local town requirement or for exempt maintenance work), a copy of the permit and any applicable plan will be emailed to the Project Manager (and the project team where deemed necessary) to be incorporated into the Construction Field Issue.

STORMS work management system input – For STORMS work, no EFI is prepared unless multiple permits are required for the project (see guidance above). If only a MA Order of Conditions, MA Determination of Applicability, RI DEM permit, RI CRMC permit, RI SESC Approval, or NH Utility Notification is required, then the permit is attached in the Documents tab and conditions noted in Remarks/Comments section. Standard STORMS boilerplate language is located in **EI-303NE**.

1.6 Timing of Work

Regulatory authorities may place seasonal or time-of-year restrictions on project construction elements. These time-of-year restrictions may be state or permit-specific, and shall be adhered to.

Work during frozen conditions. Activities conducted once wetland areas are frozen sufficient to minimize rutting and other impacts to the surrounding environment may be authorized by the National Grid Environmental Scientist. Work during this time also generally reduces disturbance of aquatic and terrestrial wildlife movement by avoiding sensitive breeding and nesting seasons. When not using mats for access, vehicles shall not be allowed to drive across wetlands without the prior approval of the National Grid Environmental Scientist.

Work during the regulatory low-flow period. Conducting work during the low-flow period can reduce impacts to surface water and generally avoids spawning and breeding seasons of aquatic organisms. If the water is above normal seasonal levels, adjustments to work activities and methods are required.

1.7 Alternate Access

1.7.1 Manual Access

In some cases such as for smaller projects, work areas can be accessed manually. This includes access on foot through upland and shallow wetland areas, access by boat through open water or ponded areas, and climbing of structures where possible. Smaller projects, such as repair of individual structures, or parts of structures, that do not categorically require the use of heavy machinery, shall be accessed manually to the greatest extent practicable.

1.7.2 Use of Overhead/Aerial Access

Using helicopters can be expensive and is not always feasible, but it may be appropriate in some situations in order to get workers and equipment to a site that otherwise may be very difficult to access. The use of overhead and/or aerial equipment may be beneficial for work in areas where larger water bodies, deep crevices, or mountainous areas hinder ground access. The landing area for helicopters shall be reviewed for environmentally sensitive resources. Use of helicopters requires Project Manager and Senior Management approval.

2.0 Inspection, Monitoring and Maintenance

All construction practices and controls shall be inspected on a regular basis and in accordance with all applicable permits and local, state, and federal regulations to avoid and correct ANY damage to sensitive areas.

The construction crews shall be responsible for completing daily inspections, and IMMEDIATELY bring any **damage or observed erosion, or failed erosion controls** to the attention of the Person-In-Charge and the National Grid Environmental Scientist. Where applicable and/or as directed by environmental permits issued for the project, the Project Environmental Consultant shall conduct weekly (at a minimum) inspections of the project work areas and shall document their inspection using the Stormwater, Wetlands & Priority Habitat Environmental Compliance Site Inspection / Monitoring Report form found in **Appendix 3** and issue the report within 24 hours. The Person-in-Charge shall work with the National Grid Environmental Scientist and the Project Environmental Consultant to determine when and how the repairs shall be made.

Project-specific Action Logs and Long-Term Restoration Logs are prepared as needed by the National Grid Environmental Scientist or the Project Environmental Consultant to track issues and/or repairs and assign responsible parties.

3.0 Best Management Practices

The BMP sections presented in this EG address access, construction, snow and ice management, structures in wetlands, access road maintenance and repair, clean-up and restoration standards, ROW gates, field refueling and maintenance operations, management of spills/releases, and a summary of key construction BMPs.

Note that BMPs shown on any permit drawings for a specific project may need to be revised and or supplemented during the execution of a project based on unforeseen or unexpected factors such as extreme weather or unknown subsurface conditions. It is the responsibility of the Contractor to work with the National Grid Environmental Scientist and/or the Project Environmental Consultant to identify necessary changes and to ensure that construction-related impacts to wetlands, water bodies and other environmentally sensitive areas are avoided.

Any deviation from the approved BMPs shown in the EFI and/or SWPPP plans shall be communicated immediately to the National Grid Environmental Scientist as it may require additional permitting or could result in a permit violation.

3.1 Wetland Boundary Demarcation

Prior to the start of any activity conducted under an environmental permit, wetland boundaries shall be reviewed. Flagging for wetland boundaries, stream banks and other resource areas shall be refreshed as needed. This may become particularly important when the original flagging was placed in previous seasons and now may have become obscured.

3.2 Sedimentation and Erosion Controls

Appropriate sedimentation and erosion control devices shall be installed at work sites, in accordance with permit conditions and/or regulatory approvals, and as needed to prevent adverse impacts to water resources and adjacent properties.

The overall purpose of such controls is to prevent and control the movement of disturbed soil and sediment from work sites to adjacent, undisturbed areas, and particularly to water resources, public roads and adjacent properties. All proprietary controls shall be installed per manufacturer's recommendations and specifications.

Appropriate sedimentation and erosion control devices include but are not limited to: silt fencing, straw bales, wood chip bags, straw wattles, compost socks, erosion control blankets, mulch, slope interruption practices, flocculent powder/blocks and storm drain/catch basin inlet protection. Such controls shall be installed between the work area and environmentally sensitive areas such as wetlands, streams, drainage courses, roads and adjacent property when work activities shall disturb soils and result in a potential for causing sedimentation and erosion.

In Massachusetts, use of monofilament-encased wattles shall be avoided in mapped Priority Habitat for snakes and amphibians. For projects with work within mapped Priority Habitat for snakes and amphibians, wattles that are encased in a sock, hemp, fiber, or movable jute netting are required to prevent entrapment. Also, "wildlife gaps" should occur every 50 feet, if possible, given wetland permit conditions. This spacing of the wattles allows snakes and amphibians to move across the ROW. Refer to the Amphibian and Reptile BMPs in **Appendix 4**.

Staked straw bales often serve as the demarcation of the limits of work and/or sensitive areas to be avoided. Work shall never be conducted outside the limit of erosion controls without prior approval from the National Grid Environmental Scientist.

Project plans depict proposed erosion controls, however field conditions may warrant additional practices be implemented (e.g., wet conditions, frozen conditions, poorly drained soils, steep slopes, materials used for work pads, transition areas to construction mats, number of trips across work areas, etc.).

Any deviation from the approved erosion controls shown in the EFI and/or SWPPP plans needs to be communicated immediately to the National Grid Environmental Scientist as it may require additional permitting or result in a permit violation.

Appendix 4 provides typical sketches of common sedimentation and erosion controls. If a SWPPP is required for the project, maintenance and inspection of erosion controls shall follow the SWPPP requirements. Sedimentation and erosion controls shall be properly maintained and inspected on a periodic basis, until work sites are properly stabilized and restored. Inspections shall be documented using the Inspection Form “Storm Water, Wetlands & Priority Habitat Environmental Compliance Site Inspection/Monitoring Report” (**Appendix 3**).

The sequence and timing of the installation of sedimentation and erosion control measures is critical to their success. Sedimentation and erosion controls shall be installed prior to commencing construction activities that may result in any soil disturbance or cause otherwise polluted site runoff. Inspection of these devices may be required by the National Grid Environmental Scientist or by regulators prior to the start of work. The installation of water bars and other erosion control measures shall be installed shortly thereafter.

3.3 Concrete Wash Outs

Concrete wash outs shall be used for management of concrete waste. Concrete and concrete washout water shall not be deposited or discharged directly on the ground, in wetlands or waterbodies, or in catch basins or other drainage structures. Where possible, concrete washouts shall be located away from wetlands or other sensitive areas. Consult the National Grid Environmental Scientist on proposed concrete wash out locations prior to their use. Following the completion of concrete pouring operations, the wash outs shall be disposed of off-site with other construction debris. Refer to BMPs in **Appendix 4**.

3.4 Construction Activities in Standing Water

The use of silt curtains or turbidity barriers may be required when working in or adjacent to standing water such as ponds, reservoirs, low flowing rivers/streams, or coastal areas. Silt curtains and turbidity barriers prevent sediment from migrating beyond the immediate work area into the resource areas.

Coffer dams constructed using sheet piling or large sandbags (Trade names such as “the Big Bag” or “DamItDams”) may be used to temporarily isolate and contain a work area in standing water.

When working in standing water, an oil absorbent boom, in addition to a silt curtain or other temporary barrier, shall be placed around the work area for spill prevention.

Work in drinking water reservoirs or other waters may require extensive regulatory agency review, even for maintenance work, which could result in additional time required for permitting, review and material procurement prior to the start of work.

3.5 Dewatering

Where excavations require the need for dewatering of groundwater or accumulated stormwater, the water shall be treated before discharge. Appropriate controls include dewatering basins, flocculent blocks, filter bags, filter socks, or weir tanks. Schematics of these BMPs are included in **Appendix 4**. Water trucks or fractionation tanks may be utilized if watertight containers are desired for controlled on-site discharge or for off-site discharge into an approved dewatering area when site restrictions make it difficult to utilize other dewatering methods on-site. Dewatering discharge water shall never be directed into wetlands, streams/rivers, other sensitive resource areas, catch basins, other stormwater devices, or substation Trenwa trenches. Dewatering flow shall be controlled so that it does not cause scouring or erosion through the use of a dewatering basin, filter sock, or equivalent. If it is determined that the chosen controls are not appropriately filtering the fine sediment from the dewatering pumpate then the National Grid Environmental Scientist shall be notified immediately and the controls shall be revised or supplemented.

When establishing a dewatering basin, consideration should be given to the anticipated volume of water and rate of pumping in determining the size of the dewatering basin. Dewatering basins shall be constructed on level ground. Once pumping commences, the basin shall be monitored frequently to assure that the rate of water delivery to the structure is low enough to prevent water from flowing, unfiltered, over the top of the basin walls. The basin shall be monitored throughout the dewatering process because the rate of filtration shall decrease as sediment clogs the filter fabric. If the basin is not appropriately filtering the fine sediment from the dewatering pumpate then the basin may need to be supplemented with a flocculent block. Field conditions shall dictate how often the basin should be inspected.

Distance to sensitive areas, direction of flow (toward or away from protected, or sensitive areas, such as wetlands, ponds, or streams), amount of vegetative ground cover between the basin and nearby sensitive areas, ground conditions (ledge, frozen, etc.), volume of water being pumped, and pump-rate, are some of the factors to be considered when determining an inspection frequency. Clogged filter fabric shall be replaced and accumulated sediment shall be removed as necessary from the basins to maintain efficacy.

Any new dewatering location (not previously reviewed and approved by the National Grid Environmental Scientist during project planning or permitting) shall be reviewed and the discharge location approved by the National Grid Environmental Scientist before use.

Complex projects that require large scale dewatering shall require individual review by the National Grid Environmental Scientist and may trigger additional permitting.

Dewatering in areas of known chemical contamination may require a separate NPDES permit, or other approval, and treatment or containment system. Consult with the National Grid Environmental Scientist.

3.5.1 Overnight Dewatering

Some projects may necessitate 24-hour dewatering for on-site construction activities. Overnight dewatering will be evaluated on a case-by-case basis by the National Grid Environmental Department.

If it is necessary to conduct overnight dewatering on a project, a dewatering plan must be submitted to the Environmental Department for review and approval **5 business days prior to beginning dewatering activities**. Sufficient knowledge of flow, discharge, and re-infiltration rate of water must be obtained and submitted for review. The Environmental Department may require monitored dewatering for a period of time in order to provide this data in support of a request for 24-hour dewatering. The dewatering plan must include at a minimum:

1. Location of dewatering system, system components (basin, frac tank, etc), and materials.
2. Location of discharge and distance from closest wetland.
3. Location of erosion controls. A secondary perimeter of erosion controls will be required around the dewatering system for overnight dewatering.
4. Peak flow, discharge rate and re-infiltration rates.
5. Visual monitoring plan for discharge. Expected duration of dewatering.
6. Emergency provisions if overnight, unattended dewatering is proposed.

3.5.2 Dewatering Clean Up/Restoration

Basins shall be cleaned and removed as soon as dewatering is complete. Sediment removed from the dewatering basin shall be allowed to dry before being disposed of by evenly spreading it over unvegetated upland areas where erosion is not a concern if clean or removing it from the site for proper disposal. Off-site trucking of wet soils is prohibited. The sediment disposal area shall be approved by the National Grid Environmental Scientist or the Project Environmental Consultant prior to use. Stabilization measures shall also need to implemented and approved by the National Grid Environmental Scientist or the Project Environmental Consultant. Soils/sediments shall be dewatered and dried to the point practicable for either on-Site reuse or off-Site transport.

3.6 Check Dams

Check dams are a porous physical barrier installed perpendicular to concentrated storm water flow. They are used to reduce erosion in a swale by reducing runoff energy (velocity), while filtering storm water, thereby aiding in the removal of suspended solids.

Check dams should only be used in small drainage swales that shall not be overtopped by flow once the dams are constructed. These dams should not be placed in streams. Check dams are typically installed in ROWs or on other construction sites prior to the start of soil disturbing work. Per the Rhode Island Soil Erosion and Sediment Control Handbook, no formal design is required for a check dam if the contributing drainage area is 2 acres or less and its intended use is shorter than 6 months; however, the following criteria should be adhered to when specifying check dams.

- The drainage area of the ditch or swale being protected should not exceed 10 acres.
- The maximum height of the check dam should be 2 feet.
- The center of the check dam must be at least 6 inches lower than the outer edges.
- The maximum spacing between the dams should be such that the toe at the upstream dam is at the same elevation as the top of the downstream dam.

Per the NHDES stormwater manual, the use of check dams should be limited to swales with longitudinal slopes that range between 2 to 5 percent that convey drainage from an area less than 1 acre. Existing conditions that exceed these limitations should be assessed in the field and discussed with the National Grid Environmental Scientist to determine the viability of this BMP for the specific application. Check dams are often comprised of stone, straw bales, sand bags, or compost/silt socks. Use of check dams should be coordinated with the National Grid Environmental Scientist to ensure that the material selection, spacing and construction method are appropriate for the site. Check dams composed of biodegradable materials (e.g. straw bales or wattles, wood chip bags) may require periodic replacement for continued proper functioning[1]. Refer to BMPs in **Appendix 4**.

3.7 Water Bars

Water bars should be used on sloping ROWs to divert storm water runoff from unstabilized or active access roads when needed to prevent erosion. Surface disturbance and tire compaction promote gully formation by increasing the concentration and velocity of runoff. Water bars are constructed by forming a ridge or ridge and channel diagonally across the sloping ROW. Each outlet should be stable. The height and side slopes of the ridge and channel are designed to divert water and to allow vehicles to cross. When siting water bars, consideration shall be given to the sensitivity of the area receiving the diverted runoff. For example, runoff should not be directed into a wetland, waterbody, other environmentally sensitive areas, or to private property or public roadways. Refer to BMPs in **Appendix 4**.

3.8 Retaining Walls

In some situations, retaining walls comprised of concrete blocks, gabions, boulders or other comparable materials may be required to stabilize the shoulder of existing access roads and/or supplement required erosion controls. Installation of such measures shall not be allowed as a maintenance activity. Should these controls be considered for a project, it shall be reviewed by the National Grid Environmental Scientist, as design and additional permitting may be required.

3.9 Slope Stabilization

Temporary slope stabilization practices help to keep exposed, erodible soils stabilized while vegetation is becoming established. Acceptable temporary slope stabilization practices may include the use of erosion control blankets, or hydraulic erosion control. Erosion control blankets, often comprised of natural fibers (e.g., jute, straw, coconut, or other degradable materials) are a useful slope stabilization, erosion control and vegetation establishment practice for ditches or steep slopes. Blankets are typically installed after final grading and seeding for temporary or permanent seeding applications. Hydraulic erosion control practices, including Bonded Fiber Matrix or hydroseed with a soil stabilizer (e.g., tackifier and/or mulch) may be an acceptable or desirable alternative form of temporary slope stabilization. For all practices, manufacturer's specifications should be followed for installation depending on slope and other field conditions. Consult the National Grid Environmental Scientist prior to selecting and installing any slope stabilization practices. Refer to BMPs in **Appendix 4**.

[1] Grass growth on a biodegradable type check dam is evidence that the material is decomposing. While this doesn't mean it is no longer functioning, it means it may be in a weakened condition and could potentially fail under high flow velocity. It is acceptable for grass to be growing on a stone check dam.

3.10 Maintenance of Sedimentation and Erosion Controls

Sedimentation and erosion controls shall be maintained in good operational condition during the course of the work. This includes, but is not limited to, replacing straw bales that are no longer in good condition, re-staking straw bales, replacing or re-staking silt fence, and removing accumulated sediment. Remove sediment before it has accumulated to one half the height of any exposed silt fence fabric, straw bales, other filter berm, check dams or water bars. Accumulated sediment shall be removed from sedimentation basins to maintain their efficacy. Manage the removed sediment by evenly spreading it over unvegetated upland areas where erosion is not a concern, by stockpiling and stabilizing, or by disposing of off-site. Stabilization measures shall also need to be implemented and approved by the National Grid Environmental Scientist or the Project Environmental Consultant. Where a SWPPP has been prepared for a specific site, the guidelines documented therein shall govern the management of sediment.

4.0 Right-of-Way (ROW) Access

Whenever possible, access shall be gained along existing access routes or roads within the ROW. However, in some cases there is no existing access. In many cases, temporary access can be utilized. The following practices provide general guidance on accessing a ROW. Check with a National Grid Environmental Scientist to determine if any environmental permitting is required before utilizing a temporary access.

Note that the building of new roads or enlargement of existing roads is **prohibited** unless this activity is allowed by a project-specific permit, and the new roads appear on the Site Plans that were authorized in the regulatory approvals.

4.1 Off-ROW Access

Off-ROW access shall be evaluated for wetlands, rare species, cultural resources and other potential sensitive receptors, as applicable. National Grid Real Estate and Stakeholder Relations shall also be contacted as soon as possible once off-ROW access is determined to be needed.

4.2 Stabilized Construction Entrance/Exit for Access to ROWs from Public or Private Roads

A suitable (minimum 15-foot wide by 50-foot long) construction entrance/exit shall be installed at the intersection of the ROW access road/route with public/private paved roads, or other such locations where equipment could track mud or soil onto paved roads. The construction entrance/exit should be comprised of clean stone installed over a geotextile fabric. Geotextile fabric may be omitted for permanent construction entrances/exits on a case-by-case basis with the approval of the National Grid Environmental Scientist. Refer to BMPs in **Appendix 4**.

Construction entrance areas shall be monitored and maintained to ensure that stone or other material is not deposited onto the roadway, causing a safety concern. Where track-out of sediment has occurred onto a roadway, it shall be swept off the road by the end of that same work day.

If a construction entrance/exit is clogged with sediment and no longer functions, the sediment and stone may require removal and replacement with additional clean stone (clean stone refreshment) to ensure this tracking pad is performing its intended function adequately. Heavier traffic use may require this clean stone refreshment multiple times throughout a project. Reinforcement of these stabilized construction entrance/exits with asphalt binder or asphalt millings is not likely to be considered "maintenance" and may trigger additional permitting requirements[2]. In some cases, heavily used construction entrances/exits may benefit from the installation of a 5-15 foot strip of asphalt binder or asphalt millings closest to the paved roadway to capture any stone that is tracked from the stone apron. Such cases shall be evaluated on an individual basis with the National Grid Environmental Scientist.

Once work is complete, the construction entrance/exit shall either be removed or retained, depending upon future maintenance-related access needs, property ownership, and/or project-specific approvals. If removed, the area shall be graded, seeded (if adequate root and seed stock are absent) and mulched. Proper approvals for leaving access roads in place shall be obtained; contact the National Grid Environmental Scientist and Property Legal.

4.3 Maintenance of Existing Access Roads

In many cases, the existing access road may need to be maintained to allow passage of the heavy equipment required for scheduled maintenance work. Access roads cannot deviate from the approved and permitted access plans. Maintenance of these roads may include adding clean gravel or clean crushed stone to fill depressions and eroded areas. This activity shall be conducted only within the width of the existing access road footprint and does not include widening existing access roads

If gravel begins to migrate onto the existing vegetated road shoulder, this gravel shall be removed during the project and/or after the completion of use of the road to ensure the road fill is not spreading into adjacent resource areas, or resulting in the road becoming much wider than its pre-existing or permitted condition. In some areas of mapped rare species habitat or other sensitive areas where project-specific permit conditions require the prevention of the migration of sediments into adjacent resources, an engineered stabilization system (e.g., GeoWeb or similar) may be suitable to prevent sedimentation while allowing for unrestricted wildlife migration.

In Massachusetts, any proposed widening of access roads in turtle Priority Habitat would require individual consultation with NHESP and, depending on the level of impact proposed, may require a Project Review filing. The limited filling of ruts or potholes is compatible with the National Grid Operation and Maintenance Plan approved by NHESP under the Massachusetts Endangered Species Act, however, severely rutted access roads in turtle Priority Habitat that require extensive linear feet of stone for safe passage will require individual consultation with NHESP.

[2] Depending on the road, use of an asphalt binder or asphalt millings as a construction entrance/exit may trigger state or local permit requirements.

Major reconstruction projects may require multiple permits. In all cases, the fill to be used for existing access roads shall be clean and free of construction debris, trash or woody debris. Use of processed gravel may be approved by the Person-In-Charge and the National Grid Environmental Scientist, on a case-by-case basis. If clean stone is used then addition of more erosion controls may not be necessary.

4.5 Maintenance of Existing Culverts

Damaged culverts may not be repaired or replaced without consulting with the National Grid Environmental Scientist to determine if a permit is required. For functioning culverts, care shall be taken to protect adjacent wetlands and watercourses by installing appropriate sedimentation and erosion controls around the downstream end of the culvert. Culverts shall be repaired/replaced in kind and shall not be changed in size unless approval has been obtained from the National Grid Environmental Scientist. In-kind replacement is replacement using the same material, functional inverts, diameter and length as the existing culvert. Changes to any of these characteristics shall require permitting. Installation of any **new** culvert is not allowed without obtaining all necessary permits first. Refer to BMPs in **Appendix 4**.

If, at the time of anticipated replacement, there is heavy flow through the culvert, the Person-In-Charge shall consult with the National Grid Environmental Scientist, to verify whether the culvert shall be replaced at that time. Water may need to be temporarily diverted during culvert repair/replacement. There typically are seasonal restrictions limiting both the replacement of existing culverts as well as installation of new culverts to the low-flow period. The low-flow period can vary from state to state. If any unexpected conditions are encountered during culvert replacement, the National Grid Environmental Scientist shall be contacted immediately prior to the work being completed for additional consultation.

4.6 Temporary Construction Access over Drainage Ditch or Swale

In some situations, construction access from paved roads onto ROWs may require the crossing of drainage ditches or swales along the road shoulder. In these situations, the installation of construction mats, mat bridges or temporary culverts may facilitate construction access over the ditches or swales. These culverts shall be temporary only, sized for peak flow, and shall be removed after construction is complete. Consult with the National Grid Environmental Scientist prior to installation. In addition, if access over existing culverts may require extending the culvert, consult with the National Grid Environmental Scientist. Refer to BMPs in **Appendix 4**.

4.7 Construction Material along ROW

After preparing a site by clearing and/or installing any necessary erosion and sediment controls and prior to the start of construction, material such as poles, cross-arms, cable, insulators, stone and other engineered backfill materials may be placed along the ROW, as part of the project. The stockpiling of stone and other unconsolidated material on construction mats shall be avoided, if determined necessary due to access and work pad constraints, the material must be placed on a geotextile fabric and be properly contained with a sedimentation barrier such as straw wattle. No construction material shall be placed in wetlands or other sensitive resource areas unless authorized by the National Grid Environmental Scientist or Project Environmental Consultant.

5.0 Winter Conditions

5.1 Snow Management

Refer to **Appendix 6** for the current Snow Disposal Guidelines.

5.2 De-Icing

Where allowed, calcium chloride is preferred as a de-icing agent when applied according to manufacturer's guidelines in upland areas. Sand shall be used on construction mats through wetland areas.

Consult with the National Grid Environmental Scientist on de-icing agents when working in a facility or substation close to resource areas. Many municipalities have specific requirements for de-icing agents allowed within 100 feet of wetland resources and other sensitive areas.

5.3 Snow and Ice Management on Construction Mats

Proper snow removal on construction mats shall avoid the formation of ice. To avoid the formation of ice, snow shall be removed from construction mats before applying sand. Prior to their removal from wetlands, sand shall be collected from the construction mats and disposed of in an upland area. A round street sweeping brush mounted on the front of a truck may be an effective way to remove snow from construction mats. Propane heaters may also be suitable solutions for snow removal and/or de-icing of construction mats.

Once construction mats are removed, wetlands shall be inspected for build up of sand that may have fallen through construction mats. Care shall be taken to inspect wetland crossings as each mat is removed to ensure sand is properly removed and disposed of off-site.

6.0 Construction Mats

The use of construction mats allows for heavy equipment access within wetland areas. The use of construction mats minimizes the need to remove vegetation beneath the access way and helps to reduce the degree of soil disturbance and rutting in soft wetland soils. Construction mats most often used by National Grid are wooden timbers bolted together typically into 4-ft by 16-ft sections, wooden lattice mats, or composite mats. In some cases, construction mats or other mats are used for staging or access in upland areas based on site conditions (e.g., agricultural field access). Refer to BMPs in **Appendix 4**.

Typically construction mats may be installed on top of the existing vegetation, however in some instances cutting large woody vegetation may be required. Check with National Grid Environmental Scientist prior to cutting or clearing vegetation for construction mat placement.

Where an extended period of time has lapsed since wetland delineation and start of construction, and new vegetative growth has concealed wetland flagging or flagging is simply no longer obviously visible, wetland boundaries should be re-flagged where necessary prior to the installation of matting.

Follow the approved plans in the EFI for construction mat installation and do not deviate from the plans. **Any deviation from the approved plans needs to be communicated immediately to the National Grid Environmental Scientist as it may require additional permitting, require stopping the project or result in a permit violation or revocation.**

6.1 Construction Mats and Mowing

Close coordination with the mowing contractor shall be required to ensure that access plans are followed, and construction mats are utilized when necessary. Sometimes mowing contractors may have to work off the leading edge of a construction mat to mow in order to lay the next construction mat and continue further into the wetland. Under no circumstances shall trees or shrubs be allowed to be pulled out of the wetland by the root ball. The root ball of trees and shrubs shall remain intact. Chipping debris and excessive amounts of slash shall not be placed in wetlands or other resource areas. In some instances, it may be beneficial to pile a reasonable amount of slash within a nearby upland area to create habitat for wildlife. This activity shall be approved by the National Grid Environmental Scientist.

6.2 Stream Crossings and Stream Bank Stabilization

Stream crossings shall be bridged with construction mats or other temporary minimally-intrusive measures unless fording is acceptable for the site and is authorized by the National Grid Environmental Scientist. Care shall be taken when installing a construction mat bridge to insure that the stream bed and banks are not damaged during installation and removal and that stream flow is not unduly restricted. Where stream width allows, construction mats shall be installed to span the watercourse in its entirety without stringer placement in the water or any restriction of stream flow. Environmental permits may be required to cross or disturb protected waters, depending upon state-specific regulatory requirements. Refer to BMPs in **Appendix 4**. Immediately following construction mat removal, all stream banks shall be stabilized and restored to prevent sedimentation and erosion.

6.3 Cleaning of Construction Mats

Mats shall be certified clean by the vendor prior to installation. The vendor shall use the certification form provided as **Appendix 5** to document compliance. Clean is defined as being free of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials prior to being brought to the project site. Any equipment or timber mats that have been placed or used within areas containing invasive species within the project site shall be cleaned of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials at the site of the invasive species prior to being moved to other areas on the project site to prevent the spread of invasive species from one area to another[3]. **Mats shall be cleaned prior to being removed at the completion of the project: exceptions to this requirement**

[3] On ROW projects where multiple wetlands may be dominated by the same invasive species, cleaning may not be required for movement along the ROW. Check with the National Grid Environmental scientist for guidance.

may be made on a case-by-case basis. Consult with the National Grid Environmental Scientist prior to discharging or disposing of any waste water or waste material from the cleaning of construction mats.

6.4 Stone Removal for Construction Mat Placement

For situations where the matting contractor determines that stones or boulders must be removed or relocated within wetland areas in order to install safe and level structure work pads or access roads the boulders shall be moved in a manner which does not result in significant soil disturbance (i.e., pushing with a bull dozer is not allowed). The boulders shall not be placed on any existing vegetated areas within wetlands or within vernal pools. When numerous boulders shall be removed from a wetland area, they shall be deposited in an upland area outside of the flagged wetland limits, outside of any cultural resource areas and outside of any RTE species populations. Any boulders that shall be placed within buffers (In MA, the 100-foot buffer zone, and in RI, the 50-foot Perimeter Wetland, 100-foot or 200-foot Riverbank Wetlands) shall be placed to avoid causing soil disturbance and they shall be within an approved limit of work. When there is a significant number of boulders that need to be removed, the National Grid Environmental Scientist shall be consulted for guidance.

6.5 Transition onto Mats

Erosion controls and stone or wood chip ramps shall be installed to promote a smooth transition to and minimize sediment tracking onto construction mats. Geotextile may be added beneath stone or wood chip transitions to facilitate removal, as necessitated by site or permit conditions. Mat transitions shall be removed once construction mats have been removed and during restoration. Refer to BMPs in **Appendix 4**.

6.6 Construction Material on Mats

The stockpiling of stone, drill spoils and other unconsolidated material on construction mats shall be avoided unless determined necessary due to access and work pad constraints. Additional controls, such as watertight mud boxes and geotextile/filter fabric over or between construction mats shall be considered for stockpile management. If material is placed on construction mats and falls through into wetlands, the material must be removed by hand. Saturated soils shall be allowed to dewater prior to off-site transport for sufficient time to ensure that water/sediment is not deposited onto construction mats or public roads during transport. Heavy machinery shall not be left overnight on mats located within floodplain unless approved by the National Grid Environmental Scientist, the machinery is still in use, and removal of the equipment requires the use of additional equipment to move it and would increase vehicle trips in/ou of wetlands. In these situations and when approved by the National Grid Environmental Scientist, the equipment shall be secured against vandalism and secondary containment measures shall be employed where feasible. Mat anchoring shall be evaluated, see below.

6.7 Mat Anchoring

The National Grid Environmental Scientist and Project environmental consultant shall indicate to the project team when mat anchoring may or shall be necessary. The matting contractor will propose the method of mat anchoring, which will be approved by the National Grid Environmental Scientist and the

National Grid Construction Supervisor. The need for anchoring should be noted in the project EFI, on the project access and matting plans, and in the scope of the bid document (if externally sourced).

Anchoring of construction mats should be considered when any of the following conditions are presented at a project work location:

Location	Considerations
Stream crossings Shorelines of Ponds/Lakes Wetlands Floodplains	When located in a mapped flood area (A). When mapped 100-year flood elevations (AE) are greater than 2 ft above existing grades. Where past flash flood events have occurred. Where steep terrain is present or surrounds the project location. When mats will be in place during hurricane season for greater than 2 weeks.
Tidal areas	When located in a Velocity (V or VE) Zone. When mats will be in place during a moon tide cycle. When mats will be in place during hurricane season for greater than 2 weeks.

Examples of mat anchoring are provided below, but the implementation methods for anchoring mats are not limited to these examples. Where anchoring is determined to be necessary, the matting contractor should propose a method suitable based on field conditions and that takes crew safety, slip/trip/fall hazards, size of matting footprint, and other project and site-specific factors into consideration. Refer to BMPs in **Appendix 4**.

Limited sets of mats

- Cable or rope in chain pockets and run linearly, or
- Linear ropes anchored using helical screws, manta ray anchors, or posts.

Larger sets of mats or those without chain pockets

- Chain link fence posts or other posts driven in along mat edge every 3-4 feet and ropes then laced across mats between opposing posts before storm event, or
- Anchor bolts added to mats, then cable is laced between bolts and tied to helical or manta ray anchor.

6.8 Corduroy Roads

Corduroy roads are a wetland crossing method where logs are cut from the immediate area and used as a road bed to prevent rutting from equipment crossing. This technique is designed to be used in areas of wetland crossings where there is no defined channel or stream flow and should never be used in streams. Corduroy logs shall be placed in the narrowest area practicable for crossing with the logs placed perpendicular to the direction of travel across wet area. The use of corduroy logs shall only be in emergencies when approved by the National Grid Environmental Scientist or when they have been specifically permitted as part of a project. Refer to BMPs in **Appendix 4**.

6.9 Construction Mat Removal

Once construction mats are removed, wetlands shall be inspected for build up of sand or other materials that may have fallen through construction mats. Care shall be taken to inspect wetland crossings as each mat is removed to ensure any materials are properly removed and disposed of off-site.

6.10 Utility Air Bridging

In ROWs where other utility facilities (including but not limited to gas, oil, fiber optic, electric, water, and sewer) are co-located within the transmission ROW, bridging may be required to cross those facilities. The project team shall coordinate with the respective utility company prior to determining if bridging or permanent crossings are required.

7.0 LGP Equipment Use

Only when approved by the National Grid Environmental Scientist on a case-by-case basis shall equipment with a LGP **psi that meets the state-specific USACE General Permit requirement when loaded** be allowed to access through wetlands. Refer to the state-specific General Permit for the definition of LGP in each state at: http://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/, or to the summary table provided below. The National Grid Environmental Scientist's approval of the use of LGP equipment through wetlands depends on several criteria including:

- Time of year. LGP equipment use may be allowed if weather and field conditions at the time of construction are suitable to eliminate/minimize the concern of rutting or other impacts. Frozen, frozen snow pack, low flow, drought conditions, or unsaturated surface soil conditions are typically acceptable conditions. Spring and fall construction, due to the typical higher precipitation, are not suitable times of year for LGP equipment use.
- Number of trips. Multiple trips through a wetland have shown to increase the potential for damage and require matting. LGP equipment use shall likely only be approved if trips are limited to one trip in and one trip out.
- Type of wetland system. Some wetlands have harder soils/substrate, and may be passable without causing significant damage. Some of the wetlands along National Grid ROWs have existing hard bottom roads that have been vegetated over time and may be traversed with LGP equipment without construction mats.
- Emergencies. LGP equipment use may be allowed during emergency or storm conditions for outage restoration.
- State-specific USACE General Permit Performance Standards. The standard is for no impact to the wetland, which may be obtained by using LGP equipment **when loaded**). "*Where construction requires heavy equipment operation in wetlands, the equipment shall either have low ground*

pressure (as specified in the USACE GP), or shall not be located directly on wetland soils and vegetation; it shall be placed on construction mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation."

- Local bylaws. Municipal wetland bylaws, where applicable, shall be reviewed for prohibitive conditions or applicable performance standards.

LGP equipment is prohibited in the following resources areas:

- Stream crossings
- State listed-species habitat
- Outstanding Resource Waters (ORWs)
- Vernal pools
- Archaeological sensitive areas

Where LGP equipment use is desired in lieu of construction mats, the construction supervisor should identify these areas on marked-up access plans. A site visit with the Project Environmental Monitor should be scheduled to assess if the proposed locations are potential candidates. The Project Environmental Monitor will document potentially suitable locations and dismiss others as unsuitable.

ACOE New England District General Permit Requirements

State	Restrictions	Maximum PSI (when loaded) for Use without Mats	Reference
MA	*One of the following must apply:* Equipment operated within wetlands shall: a) Have low ground pressure; b) Be placed on timber mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation; or c) Equipment must be operated on adequately dry or frozen conditions such that shear pressure does not cause subsidence of the wetlands immediately beneath equipment and upheaval of adjacent wetlands.	3 psi	MA General Permit, General Condition 13
NH	*One of the following must apply:* Equipment operated within wetlands shall: a) Have low ground pressure; b) Be placed on timber mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation; or c) Be operated on frozen wetlands.	4 psi	NH General Permit, General Condition 17
VT	*One of the following must apply:* Equipment operated within wetlands shall: a) Have low ground pressure; b) Be placed on timber mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation; or c) Be operated on frozen wetlands such that shear pressure does not cause subsidence of the wetlands immediately beneath equipment and upheaval of adjacent wetlands. Note: Written authorization from the Corps required to waive the use of mats during frozen or dry conditions.	3 psi	Vermont General Permit, General Condition 14
RI	*One of the following must apply:* Equipment operated within wetlands shall: a) Have low ground pressure; b) Be placed on timber mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation; or c) Be operated on frozen wetlands such that shear pressure does not cause subsidence of the wetlands immediately beneath equipment and upheaval of adjacent wetlands.	6 psi	Rhode Island General Permit, General Condition 15

State	Restrictions	Maximum PSI (when loaded) for Use without Mats	Reference
	Note: Written authorization from the Corps required to waive the use of mats during frozen or dry conditions.		

Due to the fact that ground conditions may change between the time of the evaluation and construction, LGP equipment approval is required **at the time of construction for each wetland crossing** and shall be dependent upon the above conditions. In addition, LGP equipment use and approval shall be assessed by the National Grid Environmental Scientist or Project Environmental Monitor during construction on a continuing basis

Once a location is approved for the use of LGP equipment:

- The Construction Supervisor must check-in with the Project Environmental Monitor at least two weeks before construction begins to ensure conditions remain suitable for LGP equipment use, and weather conditions are favorable.
- The Project Environmental Monitor must observe the equipment when in use.
- LGP equipment use shall cease immediately if field conditions are found to be unsuitable (i.e. soil rutting greater than six inches or the destruction of vegetation root systems beyond the capacity of natural revegetation).
- **If wetlands damage occurs, the use of the LGP equipment shall be suspended, and the wetlands be restored.**
- Any LGP equipment used within areas containing invasive species within the project site shall be cleaned of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials at the site of the invasive species prior to being moved to other areas on the project site to prevent the spread of invasive species from one area to another.

8.0 Soil Disturbing Activities

8.1 Dust Control

Cutting activities shall be conducted to minimize the impacts of dust on the surrounding areas. Dust suppression is an important consideration. Water or other National Grid approved equivalent in accordance with the manufacturer's guidelines may be used for dust control along ROWs in upland areas. During application of water for dust control, care shall be taken to ensure that water does not create run-off or erosion issues. Refer to BMPs in **Appendix 4.**

8.2 Clearing

Clearing is not allowed without specific permission as it constitutes soil disturbance under several regulatory programs and may trigger permitting by increasing the project's footprint of disturbance. If clearing is required for a project, the limit of clearing shall be established with flagging or construction fencing and/or erosion controls. Clearing shall be done in accordance with project specific permits. Following the completion of clearing, the limits of work shall be re-established. Refer to BMPs in **Appendix 4**.

8.3 Grubbing

Grubbing is not allowed without specific permission as it constitutes soil disturbance under several regulatory programs and likely triggers permitting by increasing the project's footprint of disturbance. If grubbing is required for a project, the limit of grubbing shall be re-established after clearing has been completed. The area of grubbing shall be identified with flagging or construction fencing and/or erosion controls. Grubbing shall be conducted in accordance with project-specific permits.

8.4 Blasting, Noise and Vibration Control

If blasting is anticipated, the project team, including the National Grid Environmental Scientist, shall be consulted. If possible, plan work in residential areas to avoid noisy activities at night, weekends or during evenings. Emergency work in residential areas should be carried out in such a way as to keep noise to a minimum at night and weekends. Equipment should be maintained as per the manufacturer's guidance to minimize noise and vibration.

Work plans must consider local noise ordinances and provide specific controls to ensure noise levels are maintained within specified limitations.

8.5 Site Grading

The work site shall not be graded other than in accordance with project permits. Any proposed grading shall be reviewed by the National Grid Environmental Scientist for wetlands, rare species habitat, areas of cultural and historical significance, and other environmentally sensitive areas prior to start of work. In some cases, additional testing for cultural or historical resources may be triggered by proposed grading; alternatives to grading may be sought due to protracted time frame of obtaining the permit associated with testing and performing the testing. Grading outside of a regulated area shall be kept to the minimum extent necessary for safe and efficient operations and shall comply with the project permit plans.

Grading shall be performed in a manner which does not increase the erosion potential at the Site (e.g., terraces or slope interruptions shall be utilized). Graded sites shall be promptly stabilized by applying a National Grid approved seed mix (if adequate root and seed stock are absent), and mulching with hay, straw or cellulose (use straw or cellulose hydromulch where the potential introduction of invasive plant species is of concern) to reduce erosion and visual impact, as soon as possible following completion of work at the site. Grading within a regulated area shall be subject to the review and approval of the National Grid Environmental Scientist.

In some municipalities, site grading activities require the prior approval of the Town Engineer, Building and Zoning Official, or Public Works Director. Local ordinances or bylaws should be reviewed for applicable restrictions and permitting thresholds

8.6 Grounding Wells

The installation of grounding wells shall require erosion controls and proper soil management. Due to the typical depth required for grounding wells (typically 50 to 200 feet or more), erosion controls shall be installed around the proposed well location when working in buffer zone, in proximity to sensitive resources or near slopes. Also, dewatering basins may be required for the proper management of groundwater. The National Grid Environmental Scientist shall be consulted for the disposal of any excess soil.

8.7 Counterpoise and Cathodic Protection

The installation of counterpoise or cathodic protection shall require erosion controls and proper soil management. The National Grid Environmental Scientist shall be consulted for the disposal of any excess soil.

8.8 Work Pads

When work pads are being constructed, only clean material shall be used in their construction. Work pads shall only be constructed in areas approved by the National Grid Environmental Scientist and shown on the approved permit access plans.

8.9 Site Staging and Parking

During the project planning and permitting process, locations shall be identified for designated crew parking areas, material storage, and staging areas. Where possible, these areas should be located outside of buffer zones, watershed protection areas, and other environmentally sensitive areas. Any proposed locations shall be evaluated for all sensitive receptors and for new projects requiring permitting, shall be incorporated onto permitting and access plans.

8.10 Soil Stockpiling

Soil stockpiles shall be located in upland areas and, if in close proximity to wetlands and wetland buffers, shall be enclosed by staked straw bales or another erosion control barrier. The stockpiling of stone, drill spoils and other unconsolidated material on construction mats shall be avoided unless determined necessary due to access and work pad constraints. Additional controls, such as watertight mud boxes and geotextile/filter fabric over or between construction mats shall be considered for stockpile management. If material is placed on construction mats and falls through into wetlands, the material must be removed by hand. Saturated soils shall be allowed to dewater prior to off-site transport for sufficient time to ensure that water/sediment is not deposited onto construction mats or public roads during transport.

8.11 Top Soil/High Organic Content Soil

When the work site requires excavation and grading, the top soil shall be stockpiled separately from the material excavated. This top soil shall be spread as a top dressing over the disturbed area during restoration of the site.

In some instances where work is occurring within wetlands, high organic content soil may be displaced. Such high organic content soil shall be segregated from other excavated materials and stockpiled for use in wetland restoration areas. Care shall be taken to minimize the handling of high organic content soil. Preferably, the soil shall be stockpiled in one location until it is moved to the restoration area.

9.0 Stone Wall Dismantling and Re-building

Removal or alteration of stonewalls shall be avoided, whenever possible. As appropriate, some stonewalls removed or breached by construction activities shall be repaired or rebuilt. Rebuilt stone walls shall be placed on the same alignment that existed prior to temporary removal, to the extent that it shall not interfere with operations. The removal and rebuilding of stone walls requires approval from the National Grid Environmental Scientist and Property Legal, and may require several weeks lead time for coordination. Note that not all states allow this technique and that dismantling may not be allowed at all due to quality or significance of the wall. Once a stone wall has been identified as requiring dismantling, the following procedures shall be followed:

- Identify stone wall that is required to be temporarily dismantled and notify project team that a site visit is warranted to review the stone wall.
- The National Grid Environmental Scientist, with support from Property Legal and/or cultural/historical consultant, shall determine if permitting or additional permissions are required prior to dismantling stone wall.
- Once permit or permissions have been received, full documentation of wall dimensions (measurements and photographs) shall be submitted to the National Grid Environmental Scientist. Documentation of the wall dimensions shall be marked onto a copy of the applicable EFI access plan (or equivalent plan) with a useful reference for future locating such as GPS coordinates and/or measurement from a permanent reference point (closest structure location or closest cross street, etc.). The wall shall be photographed from all sides with a written description of the photograph (i.e. southern side of wall looking north). In addition, documentation of the length of wall to be dismantled shall be recorded. Take special care to note if granite property bounds (or other marker) are located within the wall so additional survey can be accomplished prior to dismantling in cases where the stone wall represents a property boundary. Site visits by project team (which shall include the National Grid Environmental Scientist) are a mandatory requirement prior to dismantling.
- No dismantling shall take place until documentation has been submitted to the National Grid Environmental Scientist and approved as sufficient documentation.
- Stones from the wall shall be removed from the work area and temporarily stored in nearby location, away from wetlands; buffer zones; rare species habitat and other historical/archeological concerns.
- Avoid dismantling via the "bulldozer" method when possible as this method makes it nearly impossible to rebuild the wall in the same alignment due to its uncontrolled nature. Dismantling shall be conducted either by hand, with stones stacked as they are removed, or on less "sensitive" walls to use an excavator with a thumb to grab each stone and build a stockpile. Significant ground disturbance below the wall shall be avoided.

- Once construction and access in the area has been completed, the wall shall be rebuilt to pre-dismantled conditions or better. If rebuilding a stone wall can not be placed on the same alignment that existed prior to temporary removal, approval from the National Grid Environmental Scientist and Property Legal is required. **Note that if the wall represents a legal property boundary or is historically or culturally significant (or was previously determined to be in a very high quality condition), a professional stone masonry company may be required to document wall alignment, and conduct the dismantling and rebuilding.**

10.0 Avian Nest Removal

Avian nest removal shall be done in accordance with EG-304. Consult the National Grid Environmental Scientist prior to removing any nests. There are seasonal restrictions of the removal of avian nests and federal or state permits may be necessary prior to removal.

11.0 Drilling Fluids and Additives

When installing subsurface structures, there may be a need to utilize drilling aids such as slurries, borehole sealants, and other additives. All necessary steps shall be taken by National Grid personnel and contractors to prevent potential adverse effects on drinking water aquifers, groundwater quality, and wetlands when utilizing drilling aids. Efforts should be made to utilize natural bentonite clay-type materials, in place of polymer-based drilling aids. Regardless of the specific product type, the following requirements shall be met:

- Drilling aids must be NSF certified and manufactured to NSF-ANSI 60 standards. https://www.nsf.org/newsroom_pdf/NSF-ANSI_60_watemarked.pdf
- Product use must be in accordance with manufacturer's specifications and instructions.
- National Grid personnel or their contractor shall provide all the necessary information regarding the proposed product to be used to National Grid's Environmental Sustainability, Compliance and Licensing & Permitting Department as early as possible in the project planning phase. If the work is being performed by a contractor, this information must be included as part of their initial bid package.
- If polymer-based products are proposed for use, product information shall be included in all related environmental regulatory filings and frac-out plans, if possible.
- A qualified individual shall be designated who will confirm/verify and document the specific use of a drilling aid at each location. This will include add-mix ratios, surface area treated, volume of water within excavation, volumes/weight of additives used, and any other measurements specified by the manufacturer. No mixing will be allowed in the drilled shaft excavation.
- The Contractor or National Grid crew performing the work is responsible for neutralizing all drilling products, as applicable, in accordance with the manufacturer's specifications. This shall be performed following removal from the excavation and while held in holding tanks. A

qualified person shall be designated by the Contractor who will confirm/verify and document the appropriate neutralization activity at each location, as necessary.

- Waste drilling aids (neutralized or not) or soils that may have come into contact with drilling aids will not be disposed of on National Grid properties, discharged to any ground surface or subsurface, waterbodies, wetlands or placed on 3rd party properties.
- All product use must be completed in strict adherence with the management, storage, mixing, transporting, disposing and any other requirements of state and federal regulatory approvals and permits, as applicable.
- Relevant documentation shall be maintained by the Contractor or National Grid crew performing the work, and shall include volume of material treated and disposed and the location/facility at which it was disposed.
- National Grid will not be identified as the disposal generator for any polymer based slurry waste or additives generated by Contractor activities.
- The Contractor or National Grid crew performing the work assumes full responsibility for the safe storage of all polymers and additives during use and also assumes full responsibility for improper use and application of said polymers and additives that are deemed to have contravened aquifer and/or groundwater quality.
- National Grid reserves the right to refuse and terminate the use of any specific drilling aid at any time.

Regardless of the type of drilling aid utilized, the Contractor or National Grid crew performing the work is responsible for properly treating, containerizing, testing, transporting and disposing of any/all fluids and solids generated during their activities. All wastes must be disposed of in accordance with federal and state regulations. Relevant documentation shall be maintained and shall include volume of material treated and disposed and the location/facility at which it was disposed.

12.0 Water Withdrawal for Geotechnical Investigations

The use of water during geotechnical drilling operations may be required, and is most common during the “drive and wash” drilling technique, where 4- or 6-inch diameter casing is driven into the ground, and the soil inside the casing is washed out using a pump and hollow rods. Soil samples are generally collected at periodic intervals using a split spoon sampler (e.g., every 5 vertical feet).

The National Grid Environmental Scientist and/or Project Environmental Monitor may approve withdrawals from wetlands and waterways on a case-by-case basis should the geotechnical team advise no other options are available. Generally, the amount of water required for withdrawal is between 100 and 200 gallons, and the water is then recycled continuously in the drilling process. Certain scenarios may require additional water usage if water is lost down the boring (e.g., lost due to bedrock fractures during rock coring). The following general guidance should be adhered to when determining whether water withdrawals may be allowed during geotechnical investigations on the ROW. Approval from the National Grid Environmental Scientist and/or Project Environmental Monitor is required prior to initiating water withdrawals during geotechnical investigations.

- Withdrawals from perennial streams, ponds, lakes and large wetlands systems are preferred over small isolated wetlands to ensure the water level, water table, and hydroperiod are not affected. Prior to start of work, the Contractor shall identify which water source they prefer to withdraw from. The National Grid Environmental Scientist and/or the Project Environmental Monitor will confirm whether these sources are appropriate.
- Care should be taken to avoid alteration of wetlands or the beds and banks of surface waters. Examples of alterations include, but are not limited to, the following:
  - (a) the changing of pre-existing drainage characteristics, flushing characteristics, salinity distribution, sedimentation patterns, flow patterns and flood retention areas;
  - (b) the lowering of the water level or water table;
  - (c) the destruction of vegetation; and
  - (d) the changing of water temperature, biochemical oxygen demand (BOD), and other physical, biological or chemical characteristics of receiving waters.
- Wetlands and waterways providing habitat for rare species should be avoided unless all other options are exhausted. Under no circumstances should water be withdrawn from a Vernal Pool.
- Withdrawal pipes or stingers should be elevated off the bottom of wetlands and streams during the duration of pumping. Additionally, fabric or screening should be covering the withdrawal pipes to eliminate inadvertent harm to wildlife.
- Withdrawals should be performed in a manner that does not damage vegetation, disturb sediment, or result in the release of temporary or permanent fill material (e.g., sediment, spoils, or turbid water) into the wetland/waterway. Additional detail from geotechnical experts may be required to solidify BMP recommendations.
- Any water used for geotechnical drilling operations (including water withdrawn from surface water, brought on-site, or from other sources) shall be discharged into the open borehole or to an upland area such that the water infiltrates to the ground and is not discharged to a wetland or surface water resource area. Consultation with the National Grid Environmental Scientist and/or the Project Environmental Monitor is required if this is not feasible. At no time should water withdrawals result in a temporary or permanent fill/discharge of material (e.g. sediment, spoils, or turbid water) into the wetland or waterway.
- If water sourcing options is not determined prior to mobilization, necessary water shall be brought in by tank truck. Should withdrawal from surface water sources become necessary during soil boring work, the National Grid Environmental Scientist and/or the Project Environmental Monitor shall be notified prior to beginning withdrawal. If initial withdrawal from surface water is approved by the National Grid Environmental Scientist and/or the Project Environmental Monitor, the driller may withdraw from the surface water, as long as the above criteria are met.
- If excessive water withdrawal is necessary, the National Grid Environmental Scientist and/or the Project Environmental Monitor shall be consulted to determine whether the water source is appropriate for withdrawal.
- In New Hampshire, withdrawals made from state-owned property require written permission from

the agency with primary responsibility for monitoring and/or maintaining the site.

13.0 Gates

When not in use, gates shall be locked with a company-approved lock or double locked with the property owner's lock. New gates may be installed during a project, however, installation of a gate requires permission from the property owner, and may require environmental permitting. Consult with National Grid Real Estate and the National Grid Environmental Scientist prior to installing a new gate, as well as with the appropriate engineering department for the current company gate specifications. Refer to BMPs in **Appendix 4**. Installation of ROW access restrictions (e.g., stone, bollards, other) at road crossings also require consultation with the National Grid Environmental Scientist and Property Legal.

14.0 Signage

Specific signage may be required by permits or be specified in the EFI to limit access in certain sensitive areas. Signs shall be used to clarify allowed access and sensitive areas, such as:

- "No snow stockpiling beyond this point";
- "Approved access (to structures A-F)";
- "Do not cross this area until construction mats are in place";
- "No vehicle crossing";
- "Areas to avoid"; and
- "Environmentally Sensitive Area – Keep Out."

Signs shall be used in conjunction with snow fencing or other physical barriers as demarcation for sensitive areas (e.g., rare species areas, sensitive archeological locations, etc.) that need to be protected and avoided by construction activities. In addition, permit signs required by the regulatory agencies shall be present (i.e. MADEP, RIDEM, EPA (SWPPP), ACOE, etc) at construction sites and/or ROW access points. Construction signage shall be installed and maintained by the contractor performing the work during the project. Absence of signage does not eliminate the need to comply with access plans, permit conditions, and other regulatory requirements. Refer to BMPs in **Appendix 4**.

15.0 Refueling and Maintenance Operations

15.1 Spill Prevention and Response Plan

Spill controls shall be provided on every field vehicle. Bulk storage of fuels (55 gallons or greater) shall be approved by the National Grid Environmental Scientist prior to being brought on site. The need for a field spill plan shall be evaluated specific to the project for regulatory requirements under SPCC regulations or local ordinances. A field spill plan would include information on fuels and oils being used, approximate amounts in each container or type of equipment, location, fueling location, secondary containment, response and notification procedures, including contact phone numbers, etc. All personnel shall be briefed on spill prevention and response prior to the commencement of construction. The state-specific EI-501 and EG-502 shall be followed in the event of a spill.

Typical construction activities do not require the use or storage of large quantities of oil or hazardous materials (i.e., greater than 55 gallons). However, oil and/or hazardous materials (OHM) may be required in limited quantities to support construction or vehicle operations. Best practices shall be followed in the use and storage of OHM which include but are not limited to: storage and refueling greater than 100 feet from resource areas; maintenance of spill response equipment at work locations sufficient to handle incidental releases from operating equipment; general training for on-site personnel for spill clean up response for incidental releases of OHM; and contracting with an on-call spill response contractor that is capable of managing incidental and significant releases of OHM. There may situations that additional precautions shall be required for the storage or use of OHM (i.e., within wellhead protection areas, GA/GAA areas, Zone IIs). Storage of OHM shall be done in accordance with any applicable regulatory requirements.

15.2 Field Refueling

Small equipment such as pumps and generators shall be placed in small swimming pools or on absorbent blankets/pads, to contain any accidental fuel spills. Small swimming pools with absorbent blankets/pads, and/or other secondary containment, shall be used for refueling of fixed equipment in wetlands and should be maintained to prevent accumulation of precipitation.

15.3 Grease, Oil, and Filter Changes

Routine vehicle maintenance shall not be conducted on project sites.

15.4 Other Field Maintenance Operations

When other vehicle or equipment maintenance operations (such as emergency repairs) occur, company personnel or contractors at field locations shall bring vehicles or equipment to an access location a minimum of 100 feet away from environmentally sensitive areas (e.g., wetlands or drinking water sources). A paved area, such as a parking lot or roadway, is a preferred field maintenance location to minimize the possibility of spills or releases to the environment.

Crews shall take all usual and reasonable environmental precautions during repair or maintenance operations. Occasionally, it is infeasible to move the affected vehicle or equipment from an environmentally sensitive area to a suitable access area. When this situation occurs, precautions shall be taken to prevent oil or hazardous material release to the environment. These precautions include (but are not limited to) deployment of portable basins or similar secondary containment devices, use of ground covers, such as plastic tarpaulins, and precautionary placement of floating booms on nearby surface water bodies.

15.5 Tools and Equipment

Cleaning of tools and equipment shall be conducted away from environmentally sensitive areas (such as wetlands, buffer zones or drinking water sources) to the maximum extent possible. A paved area such as a parking lot or roadway is preferred, to minimize the possibility of spill or release to the environment. Crews shall wipe up all minor drips or spills of grease and oil at field locations.

16.0 Stabilization Deadlines for Projects Subject to EPA Construction General Permit

16.1 Deadlines to Initiate Stabilization Activities (Permanent and Temporary)

Soil stabilization measures shall be implemented immediately whenever earth-disturbing activities have permanently or temporarily ceased on any portion of the project. The following are some examples of activities that constitute initiation of stabilization:

- Preparing the soil for vegetative or non-vegetative stabilization;
- Applying mulch or other non-vegetative product to the exposed area;
- Seeding or planting the exposed area;
- Finalizing the arrangements to have stabilization product fully installed in compliance with the deadlines to complete stabilization in Section 15.2 below.

16.2 Deadlines to Complete Stabilization Activities (Permanent and Temporary)

As soon as practicable, but no later than 14 calendar days or 7 calendar days (for areas discharging to a sensitive water) after the initiation of soil stabilization measures commence the following should be completed:

- For vegetative stabilization, all activities necessary to initially seed or plant the area to be stabilized; and
- For non-vegetative stabilization, the installation or application of all such non-vegetative measures.

16.3 Vegetative Stabilization (all except for arid, semi-arid, or on agricultural lands)

- Provide established uniform vegetation (e.g., evenly distributed without large bare areas), which provides 70% or more of the density of coverage that was provided by vegetation prior to commencing earth-disturbing activities. Avoid the use of invasive species as cover.
- For final stabilization, vegetative cover must be perennial; and
- Immediately after seeding or planting a disturbed area to be vegetatively stabilized, a non-vegetative erosion control must be implemented to the area while the vegetation is becoming established. Examples include; mulch and rolled erosion control products.

16.4 Vegetative Stabilization (Agricultural Lands)

- Disturbed areas on land used for agricultural purposes that are restored to their pre-construction agricultural use are not subject to vegetative stabilization standards.

16.5 Non-Vegetative Stabilization

If using non-vegetative controls to stabilize exposed portions of your site, or if you are using such controls to temporarily protect areas that are being vegetatively stabilized, you must provide effective non-vegetative cover to stabilize any such exposed portions of the site. Examples of non-vegetative stabilization techniques include, but are not limited to, rip-rap, gabions, and geotextiles.

17.0 Clean-up and Restoration Standards

The following steps shall be taken once construction has been completed at each location along the ROW or within the project site. The following are minimum guidelines for clean-up and stabilization standards. Please refer to permit conditions for project-specific related standards. Refer to the EFI for applicable permit requirements and to determine if the site needs to be reviewed and approved by the permitting authorities prior to removal of erosion controls.

17.1 Removal of Sedimentation and Erosion Controls

After all work has been satisfactorily completed and vegetation has been re-established to a minimum of 75% cover, and upon approval by the National Grid Environmental Scientist, all non-biodegradable materials (e.g., siltation fencing, straw bale strings, stakes, straw wattle mesh casing, etc.) shall be disposed of properly off-site.

Dependent on permit requirements, sedimentation and erosion controls may not be allowed to be removed until after inspection and approval by one or more permitting authority. In most cases, removed straw bales may be used to mulch disturbed areas. Remaining straw bales that do not block the flow of water may be left in place unless they are required to be removed pursuant to permit conditions. Straw bales that block the flow of water shall be removed.

Prior to project construction being completed, the project team will develop post-construction inspection intervals to ensure timely removal of temporary BMPs. BMPs will be removed when the area is stabilized, which typically occurs when the area has either naturally stabilized (75% cover), or seed and mulch that was installed has achieved 75% cover.

17.2 In-Situ Restoration

Unless otherwise specified in permits or prescribed by the National Grid Environmental Scientist or the Project Environmental Consultant, all disturbed areas, including stream banks, wetlands and access routes, shall be restored following the completion of work. When the work is completed and construction mats have been removed, the National Grid Environmental Scientist or Project Environmental Consultant shall conduct an inspection. Wetlands shall be inspected for build up of sand or other materials that may have fallen through construction mats. Care shall be taken to inspect wetland crossings carefully after construction mat removal to ensure any materials are properly removed and disposed of off-site.

<u>Restoration of Soil Compaction</u>. If rutting or soil compaction following construction mat removal is observed, the area shall be returned to pre-existing conditions, and comparable to the surrounding area, by light hand raking or by back-blading with machinery. Restoration shall be overseen by the Project Environmental Consultant or National Grid Environmental Scientist. Deep ruts (>12”) shall be filled in using available, loose soil from the work area.

Seeding and Mulching. If adequate root and seed stock are absent and have been stripped from the area, graded sites shall be promptly stabilized by applying an approved seed mix and mulching with straw to reduce erosion and visual impact. Seeding and mulching shall be completed as soon as possible following completion of work at the site. For some wetland areas, natural re-vegetation may be more appropriate than seeding disturbed sites. Wetland areas where adequate root and seed stock are absent will be seeded using an approved wetland native seed mix. For some wetland areas, natural re-vegetation may be more appropriate than seeding disturbed sites. Refer to BMPs in **Appendix 4** for seed mix tables and mulch ratio tables.

If needed, the import of quality topsoil onto the ROW will be required. Topsoil should be tested, and approved by the Project Environmental Consultant or National Grid Environmental Scientist to determine its suitability for site conditions. Fertilizers will be approved on a case-by-case basis.

For upland areas, the disturbed vegetation and soil shall be restored and stabilized[4] by regrading the area to pre-existing conditions, if needed, seeding (if adequate root and seed stock are absent) and mulching the exposed soil, and removing strings and stakes from straw bales and using broken up straw bales for the mulch. Siltation fencing, strings and stakes shall be removed for disposal as ordinary waste. Refer to BMPs in **Appendix 4** for seed mix tables and mulch ratio tables.

For sites with excess boulders, additional boulders could be used at proposed and existing gate locations to use on either side of the gates as a deterrent for unauthorized vehicle access or be placed along the edges of work pads where steep slopes are present for safety purposes. The final placement of boulders should be reviewed prior to installation with Real Estate and the National Grid Environmental Scientist or Project Environmental Consultant.

Unless otherwise specified in Project-specific permit conditions, the National Grid Environmental Scientist or Project Environmental Consultant shall develop an inspection frequency to monitor restored areas for stabilization, germination and successful revegetation.

17.3 Invasive Species

All equipment shall be certified clean[5] utilizing the attached form (**Appendix 5**) or equivalent as approved by the vendor prior to mobilization to the work site. The vendor shall use the certification from provided as **Appendix 5** to document compliance with invasive species management BMPs. Clean is defined as being free of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials prior to being brought to the project site. Any equipment that has been placed or used within areas containing invasive species within the project site shall be cleaned of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials at the site of the invasive species prior to being moved to other areas on the project

[4] For projects subject to the 2012 CGP, stabilization is required within 14 days, or within 7 days for sensitive areas.

[5] The **Appendix 5** certification form (or equivalent as approved by National Grid Environmental Scientist) shall be used to document the clean certification

site to prevent the spread of invasive species from one area to another[6]. **Equipment shall be cleaned prior to being removed at the completion of the project: exceptions to this requirement shall be determined on a case-by-case basis.** Consult with the National Grid Environmental Scientist prior to discharging or disposing of any waste water or waste material from the cleaning of equipment.

17.4 Cleaning of Equipment

At the completion of the project, equipment shall be cleaned prior to being de-mobilized to prevent tracking of material onto roads and causing safety issues. Consult with the National Grid Environmental Scientist prior to discharging or disposing of any waste water or waste material from the cleaning of equipment.

17.5 Access Roads

Constructed gravel roads shall be left in place following project completion unless permit conditions require their removal. Refer to the specific permit conditions for these provisions. If the road is to be removed, the crushed stone and geotextile fabric shall be removed from the work site. Seeding and/or mulching of gravel roads is generally not required, unless necessary to prevent erosion. Pre-existing sandy soils within mapped rare turtle habitat shall not be seeded unless directed by the National Grid Environmental Scientist so as to not alter nesting habitat.

17.6 Stone Work Pads

Unless permit conditions or property owner's require the removal of constructed stone work pads following project completion, constructed work pads shall be left in place. Refer to the specific permit conditions for these provisions.

17.7 Construction Materials on ROWs

As soon as the structure work has been completed, all used parts and trash are to be picked up and removed from the project site. Retired poles shall be removed in accordance with National Grid Engineering Standard SP.06.01.301. In some cases, the used material from structure work may be temporarily stored at the work area by placing it out of the wetlands or other sensitive resource area until work in the adjacent areas has been completed. However, treated wood poles shall never be stored in standing water or in wetlands. If the project is cancelled, all material shall be removed from the project site. Excess material brought to the project site shall be removed upon project completion. Consult with the National Grid Environmental Scientist on whether the work site shall be restored in addition to the measures outlined above

17.8 Improved Areas

Yards, lawns, agricultural areas, and other improved areas shall be returned to a condition at least equal to that which existed at the start of the project. Off-ROW access shall never be assumed and shall be coordinated through Real Estate before being implemented. Depending on the access point, construction matting or other BMPs may be required to prevent ruts, lawn damage, or other property damage.

[6] On ROW projects where multiple wetlands may be dominated by the same invasive species, cleaning may not be required for movement along the ROW. Check with the National Grid Environmental Scientist for guidance.

Restoration following the completion of work and any use of improved areas shall be conducted in accordance with the measures outlined above.

17.9 Property Damage

All damage to property occurring as a result of a project shall be immediately repaired or replaced. In some locations, it may be desirable to document pre-existing damage prior to work commencing in that area in order to demonstrate afterwards that the damage did not result from the project. Work crews, the Project Environmental Consultant or the National Grid Environmental Scientist shall document repairs that were performed in response to damage from unauthorized vehicle use.

17.10 Overall Work Site

Upon satisfactory completion of work, the construction personnel shall remove all work-related trailers, buildings, rubbish, waste soil, temporary structures, and unused materials belonging to them or used under their direction during construction, or waste materials from previous construction and maintenance operations. All areas shall be left clean, without any litter or equipment (wire, pole butts, anchors, insulators, cross-arms, cardboard, coffee cups, water bottles, etc.) and restored to a stable condition and as near as possible to its original condition, where feasible. Debris and spent equipment shall be returned to the operating facility or contractor staging area for disposal or recycling (cardboard) as appropriate in accordance with EI-111.

17.11 Material Storage/Staging and Parking Areas

Upon completion of all work, all material storage yards, staging areas, and parking areas shall be completely cleared of all waste and debris. Unless otherwise directed or unless other arrangements have been made with an off ROW or off-property owner, material storage yards and staging areas shall be returned to the condition that existed prior to the installation of the material storage yard or staging area. Regardless of arrangements made with a landowner, all areas shall be restored to their pre-construction condition or better. Also any temporary structures erected by the construction personnel, including fences, shall be removed by the construction personnel and the area restored as near as possible to its original condition, including seeding and mulching as needed.

18.0 Notification of Emergency Work

Because it is sometimes difficult to identify wetlands and other sensitive environmental areas, the National Grid Environmental Scientist shall be notified within 24 hours or by the next working day whenever emergency off-road repair work takes place. Although the routine maintenance and emergency repair work is generally allowed, due to site conditions or the scope of the project, notification to the regulating agencies may be required.

19.0 Appendices

APPENDIX 1: Glossary
APPENDIX 2: Acronyms

APPENDIX 3:	Storm Water, Wetlands & Priority Habitat Environmental Compliance Site Inspection / Monitoring Report Form
APPENDIX 4:	BMP Drawings and Guidelines
APPENDIX 5:	Certification Sheet for Invasive Species Control
APPENDIX 6:	Snow Disposal Guidelines

Appendix 1 – Glossary

Access Road – An existing, periodically maintained road often consisting of gravel and/or exposed soils or vegetated with grasses but devoid of woody vegetation, that is visible on aerial photography and shown on ROW T-sheets. May include newly permitted permanent roads (i.e., roads to be constructed in accordance with a project-specific permit).

Access Route - A pathway previously used or proposed to be used by crews for access along the ROW. Routes may be shown on ROW T-sheets or previous project access plans but are not improved as maintained gravel/exposed soil roads. Access routes may be mown and can consist of trails utilized by recreational vehicles.

Action Logs – Project-specific log used to document action items required for permit compliance. The log identifies timeframes for completion and responsible parties. The log is typically updated by the Project Environmental Consultant or the National Grid Environment Scientist and circulated to the project team on a weekly, or more frequent, basis.

Bank – The transitional slope immediately adjacent to the edge of a surface water body, the upper limit of which is usually defined by a break in slope, or, for a wetland, where a line delineated in accordance with applicable state and federal regulations that indicates a change from wetland to upland.

BMP – Best Management Practice. Individual engineered constructions or operating procedures intended to minimize and mitigate soil disturbance, erosion, sedimentation, turbid discharges, and/or impacts to sensitive receptors.

Clean - Free of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials prior to being brought to the project site.

Clean Gravel – Gravel is a type of coarse-grained soil that consists of small stones and other mineral particles. Clean Gravel shall meet the requirements in accordance with National Grid Standard Construction Specification for Electric Stations (Engineering Standard SP.08.00.001) Clean Gravel will not have fine materials that could lead to a turbid discharge.

Clean Stone (Crushed Stone) – Clean Stone (Crushed Stone) shall meet the requirements in accordance with National Grid Standard Construction Specification for Electric Stations (Engineering Standard SP.08.00.001). Clean Stone will not have fine materials that could lead to a turbid discharge.

Clearing – The cutting of trees and large bushes by hand and/or mechanical means.

Compost Socks – Tubular devices comprised of non-degradable, photodegradable, or biodegradable mesh tubing containing organic compost matrix. Compost socks are effective for intercepting site runoff, trapping sediment, and treating for soluble pollutants by filtering stormwater runoff. . Compost socks are a useful sedimentation control device along construction site perimeters, as check dams in drainage channels, as a slope interruption practice on long and/or steep slopes, and around drain or street curb inlets.

Construction Mats **- C**onstruction, swamp, and timber mats ("construction mats") are generic terms used to describe structures that distribute equipment weight to minimize disturbance to wetland soil and vegetation while facilitating passage and providing work platforms for workers and equipment. They are comprised of sheets or mats made from a variety of materials in various sizes.

Corduroy Road – Corduroy roads are cut trees and/or saplings with the crowns and branches removed, and the trunks lined up next to one another.

Dewatering Basin – An established containment area for saturated materials and pumped discharges. This measure is used for the purpose of de-watering soils prior to transport off site or for use in another location on site, and for allowing suspended sediment to settle out of pumped discharges.

Detention/Retention Basin – A detention/retention basin is designed for the purpose of detaining or retaining water. A dewatering basin is a form of detention basin

Dewatering – Use of a system of pumps, pipes and temporary holding dams to drain or divert waterways or wetlands, or lower the groundwater table before and during excavation activities.

Drainage Ditch or Swale – A clearly noticeable channel that is typically dry, except after precipitation events. Intermittent and perennial streams and rivers are not included in this definition.

Dredge – To dig, excavate, or otherwise disturb the contour or integrity of sediments in the bank or bed of a wetland, a surface water body, or other area within the regulating bodies' jurisdiction.

Dredge Spoils – Material removed as the result of dredging.

Embankment – A protective bank constructed of mounded earth or fill materials located between a roadway (or rail bed) and a seasonal stream or other wetland.

Environmental Field Issue – Document that contains copies of all project-specific environmental permits and summarizes all environmental permit conditions. The EFI is prepared by the Project Environmental Consultant or the National Grid Environment Scientist and copies are provided to the Project Manager, Construction Supervisor(s), and other team members as appropriate.

Environmental Monitoring Records – Examples of checklists and/or monitoring reports suggested for use by the Company Environmental Engineer to document conformance of the project with this Environmental Guidance and or project specific permit/license conditions.

Environmental Scientist – Formerly Environmental Engineer. The National Grid Environmental Department representative for the project or the territory where the work is located. For a map of Environmental Department staff territories, refer to the Environmental page of the National Grid infonet.

Environmentally Sensitive Areas – Examples of environmentally sensitive areas that may be found on National Grid properties are rivers, streams, ponds, lakes, wetlands, bogs, swamps, salt marshes, rare species habitat, wellhead protection areas, cultural sites, parks, preserves, schools and as otherwise defined by Federal, State or local regulations. Refer to EG-301.

Erosion Controls – The utilization of methods to prevent soil detachment and minimize displacement or washing down slopes by rainfall or run-off. Common practices include, but are not limited to:

(a) Temporary and Permanent Seeding.

(b) Mulching, Soil Binders, Tackifiers.

(c) Erosion Control Blankets.

(d) Hydraulic Erosion Control.

Excavate/Excavation – To dig, remove, or form a cavity or a hole in an area within the department's jurisdiction.

Fill (n.) – Any rock, soil, gravel, sand or other such material that has been deposited or caused to be deposited by human activity.

Fill (v.) – To place or deposit materials in or on a wetland, surface water body, bank or otherwise in or on an area within the jurisdiction of the department.

Flats – Relatively level landforms composed of unconsolidated mineral and organic sediments usually mud or sand, that are alternately flooded and exposed by the tides and that usually are continuous with the shore.

Frozen Condition – Field conditions when the upper portion of the ground surface freezes or when areas of standing water freeze solid such that vehicle passage over these areas is supported without any resulting soil disturbance. The frozen conditions must have been affected by severe cold (maximum daily temperatures less than 32 degrees F) for a continuous 2-week period.

GAA – Rhode Island groundwater classification, groundwater resources that are known, or presumed to be suitable for drinking water use without treatment, and are located in one of the three areas described below.

a) The state's major stratified drift aquifers that are capable of serving as a significant source for a public water supply ("groundwater reservoirs") and the critical portion of their recharge area as delineated by DEM;

b) The wellhead protection area for each public water system community water supply well. Community water supply wells are those that serve resident populations and have at least 15 service connections or serve at least 25 individuals, e. g. municipal wells and wells serving nursing homes, condominiums, mobile home parks, etc.; and

c) Groundwater dependent areas that are physically isolated from reasonable alternative water supplies and where existing groundwater warrants the highest level of protection. At present only Block Island has been designated as meeting this criterion.

GA – Rhode Island groundwater classification, groundwater resources that are known, or presumed to be suitable for drinking water use without treatment. However, groundwater classified by GA does not fall within any of the three priority areas described under the GAA classification.

Grade/Grading – The movement of soil and fill material to change the elevation of the land. The term refers to the combined actions of excavating and filling to change elevation or shape.

Grubbing – The removal of stumps/roots by mechanical means during site preparation activities.

Immediately - As soon as practicable, but no later than the end of the next work day, following the day when the earth-disturbing activities have temporarily or permanently ceased.

In-kind Replacement - Replacement using the same material, functional inverts, diameter and length as the existing item. In-kind replacement includes the substitution of a structure with a similar structure in approximately the same location as is practicable, and is approximately the same in design. The design may be altered to meet applicable utility standards, and may include alternate materials designed to prolong the life of that service.

Intermittent Stream – A stream that flows for sufficient time to develop and maintain a defined channel, but which might not flow during dry portions of the year.

In the Dry – Work done either during periods of low water or behind temporary diversions, such as Earth Dike / Drainage Swale and Lined Ditches designed and installed in accordance with best management practices.

Limit of Work/Disturbance – The approved project limits within regulated areas. All project related activities in regulated areas must be conducted within the approved limit of work/disturbance. The limit of work/disturbance shall be depicted on the approved permit site plans and in the EFI plans. Where it is warranted National Grid may require that these limits be identified in the field by flagging, construction fencing, and/or perimeter erosion controls.

Long-Term Restoration Logs - Project-specific log used to document restoration required following the completion of construction or as areas of the project have been completed (i.e., segments of ROW for a multi-mile project). The log is typically updated by the Project Environmental Consultant or the National Grid Environment Scientist and circulated to the project team on a weekly basis.

Low Flow Conditions – Low water flow that generally occurs during the summer, as a result of decreased precipitation and the removal of water by increased evaporation and evapotranspiration by vegetation. Work done under low-flow conditions minimizes the potential for environmental damage. The USACE defines the calendar dates for low flow conditions in its New England state-specific Programmatic General Permits.

Low Ground Pressure – Equipment that meets the USACE GP state-specific defined Pounds per Square Inch (PSI) ground pressure when loaded. Use of LGP equipment ***requires approval*** from the National Grid Environmental Scientist.

Marsh – A wetland:

a) That is distinguished by the absence of trees and shrubs;

b) Dominated by soft-stemmed herbaceous plants such as grasses, reeds, and sedges; and

c) Where the water table is at or above the surface throughout the year, but can fluctuate seasonally.

Methods – Are the construction practices and procedures that take place through choosing the proper equipment, trucks and labor to execute the earth moving activities based on the existing conditions and implementing creative and sensitive scheduling for the daily activities.

NHESP - Natural Heritage Endangered Species Program; a department within the Massachusetts Division of Fisheries and Wildlife that is responsible for protecting the 176 species of vertebrate and invertebrate animals and 259 species of native plants that are officially listed as Endangered, Threatened or of Special Concern in Massachusetts.

Perennial – A stream that contains water at all times except during extreme drought.

Permanently Ceased – Is applicable to earth disturbance activities when clearing and excavation within any area of the Project that will not include permanent structures has been completed.

Person-in-Charge – A National Grid Project Engineer, Manager, Supervisor, Field Construction Coordinator or equivalent Contractor personnel assigned to oversee and coordinate work activities.

Processed Gravel – Processed Gravel shall meet the requirements in accordance with National Grid Standard Construction Specification for Electric Stations (Engineering Standard SP.08.00.001). Processed Gravel will not have fine materials that could lead to a turbid discharge. Gravel consisting of inert material that is hard, durable stone and is free from loam and clay, surface coatings and deleterious materials.

Regulating Body – Federal, State, or local authority that has jurisdiction over resource areas that may be impacted by company operations

Regulated Wetland Area – Those areas that are subject to federal, state or local wetland regulation, including certain buffer or adjacent areas.

Repair – The restoring of an existing legal structure by partial replacement of work, or broken, or unsound parts (Env-Wt 101.73).

Replacement – The substitution of a new structure for an existing legal structure with no change in size, dimensions, location, configuration, construction, or which conforms in all material aspects to the original structure

Right-of-Way – A corridor of land where National Grid has legal rights (either fee ownership, lease or easement) to construct, operate, and maintain an electric power line and/or natural gas pipeline and may include work on customer owned properties.

River – A watercourse that is larger than a perennial stream and flows all year long.

Routine Utility Rights-of-Way Maintenance Activity – Includes but is not limited to vegetation management and repair or replacement of existing utility structures.

Sedimentation Controls – Silt fences, straw bales, compost socks/berms and other barrier devices strategically placed to intercept and treat sediment-laden site runoff.

Sensitive Water - Includes any sediment or nutrient impaired water or a water that is identified by the state, tribe or EPA as Tier 2, 2.5 or Tier 3 for antidegradation purposes.

Siltation Curtain – An impervious barrier erected to prevent silt and sand and/or fines from being washed into a wetland, surface water body or other area of concern.

Surface Water Body or Surface Waters – Those portions of waters which have standing or flowing water at or on the surface of the ground.

Spill Prevention, Control and Countermeasure Plans – Required for site operations that involve the storage of 1,320 gallons or greater of fuel and oils, both in storage containers and stored in equipment. Response actions to spills and releases are specified in these plans.

Stormwater Pollution Prevention Plan – A site-specific, written document that, among other things: (1) identifies potential sources of stormwater pollution at a construction site; (2) describes stormwater control measures to reduce or eliminate pollutants in stormwater discharge from a construction site; and (3) identifies procedures the operator will implement to comply with the terms and conditions of EPA NPDES Construction General Permit (CGP). SWPPPs must be prepared, maintained on-site, and amended as necessary in order to obtain NPDES permit coverage for specific construction site stormwater discharges under the EPA NPDES CGP.

Temporarily Ceased - Is applicable when there are earth disturbance activities such as clearing, grading, and/or excavation that are not complete, but will be idle in one area for a period of up to 14 or more calendar days, and which will resume in the future. The 14 calendar day timeframe begins as soon as you now that construction work on a portion of the Project will be left incomplete and idle. In circumstances where there are unanticipated delays and you do not know at first how long the work stoppage will continue, the requirement to immediately initiate stabilization is triggered as soon as you know with reasonable certainty that work will be stopped for 14 or more additional calendar days.

Tidal Wetlands – A wetland whose vegetation, hydrology or soils are influenced by periodic inundation or tidal waters.

Topsoil – The uppermost part of the soil, ordinarily moved in tillage, or its equivalent in uncultivated soils and ranging in depth from 2 to 10 inches.

Turbidity – The condition in which solid particles suspended in water make the water cloudy or even opaque in extreme cases.

United States Geological Survey Topographic Map – A map that uses contour lines to represent the three-dimensional features of a landscape on a two-dimensional surface. These maps use a line and symbol representation of natural and artificially created features in an area.

Wetland – An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal conditions does support, a prevalence of vegetation (more than 50 percent) typically adapted for life in saturated soil conditions (hydric soils). Wetlands include but are not limited to swamps, marshes, bogs, and similar areas.

Work Site – An area where work is performed.

Worker – Company employee, contractor, consultant working on site.

Zone II - Massachusetts - That area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at safe yield, with no recharge from precipitation). It is bounded by the groundwater divides which result from pumping the well and by the contact of the aquifer with less permeable materials such as till or bedrock. In some cases, streams or lakes may act as recharge boundaries. In all cases, Zone IIs shall extend up gradient to its point of intersection with prevailing hydrogeologic boundaries (a groundwater flow divide, a contact with till or bedrock , or a recharge boundary).

Appendix 2 – Acronyms

ASTM	American Society for Testing and Materials
BMP	Best Management Practices
EFI	Environmental Field Issue
EG	Environmental Guidance
EPA	Environmental Protection Agency
GA/GAA	Rhode Island Groundwater Classifications – see glossary
LGP	Low Ground Pressure
MA	Massachusetts
MA DEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
NE	New England
NH	New Hampshire
NH DES	New Hampshire Department of Environmental Services
NHESP	Natural Heritage Endangered Species Program
NPDES	National Pollutant Discharge Elimination System
OHM	Oil and/or Hazardous Materials
PSI	Pounds per square inch
RI	Rhode Island
RI DEM	Rhode Island Department of Environmental Management
RI CRMC	Rhode Island Coastal Resources Management Council
RI SESC	Rhode Island soil erosion and sediment control
ROW	Right-of-Way
RTE	Rare, Threatened or Endangered
SPCC	Spill Prevention, Control and Countermeasure
SWPPP	Storm Water Pollution Prevention Plan
TOY	Time-of-Year
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VT	Vermont

VT DEC	Vermont Department of Environmental Conservation
Zone II	Massachusetts Groundwater Protection district – see glossary

Appendix 3

See EG303NE_Appendix3_Reporting Form published separately

National Grid
Storm Water, Wetlands & Priority Habitat Environmental Compliance
Site Inspection / Monitoring Report

Project Name: | **Date:**

City / Town: | **Time:**

WO / WR #

IHC or Contractor? (Company Name):

Current Weather Conditions:

Precipitation Since Last Inspection (Date, Est. Duration and Est. Amount from Each Storm):

Activities / Structures / Locations Inspected:

Identify Locations / Activities / Structures within Designated Priority Habitat (Identify Rare species Observations, if any) and Mitigation / Restoration Measures Implemented:

Any Significant Discharges of Sediment to Water Bodies or Wetlands? (If "yes", state locations):

Compliance with SWPPP Storm Water Controls, O&M Plan, Order of Conditions or Other Applicable Environmental Requirements? (Explain if "no" for any feature inspected):

Additional BMPs or Other Corrective Action Needed and, if so, Where?

Compliance with Previous Observations?

National Grid
Storm Water, Wetlands & Priority Habitat Environmental Compliance
Site Inspection / Monitoring Report

Are Spill Control Supplies Available	**Yes**	**No**
Are Oil and / or Hazardous Materials Stored On Site?	**Yes**	**No**
If So, Are they Properly Labeled and Managed?	**Yes**	**No**
Are Wastes Stored On Site?	**Yes**	**No**
If So, Are they Properly Managed?	**Yes**	**No**

Miscellaneous (e.g., dumping?):

Comments:

Inspection Completed by (Name, Title, Company):

Inspector's Signature for Certification:

National Grid Environmental Dept. Representative - Signature for Certification:

Date:

Appendix 4 – BMPs

See EG303NE_Form1 for a list of BMPS

See EG303NE_Form2 for BMP details

	BMP #	Measure
Sediment & Erosion Controls	SEC-1	Weed free bale barrier
	SEC-2	Sediment control fence
	SEC-3	Silt fence / weed free barrier
	SEC-4	Silt Soxx
	SEC-5	Straw Wattle
	SEC-6	Erosion Control Blanket - Ditch
	SEC-7	Erosion Control Blanket - Slope
	SEC-8	Hydroseeding with Tackifier (slope stabilization)
	SEC-9	Mulch materials, rates and uses (from NY)
	SEC-10	Seeding options - Upland Seed Mixes
	SEC-11	Seeding options - Wetland Seed Mix
	SEC-12	Distribution Pole Erosion Control
Crossing Measures	CM-1	Prefabricated mats
	CM-2	Construction mat bridge
	CM-3	Construction mat layout (with transition)
	CM-4	Construction mat layout (with transition & BMPs)
	CM-5	Construction mat - Air Bridge
	CM-6	Corduroy road
	CM-7	Rock Ford
	CM-8	Temporary construction entrance / exit
	CM-9	Temporary construction culvert
	CM-10	Access way stabilization
	CM-11	Construction signage
	CM-12	Construction Mat Anchoring
Advanced Applications	AA-1	Reinforced silt fence
	AA-2	Sediment filter
	AA-3	Stone check dams
	AA-4	Straw / haybale check dam
	AA-5	Waterbar
	AA-6	Sandbag check dam
	AA-7	Earth dike
	AA-8	Drainage swale and lined ditch
	AA-9	Sedimentation basin
	AA-10	Dewatering basin - Small scale
	AA-11	Dewatering basin - Large scale
	AA-12	Dirtbag
	AA-13	Concrete waste sump

	AA-14	Outpak concrete washout
Advanced Applications	AA-15	Barrier fence (construction fence)
	AA-16	ROW gates / fences
	AA-17	Bollard
	AA-18	Dust control
	AA-19	Catch Basin Inlet Protection
	AA-20	Silt Sack
	AA-21	Turbidity Curtain
	AA-22	Siltsoxx Amphibian & Reptile Crossing #1
	AA-23	Siltsoxx Amphibian & Reptile Crossing #2
	AA-24	Siltsoxx Amphibian & Reptile Crossing #3
	AA-25	Cultural Avoidance

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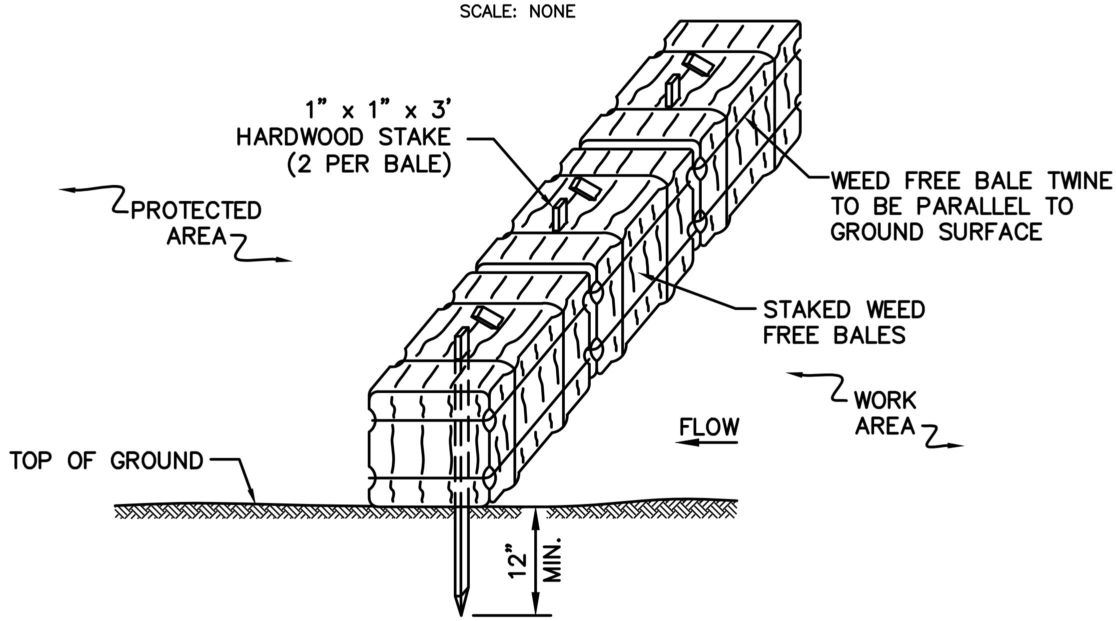
	Date	02/20/18

SUBJECT
Access, Maintenance and Construction
Best Management Practices

Reference
EP No. 3 - Natural Resource
Protection (Chapter 6)

BMP DETAIL

SCALE: NONE



NOTES:

1. THE GROUND SHALL BE PREPARED TO PROVIDE COMPLETE CONTACT WITH THE BALES.

BMP PICTURE

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SEC-1
WEED FREE BALE BARRIER

File: BALE_BARRIER.DWG

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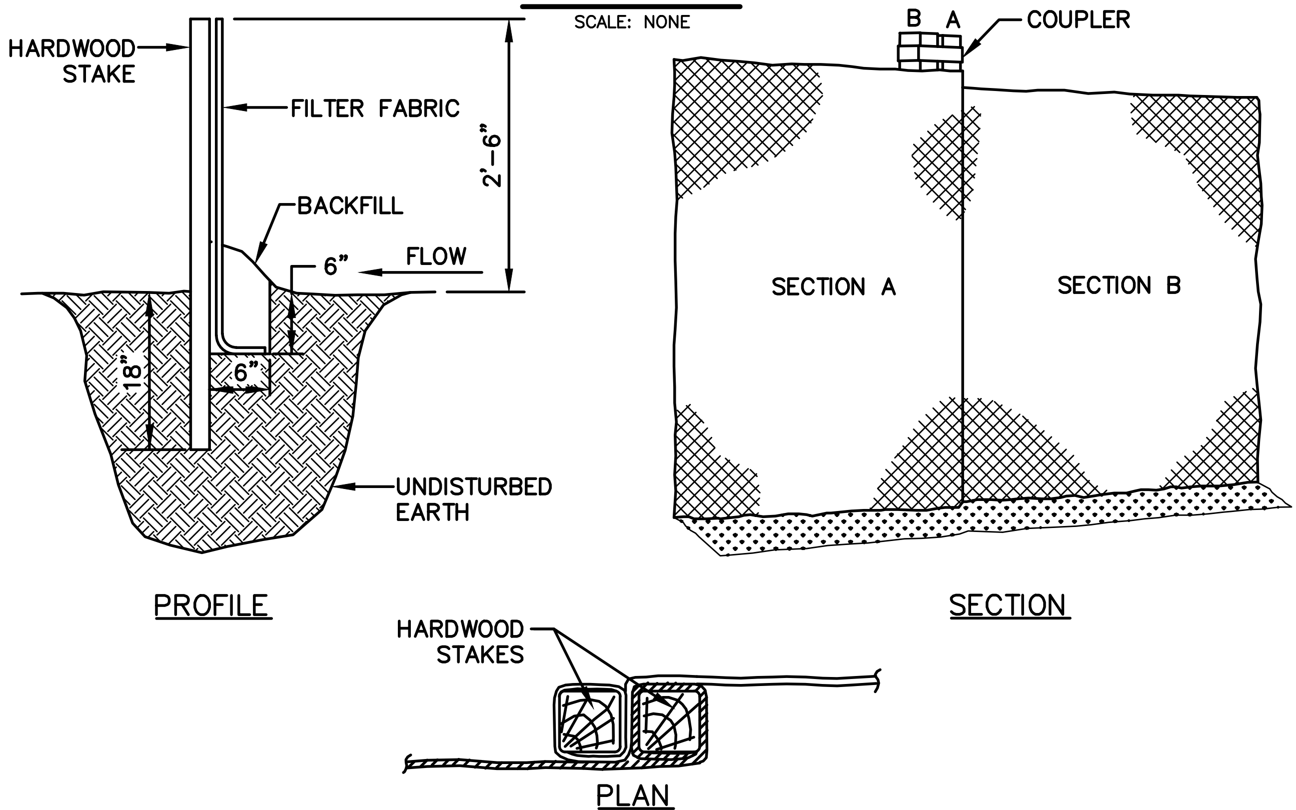
		Date	02/20/18

SUBJECT	Reference
Access, Maintenance and Construction Best Management Practices	EP No. 3 - Natural Resource Protection (Chapter 6)

BMP DETAIL

SCALE: NONE



BMP PICTURE

File: Sediment_Fence.dwg

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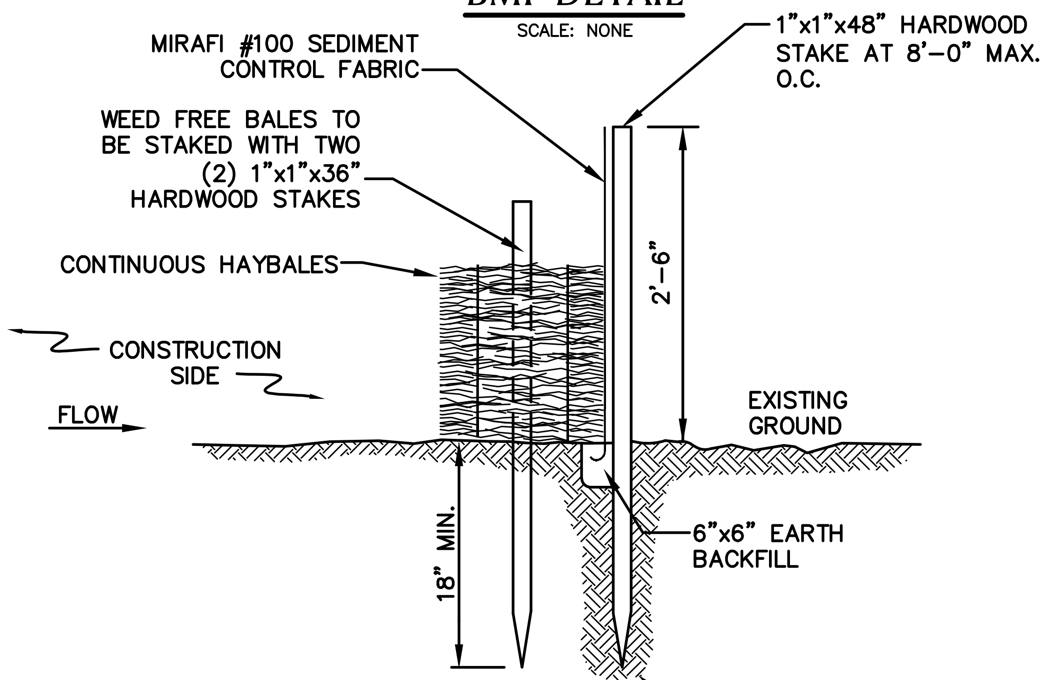
SEC-2

SEDIMENT CONTROL FENCE

BMP DETAIL

SCALE: NONE



NOTES:

1. BALES SHALL BE PLACED IN A ROW WITH THE ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. BALES SHALL BE SECURELY ANCHORED IN PLACE BY TWO (2) 1"X1"X36" HARDWOOD STAKES DRIVEN THROUGH THE BALES. THE FIRST STAKE IN EACH BALE SHALL BE ANGLED TOWARD PREVIOUSLY LAID BALE TO FORCE BALES TOGETHER.
3. INSPECTION SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
4. BALES SHALL BE REMOVED AND REPLACED WHEN THEY BECOME FILLED WITH SEDIMENT AND BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.
5. BALES SHALL BE REMOVED WHEN THE EMBANKMENTS STABILIZE.
6. BALES TO BE TWINE BOUND.

BMP PICTURE

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SUBJECT	Reference
Access, Maintenance and Construction Best Management Practices	EP No. 3 - Natural Resource Protection (Chapter 6)

BMP DETAIL

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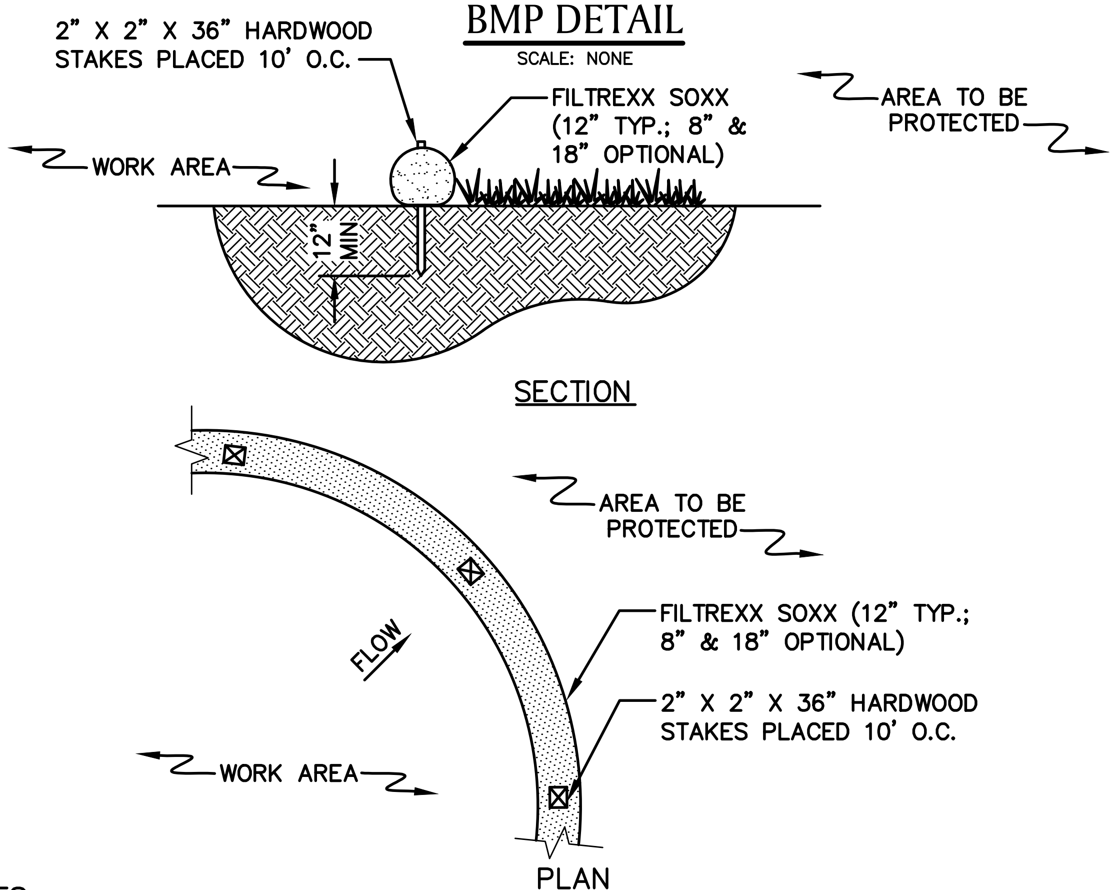

NOTES

1. PRODUCT TO BE FILTREXX SILT SOXX OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. ALL MATERIAL TO MEET FILTREXX SPECIFICATIONS.
3. FILTER MEDIA FILL TO MEET APPLICATION REQUIREMENTS.
4. MESH CONTAINMENT MATERIAL SHOULD BE KNITTED PHOTODEGRADABLE OR BIODEGRADABLE MATERIAL, WITH OPENING SIZES BETWEEN 1/8" – 3/8".
5. COMPOST MEDIA SHOULD HAVE PARTICLE SIZE WHERE 99% < 2", 50% > 1/2".
6. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

*** PICTURE AND DETAIL PROVIDED BY FILTREXX LAND IMPROVEMENT SYSTEMS**
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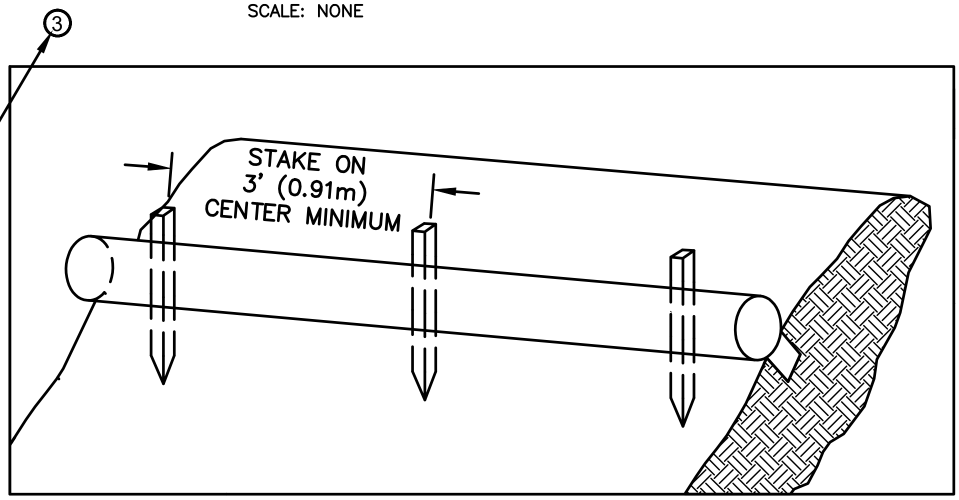
SEC-4
SILT SOXX *

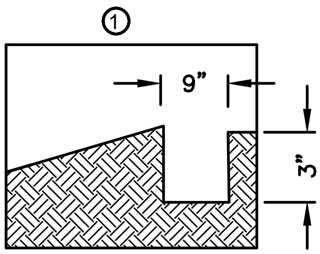
File: SiltSOXX.dwg

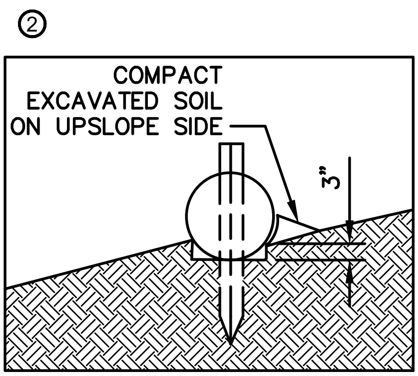
BMP DETAIL

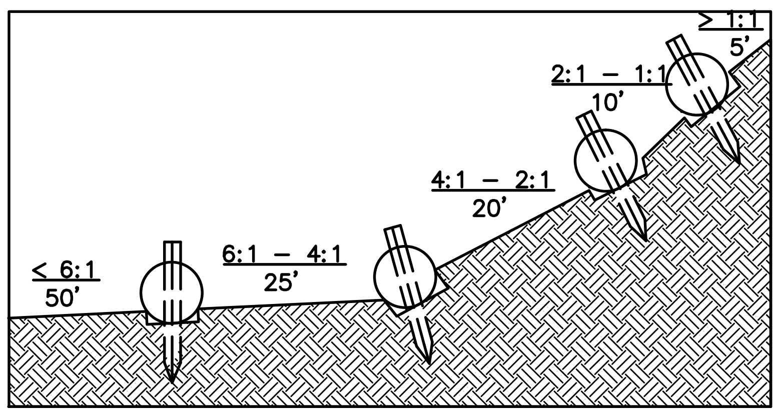
SCALE: NONE

CIRCLED NUMBERS CORRESPOND TO INSTALLATION NOTES FOR THIS STRAW WATTLE BMP DETAIL (TYP.)









TYPICAL WATTLE SPACING DETAIL

NOTES:

1. PRODUCT TO BE TENSAR NORTH AMERICAN GREEN STRAW WATTLE OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. TYPICAL WATTLE SPACING BASED ON SLOPE GRADIENT. COORDINATE SPACING AND LOCATION WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
3. MINIMUM 12" DIAMETER WATTLES SHOULD BE USED FOR HIGHLY DISTURBED AREAS (I.E., HEAVILY USED ACCESS ROAD WITH ADJACENT WETLAND) AND MINIMUM 9–10" WATTLES SHOULD BE USED FOR LESS DISTURBED SOILS.

INSTALLATION NOTES:

1. BEGIN AT THE LOCATION WHERE THE WATTLE IS TO BE INSTALLED BY EXCAVATING A 2–3" DEEP X 9" WIDE TRENCH ALONG THE CONTOUR OF THE SLOPE. EXCAVATED SOIL SHOULD BE PLACED UPSLOPE FROM THE ANCHOR TRENCH.
2. PLACE THE WATTLE IN THE TRENCH SO THAT IT CONTOURS TO THE SOIL SURFACE. COMPACT SOIL FROM THE EXCAVATED TRENCH AGAINST THE WATTLE ON THE UPHILL SIDE. ADJACENT WATTLES SHOULD TIGHTLY ABUT.
3. SECURE THE WATTLE WITH 18–24" HARDWOOD STAKES EVERY 3–4' AND WITH A STAKE ON EACH END. STAKES SHOULD BE DRIVEN THROUGH THE MIDDLE OF THE WATTLE LEAVING AT LEAST 2–3" OF STAKE EXTENDING ABOVE THE WATTLE. STAKES SHOULD BE DRIVEN PERPENDICULAR TO THE SLOPE FACE.

BMP PICTURE

STRAW WATTLE – SHALLOW SLOPE (≤4:1)
(ALTERNATE STAKING)

ALTERNATE STAKING INSTALLATION NOTES:

1. ON SHALLOW SLOPES (≤4:1), STRAW WATTLE MAY BE SECURED WITH 18–24" HARDWOOD STAKES DRIVEN AGAINST THE SIDES OF THE WATTLE INSTEAD OF THROUGH. STAKES SHALL ALTERNATE SIDES, AND BE SPACED 3–4' MAX.
2. TWINE SHALL BE TIED FROM STAKE TO STAKE, CRISS–CROSSING THE STRAW WATTLE. TIE TWINE TO STAKES BELOW THE HEIGHT OF THE WATTLE.

*** DETAIL AND PICTURE PROVIDED BY TENSAR NORTH AMERICAN GREEN**
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SUBJECT	Reference
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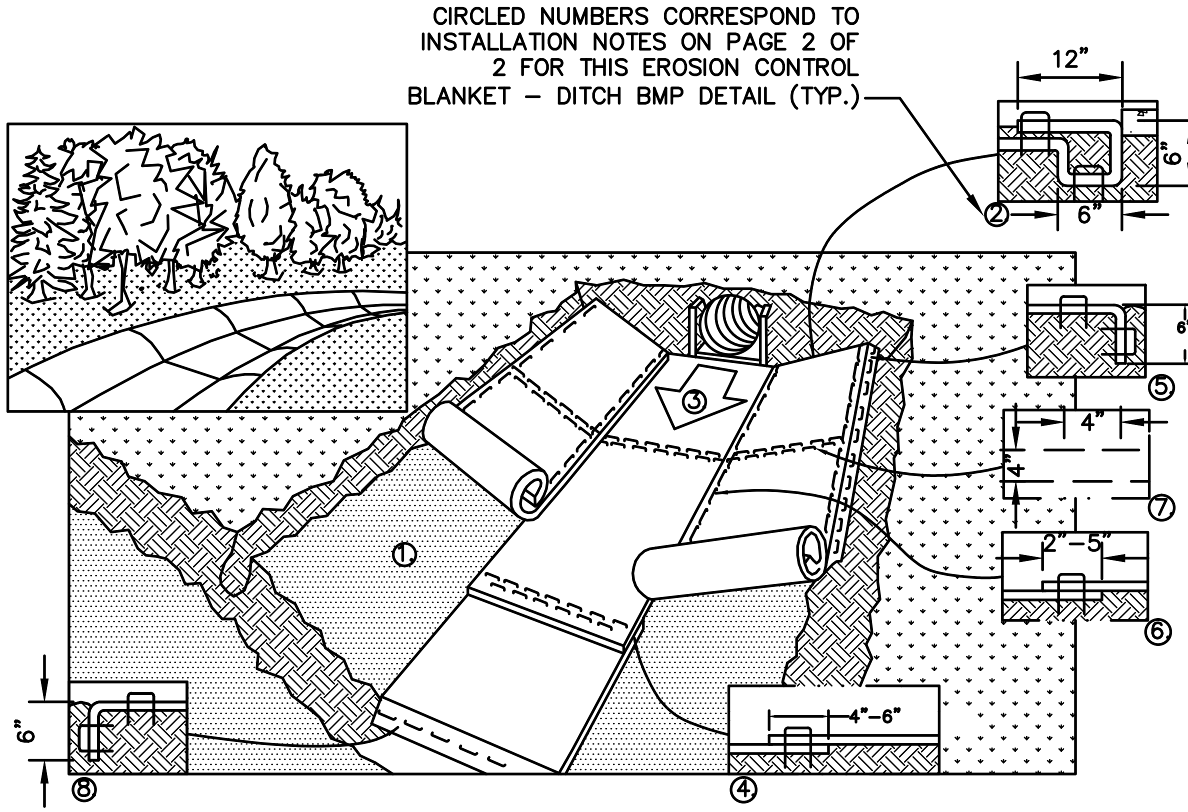
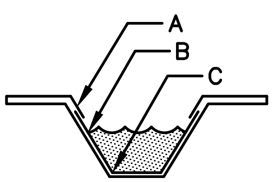
BMP DETAIL

SCALE: NONE





CRITICAL POINTS

A. OVERLAPS AND SEAMS
B. PROJECTED WATER LINE
C. CHANNEL BOTTOM/SIDE SLOPE VERTICES

NOTES:

1. PRODUCT TO BE NORTH AMERICAN GREEN EROSION CONTROL BLANKET OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. HORIZONTAL STAPLE SPACING SHOULD BE ALTERED IF NECESSARY TO ALLOW STAPLES TO SECURE THE CRITICAL POINTS ALONG THE CHANNEL SURFACE.
3. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15 CM) MAY BE NECESSARY TO PROPERLY ANCHOR THE ROLLED EROSION CONTROL PRODUCTS (RECP's).

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SEC-6
EROSION CONTROL BLANKET - DITCH * (1 OF 2)

File: Erosion_Blanket_Ditch.dwg

BMP DETAIL

INSTALLATION NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE RECP's IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH WITH APPROXIMATELY 12" (30 CM) OF RECP's EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMAPCT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30 CM) PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30 CM) ACROSS THE WIDTH OF THE RECP's.
3. ROLL CENTER RECP's IN DIRECTION OF WATER FLOW IN BOTTOM OF CHANNEL. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. ™ WHEN USING THE DOT SYSTEM , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. PLACE CONSECUTIVE RECP's END OVER END (SHINGLE STYLE) WITH A 4" - 6" (10 CM -15 CM) OVERLAP. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10 CM) APART AND 4" (10 CM) ON CENTER TO SECURE RECP's.
5. FULL LENGTH EDGE OF RECP's AT TOP OF SIDE SLOPES MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. ADJACENT RECP's MUST BE OVERLAPPED APPROXIMATELY 2" - 5" (5 CM -12.5 CM) (DEPENDING ON RECP's TYPE) AND STAPLED.
7. IN HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT (9 M - 12 M) INTERVALS. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10 CM) APART AND 4" (10 CM) ON CENTER OVER ENTIRE WIDTH OF THE CHANNEL.
8. THE TERMINAL END OF THE RECP's MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.

BMP PICTURE

*** PICTURE AND DETAIL PROVIDED BY TENSAR NORTH AMERICAN GREEN**
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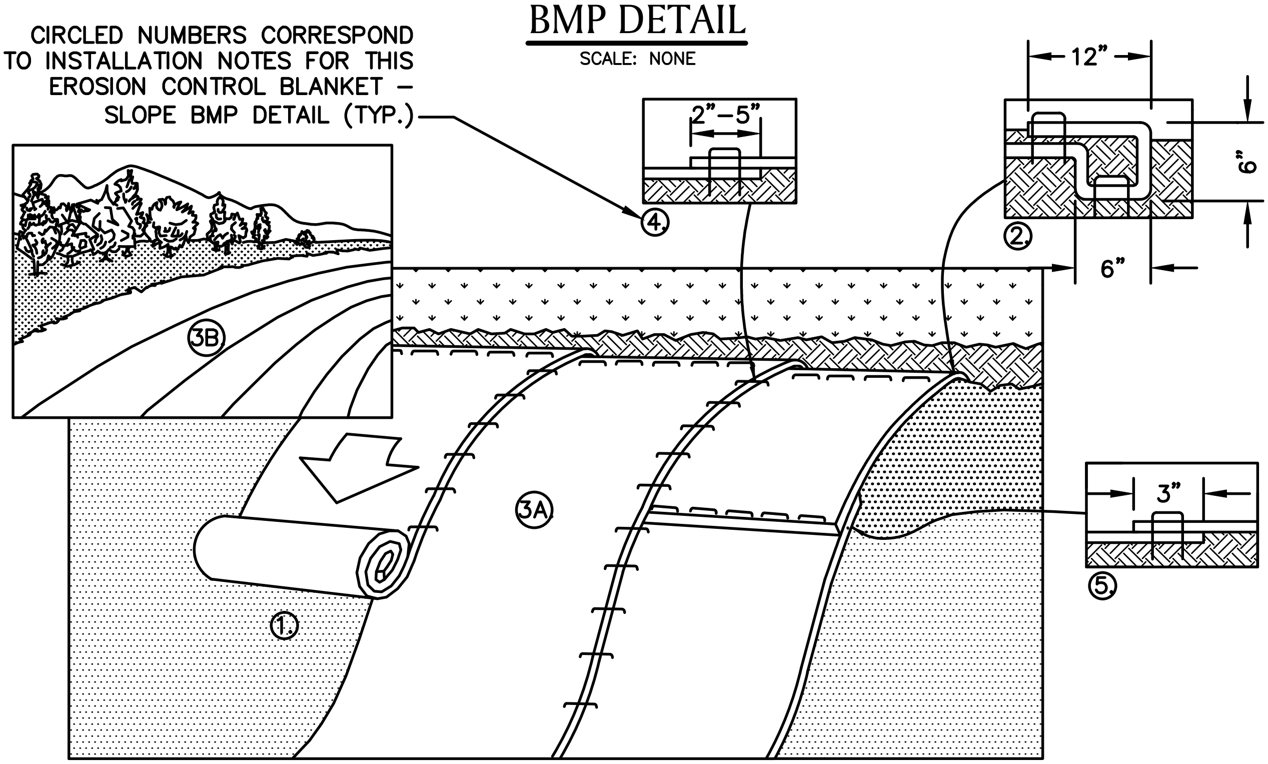
SEC-6
EROSION CONTROL BLANKET - DITCH * (2 OF 2)

File: Erosion_Blanket_Ditch.dwg

BMP DETAIL

SCALE: NONE



NOTES:

1. PRODUCT TO BE NORTH AMERICAN GREEN EROSION CONTROL BLANKET OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLES OR STAKE LENGTHS GREATER THAN 6" (15 CM) MAY BE NECESSARY TO PROPERLY SECURE THE RECP's.

INSTALLATION NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL–O–SEED DO NOT SEED PREPARED AREA. CELL–O–SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE RECP's IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH WITH APPROXIMATELY 12" (30 CM) OF RECP's EXTENDED BEYOND THE UP–SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30 CM) PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30 CM) APART ACROSS THE WIDTH OF THE RECP's.
3. ROLL THE RECP's (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES ™ IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. THE EDGES OF PARALLEL RECP's MUST BE STAPLED WITH APPROXIMATELY 2" – 5" (5 CM – 12.5 CM) OVERLAP DEPENDING ON RECP's TYPE.
5. CONSECUTIVE RECP's SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" (7.5 CM) OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" (30 CM) APART ACROSS ENTIRE RECP's WIDTH.

BMP PICTURE

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SEC-7
EROSION CONTROL BLANKET - SLOPE * (2 OF 2)

BMP PICTURE

NOTES:

1. COORDINATE MIXTURE TYPE AND APPLICATION AREAS WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST PRIOR TO CONSTRUCTION.
2. A MINIMUM OF 1500 LBS. PER ACRE OF A PAPER/CORN FIBER OR EQUIVALENT WITH NATURAL TACKIFIERS WILL BE USED ON SLOPES LESS THAN 3:1.
3. A BFM (BONDED FIBER MATRIX) WILL BE USED ON SLOPES GREATER THAN 2:1.
4. A FGM (FLEXIBLE GROWTH MATRIX) OR ESM (EXTREME SLOPE MATRIX) WILL BE USED ON SLOPES GREATER THAN 1:1.
5. REFER TO BMP #10 FOR SEED MIXTURE OPTIONS.

File: Hydroseeding.dwg

*** PICTURE PROVIDED BY TENSAR NORTH AMERICAN GREEN**
*** TACKIFIER INFORMATION PROVIDED BY FILTREXX LAND IMPROVEMENT SYSTEMS AND TENSAR NORTH AMERICAN GREEN**

APPROVED BY: VICE PRESIDENT, ENVIRONMENTAL SERVICES

SEC-8
HYDROSEEDING WITH TACKIFIER
(SLOPE STABILIZATION) *

BMP

Definition

Applying coarse plant residue or chips, or other suitable materials, to cover the soil surface.

Purpose

The primary purpose is to provide initial erosion control while a seeding or shrub planting is establishing. Mulch will conserve moisture and modify the surface soil temperature and reduce fluctuation of both. Mulch will prevent soil surface crusting and aid in weed control. Mulch is also used alone for temporary stabilization in non-growing months.

Conditions Where Practice Applies

On soils subject to erosion and on new seedings and shrub plantings. Mulch is useful on soils with low infiltration rates by retarding runoff.

Criteria

Site preparation prior to mulching requires the installation of necessary erosion control or water management practices and drainage systems.

Slope, grade and smooth the site to fit needs of selected mulch products.

Remove all undesirable stones and other debris to meet the needs of the anticipated land use and maintenance required.

Apply mulch after soil amendments and planting is accomplished or simultaneously if hydroseeding is used.

Select appropriate mulch material and application rate or material needs. Determine local availability.

Select appropriate mulch anchoring material.

NOTE: The best combination for grass/legume establishment is straw (cereal grain) mulch applied at 2 ton/acre (90 lbs./1000sq.ft.) and anchored with wood fiber mulch (hydromulch) at 500 – 750 lbs./acre (11 – 17 lbs./1000 sq. ft.). The wood fiber mulch must be applied through a hydroseeder immediately after mulching.

NOTE:

1. PICTURE DEPICTS STRAW MULCH APPLICATION (FROM MULCH SPREADER) ON STEEP SLOPE WITH AN IMPROVED DRAINAGE SWALE.
2. COORDINATE MULCH MATERIALS AND RATES WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

UPLAND ROW RESTORATION MIX – GENERAL

Species Composition Options:

- Andropogon gerardii; Niagra Big Bluestem
- Schizachyrium scoparium; Little Bluestem
- Elymus Canadensis; Canada Wild Rye
- Elymus virginicus; Virginia Wildrye
- Lolium multiflorum; Annual Ryegrass
- Sorghastrum nutans; Indiangrass
- Chamaecrista fasciculate; Partridge Pea
- Desmodium canadense; Showy Tick Trefoil
- Helioposis helianthoides; Ox–Eye Sunflower
- Panicum virgatum; Switchgrass
- Rudbeckia hirta; Black Eyed Susan
- Poa palustris; Fowl Bluegrass
- Agrostis perennans; Upland Bentgrass
- Agrostis alba; Redtop
- Festuca rubra; Red Fescue
- Lotus corniculatus; Birds–Foot Trefoil
- Chrysanthemum leucanthem; Ox–Eye Daisy
- Aster novae–angliae; New England Aster

Example Seed Mixes:

1. Native Upland wildlife forage and Cover Meadow Mix – Ernst Conservation Seeds (ERNMX–123)
2. Eastern Ecotype Native Grass Mix– Ernst Conservation Seeds (ERNMX–177)
3. New England Native Warm Season Grass Mix – New England Wetland Plants, Inc.
4. New England Logging Road Mix – New England Wetland Plants, Inc.
5. Northeast Upland Wildflower/Restoration Erosion Mix – Southern Tier Consulting (STCMX–2)

UPLAND ROW RESTORATION MIX – DRY/ROCKY SITES

Species Composition Options:

- Festuca rubra; Red Fescue
- Schizachyrium scoparium; Little Bluestem
- Elymus Canadensis; Canada Wild Rye
- Bouteloua gracillis; Blue Grama
- Lolium multiflorum; Annual Ryegrass
- Lolium perenne; Perennial Ryegrass
- Agrostics scabra; Rough Bentgrass
- Agrostis perennans; Upland Bentgrass
- Sorghastrum nutans; Indiangrass

Example Seed Mixes:

1. New England Erosion Control/ Restoration Mix for Dry Sites – New England Wetland Plants, Inc.
2. Ernst Conservation Seeds and similar companies can create a custom seed mix matching the composition above (with site specific additions if necessary).

WETLAND ROW RESTORATION MIX

Species Composition Options:

- Agrostis stolonifera; Creeping Bentgrass
- Poa trivialis; Rough Bluegrass
- Alopecurus arundinaceus; Creeping Meadow Foxtail
- Lolium multiflorum; Annual Ryegrass
- Festuca rubra; Creeping Red Fescue
- Elymus virginicus; Virginia Wildrye
- Schizachyrium scoparium; Little Bluestem
- Andropogon gerardii; Niagra Big Bluestem
- Carex vulpinoidea; Fox sedge
- Panicum virgatum; Switchgrass
- Agrostis scabra; Rough Bentgrass
- Aster novae-angliae; New England Aster
- Eupatorium perfoliatum; Boneset
- Euthamia graminifolia; Grass Leaved Goldenrod
- Scirpus atrovirens; Green Bulrush
- Verbene hastate; Blue Vervain
- Juncus effusus; Soft Rush
- Scirpus cyperinus; Wool Grass
- Panicum clandestinum; Deertongue

Example Seed Mixes

1. New England Erosion Control/Restoration Mix for Detention Basins and Moist Sites – New England Wetland Plants, Inc.
2. Northeast Wetland Grass Seed Mix – Southern Tier Consulting (STCMX-7)
3. Ernst Conservation Seeds and similar companies can create a custom seed mix matching the composition above (with site specific additions if necessary).

GERNERAL NOTES:

1. Seed mixes described herein are intended to cover a variety of typical new england landscapes. However, site specific seed mixes will need to be evaluated in coastal or mountainous regions.
2. Seed mixes described herein are intended for general ROW restoration. Site specific wetland seed mixes may be required by local, state and/or federal regulators for certain impacts to wetlands.
3. All seed mixes are to be approved by National Grid Environmental Scientist prior to construction and must conform with all project permits.
4. Seedbed preparation and maintenance as well as temporary erosion and sediment controls are crucial to the establishment of newly seeded areas. Coordinate with National Grid Environmental Scientist on seed bed preparation and maintenance as well as temporary erosion and sediment controls prior to construction.

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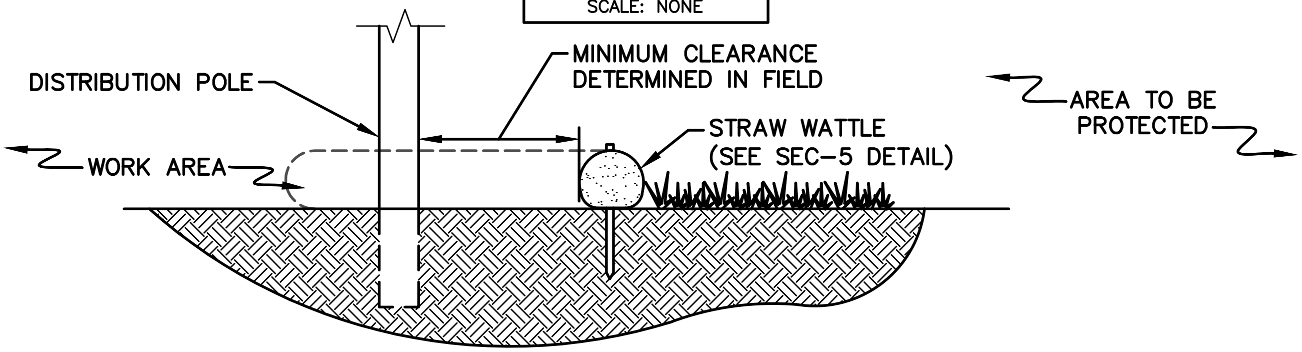
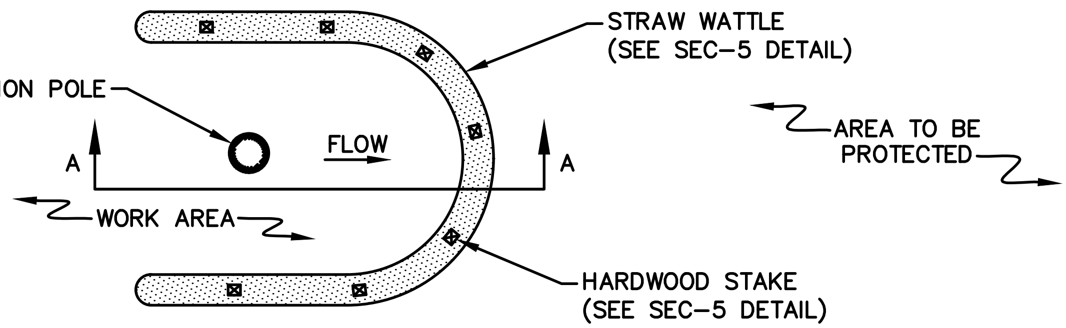
BMP DETAIL

SCALE: NONE



SECTION A–A



PLAN

NOTES

1. PRODUCT TO BE STRAW WATTLE OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST (SEE SEC–5 BMP DETAIL).
2. STRAW BALE BARRIER PER SEC–1 BMP DETAIL TO BE AN AVAILABLE ALTERNATE DEPENDING ON SITE CONDITIONS AT THE DIRECTION OF NATIONAL GRID ENVIRONMENTAL SCIENTIST (SEE FIGURE 2).
3. MINIMUM CLEARANCE BETWEEN POLE AND EROSION CONTROL TO BE DETERMINED BY CONDITIONS OF POLE INSTALLATION/REPLACEMENT WORK AND ASSOCIATED DISTURBANCE.

BMP PICTURE

FIGURE 1: TYP. STRAW WATTLE APPLICATION

FIGURE 2: ALT. STRAW BALE APPLICATION

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SEC-12
DISTRIBUTION POLE
SEDIMENT CONTROL

File: SiltSOXX.dwg

BMP PICTURE

SCALE: NONE

NOTES:

1. PRODUCT TO BE ALTURNAMATS' PREFABRICATED MATS OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. PRODUCT AVAILABLE IN 4X8' UNITS.
3. IF MATS ARE INSTALLED IN A WETLAND AREA, INSTALL EROSION CONTROLS TO CONTAIN MATERIAL UTILIZED IN THE MAT TRANSITIONS.

File: Prefab_Mats.dwg

* PICTURE PROVIDED BY ALTURNAMATS

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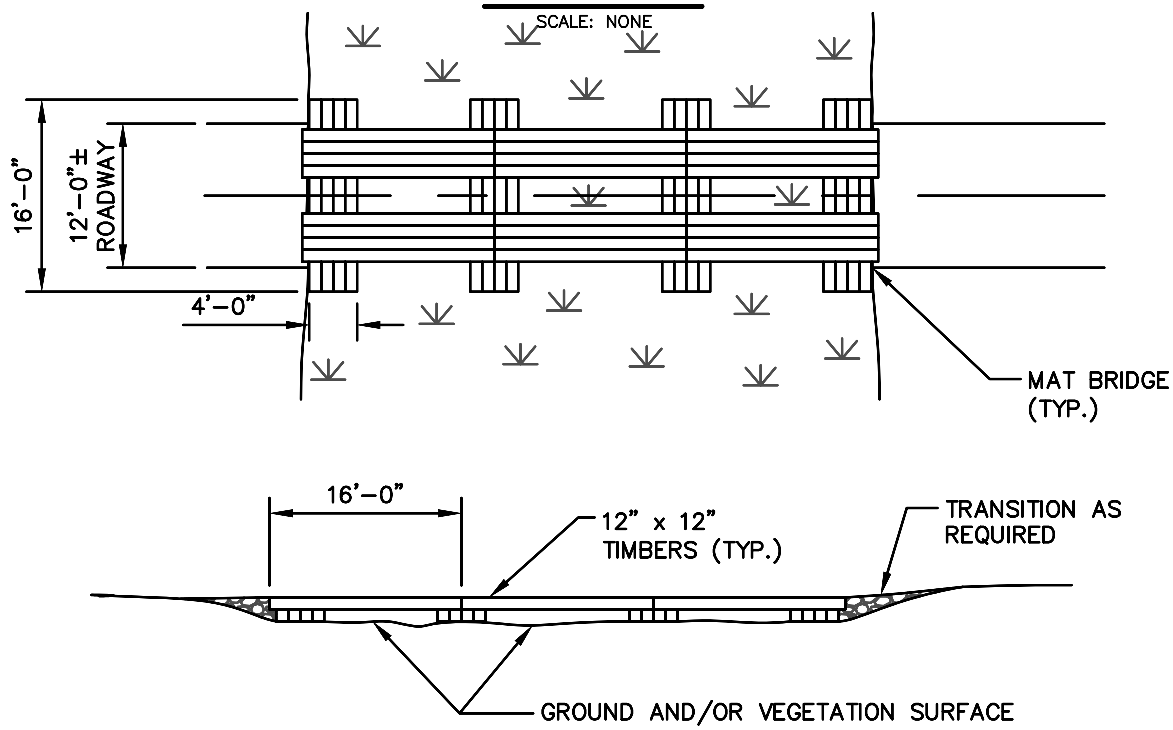
CM-1
PREFABRICATED MATS *

BMP DETAIL



NOTES:

1. IF MATS ARE INSTALLED IN A WETLAND AREA, INSTALL EROSION CONTROLS TO CONTAIN MATERIAL UTILIZED IN THE MAT TRANSITIONS.

BMP PICTURE

BMP PICTURE - SINGLE SPAN

SCALE: NONE

NOTES:

1. WHERE STREAM WIDTH ALLOWS, INSTALL CONSTRUCTION MATS TO SPAN THE WATERCOURSE IN ITS ENTIRETY WITHOUT STRINGER PLACEMENT IN THE WATER OR ANY RESTRICTION OF STREAM FLOW.

2. INSTALLATION OF THE CONSTRUCTION MAT BRIDGE SHALL NOT DAMAGE THE STREAM BED AND BANKS. WHERE POSSIBLE, FOOTERS SHALL BE PLACED PARALLEL TO THE TOP OF THE STREAM BANKS, WITH ACCESS MATTING PLACED ACROSS THE TOP OF THE STRINGERS DISTRIBUTING THE WEIGHT OF THE CONSTRUCTION EQUIPMENT.

3. AT STREAM CROSSINGS THAT CANNOT BE SPANNED BY A SINGLE SECTION OF CONSTRUCTION MATTING, AND WHERE PERMITS ALLOW, STRINGERS SHALL BE PLACED ATOP THE STREAM BED PARALLEL TO THE FLOW OF WATER.

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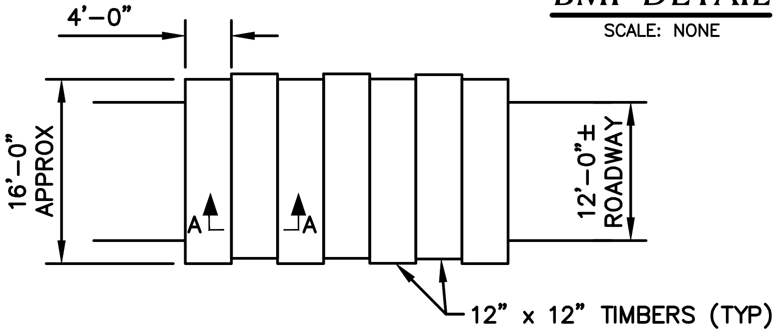
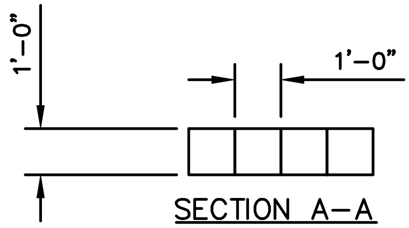
BMP DETAIL

SCALE: NONE

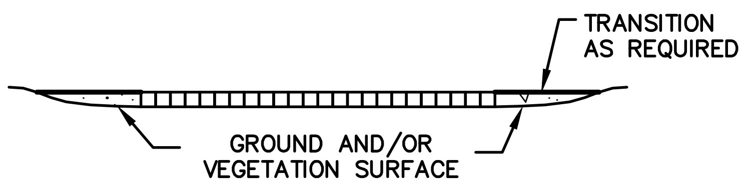


TYPICAL PLAN VIEW



SECTION A-A

TYPICAL MAT SECTION BOLTED TOGETHER



TYPICAL SECTION VIEW

NOTES:

1. TO BE INSTALLED IF NECESSARY TO PREVENT RUTTING, TO ACCESS STRUCTURES.
2. THIS DETAIL SHOWS TYPICAL DIMENSIONS. SOME CONTRACTOR'S CONSTRUCTION MATS ARE DIMENSIONALLY DIFFERENT FROM WHAT IS SHOWN HERE.
3. DEPENDENT ON SITE CONDITIONS, MULTIPLE LAYERS OF CONSTRUCTION MATS MAY BE INSTALLED.

BMP PICTURE

File: Swamp_Mat_Layout.dwg

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CM-3

CONSTRUCTION MAT LAYOUT (WITH TRANSITION)

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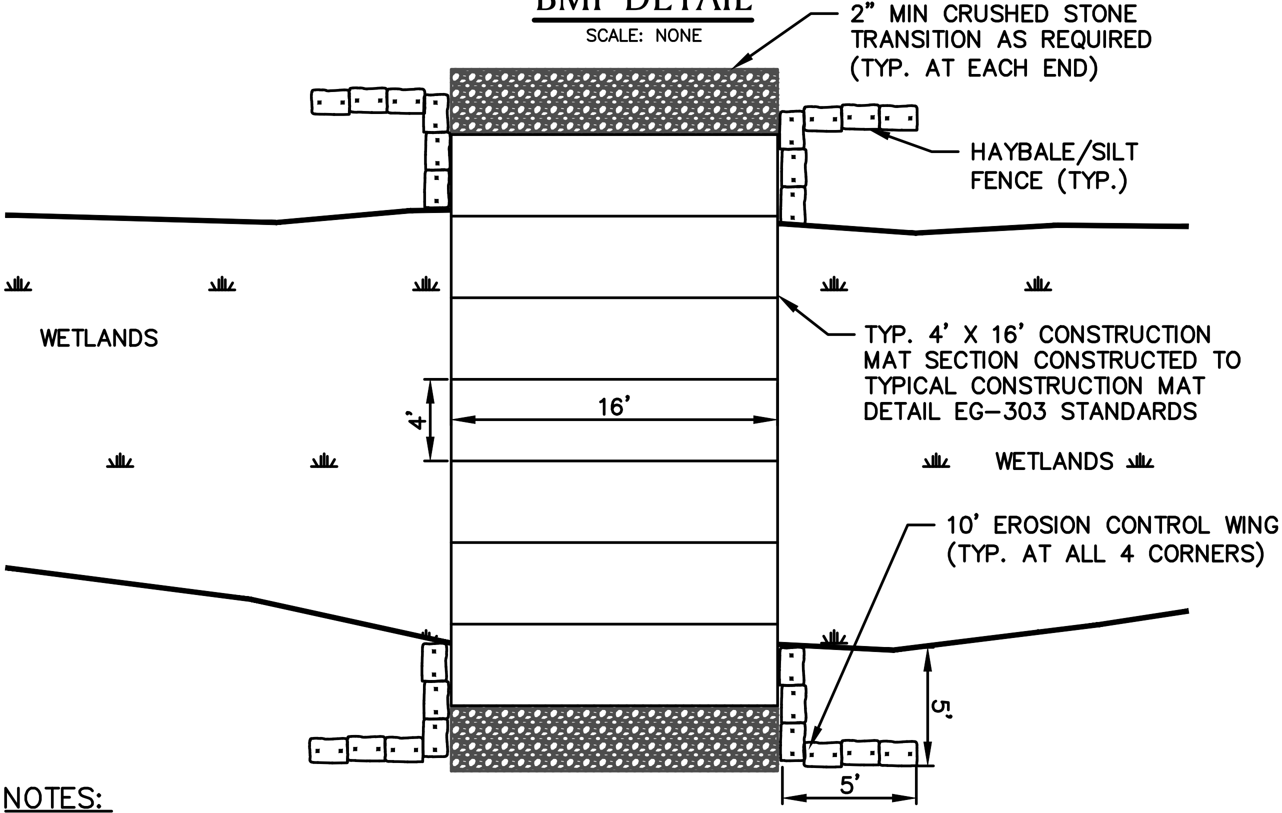
BMP DETAIL

SCALE: NONE



NOTES:

1. ADD FILTER FABRIC AS NEEDED UNDER STONE TRANSITION RAMPS.
2. ALL MEASUREMENTS AND LOCATIONS ARE APPROXIMATE.

BMP PICTURE

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CM-4

CONSTRUCTION MAT LAYOUT (WITH TRANSITION AND BMPs)

File: Swamp_Mat_Transition and BMPs.dwg

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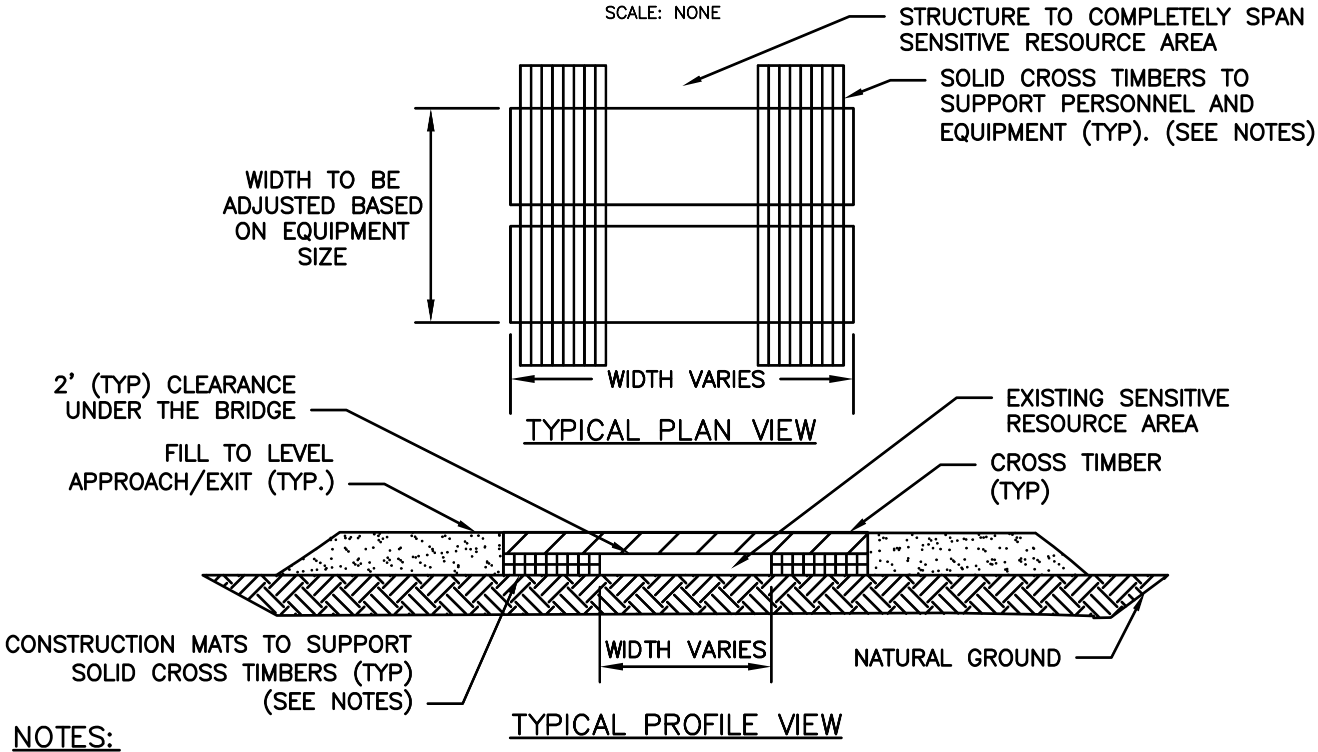
BMP DETAIL

SCALE: NONE



NOTES:

1. THE DETAIL SHOWN IS CONCEPTUAL. CONSTRUCTION MATS AND CROSS TIMBERS SHALL BE SIZED AND SELECTED BASED ON SPAN WIDTH, CROSSING EQUIPMENT AND FIELD CONDITIONS.
2. THE NUMBER OF CONSTRUCTION MATS MAY VARY DEPENDING ON THE CLEARANCE HEIGHT.
3. EQUIPMENT AND PERSONNEL LOAD SHALL BE DISTRIBUTED ON ALL TIMBERS.
4. EACH EQUIPMENT OPERATOR AND USER OF THE FIELD BRIDGE SHALL BE FAMILIAR WITH THE DESIGN AND THE MAXIMUM EQUIPMENT AND PERSONNEL LOADS.
5. THIS DETAIL MAY NOT BE APPLICABLE IN ALL FIELD CONDITIONS.
6. INSTALL EROSION CONTROLS ADJACENT TO THE CULVERT ENDS TO PROTECT THE WATERWAY FROM ROADWAY DEBRIS.

BMP PICTURE

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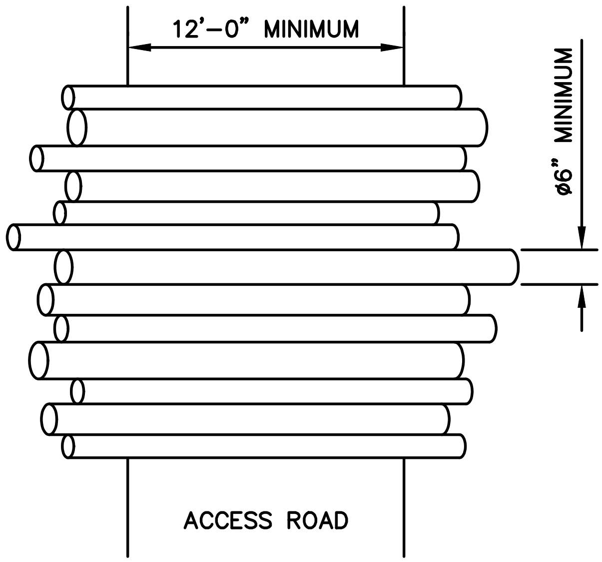
CM-5
CONSTRUCTION MAT - AIR BRIDGE

File: Swamp_Mat_AIR BRIDGE.dwg

BMP DETAIL

SCALE: NONE



RANDOM LENGTH AND DIAMETER LOGS PLACED ACROSS AN ACCESS ROAD

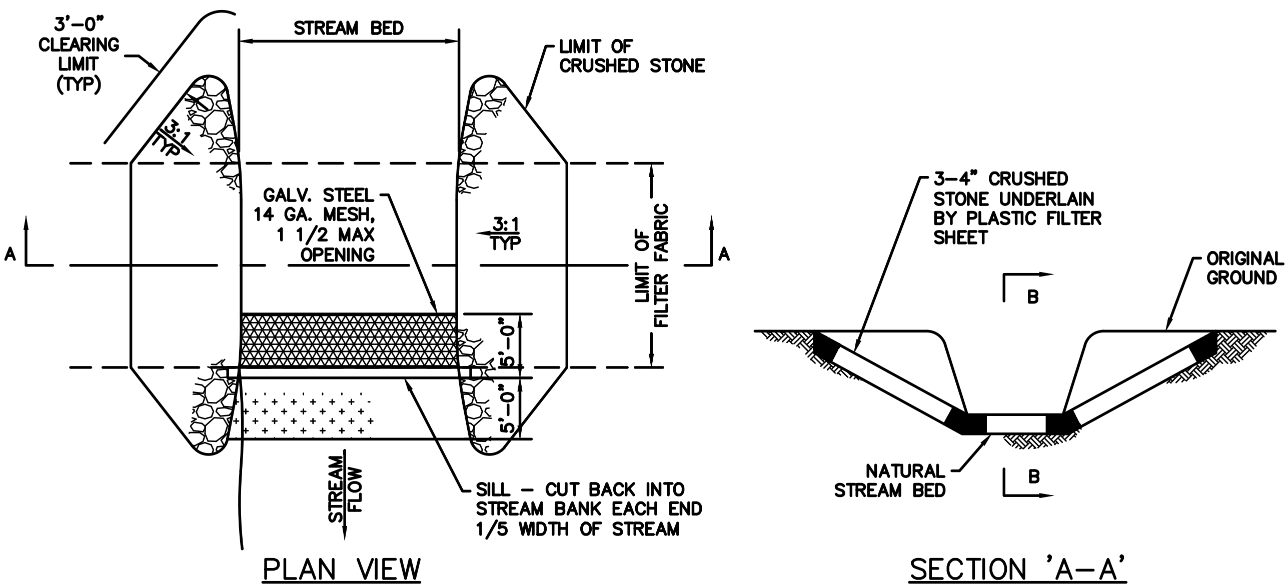
NOTE:

1. A SIMILAR BRUSH MAT INSTALLATION CONSISTING OF SMALLER DIAMETER STEMS AND LOGS CAN BE USED.
2. CORDUROY ROADS SHALL ONLY BE USED IN EMERGENCIES OR AFTER APPROVAL FROM THE PROJECT ENVIRONMENTAL CONSULTANT OR NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

BMP DETAIL

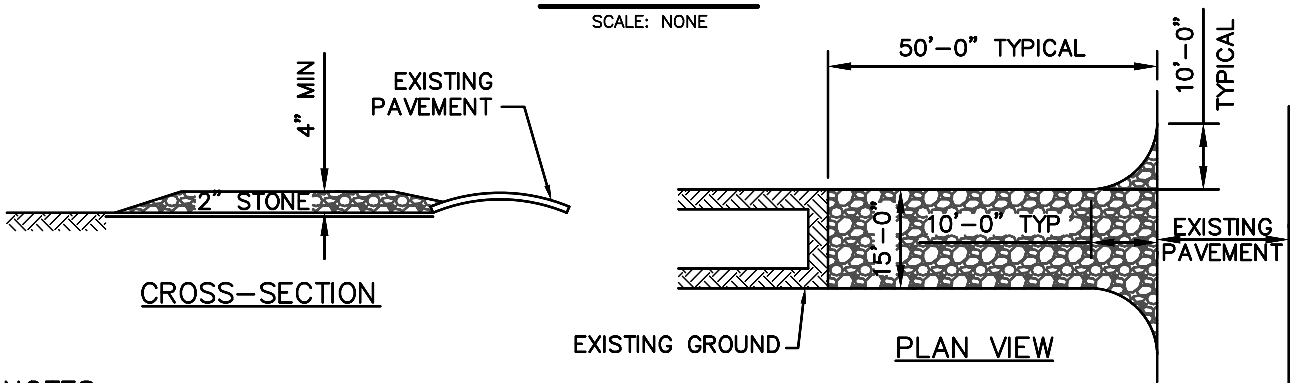
SCALE: NONE



BMP PICTURE

BMP DETAIL

SCALE: NONE



NOTES:

1. STONE SIZE – USE 2" STONE (MINIMUM) TO 6" STONE (MAXIMUM)
2. LENGTH – GREATER THAN OR EQUAL TO 50 FEET
3. THICKNESS – 4"
4. WIDTH – FIFTEEN (15) FOOT TYP., BUT NOT LESS THAN FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS.
5. SURFACE WATER – ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS ENTRANCE. IF PIPING IS IMPRACTICAL, MOUNTABLE BERM SHALL BE PERMITTED.
6. MAINTENANCE – THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH SHALL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED IMMEDIATELY.
7. PERIODIC INSPECTION AND NEEDED MAINTENANCE SHALL BE PROVIDED.
8. THE CLEAN STONE SHOULD BE INSTALLED OVER A GEOTEXTILE FABRIC. GEOTEXTILE FABRIC MAY BE OMITTED FOR PERMANENT CONSTRUCTION ENTRANCES/EXITS ON A CASE-BY-CASE BASIS WITH THE APPROVAL OF THE NATIONAL GRID ENVIRONMENTAL SCIENTIST.
9. FOLLOWING CONSTRUCTION, THE CONSTRUCTION ENTRANCE/EXIT SHALL BE REMOVED AND THE AREA GRADED, SEEDED, AND MULCHED AS NEEDED. ENTRANCE/EXITS MAY REMAIN DEPENDING UPON FUTURE ACCESS NEEDS AND/OR PROJECT-SPECIFIC APPROVALS BUT REQUIRES APPROVALS FROM THE NATIONAL GRID ENVIRONMENTAL SCIENTIST AND PROPERTY LEGAL.

BMP PICTURE

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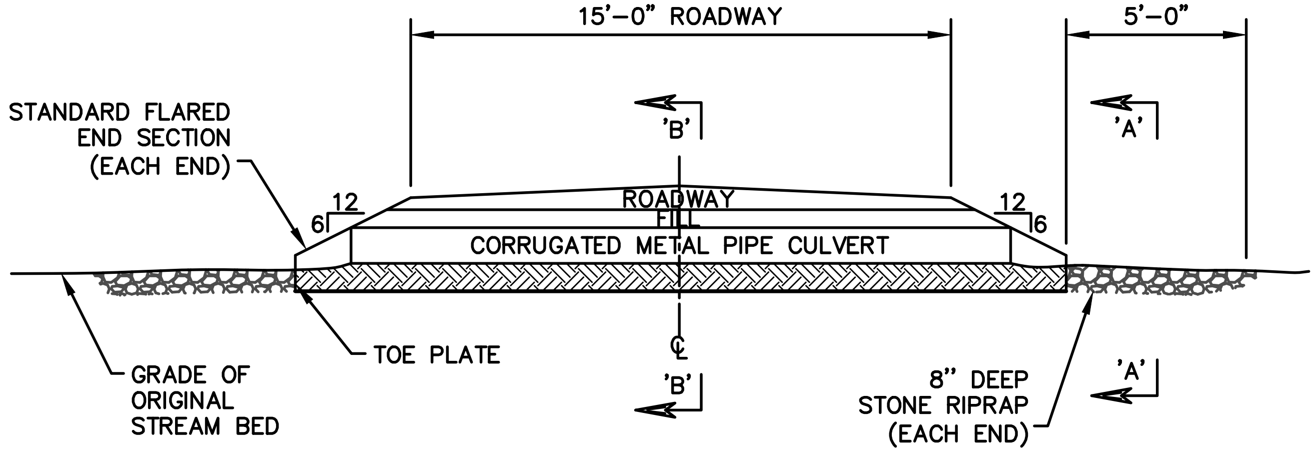
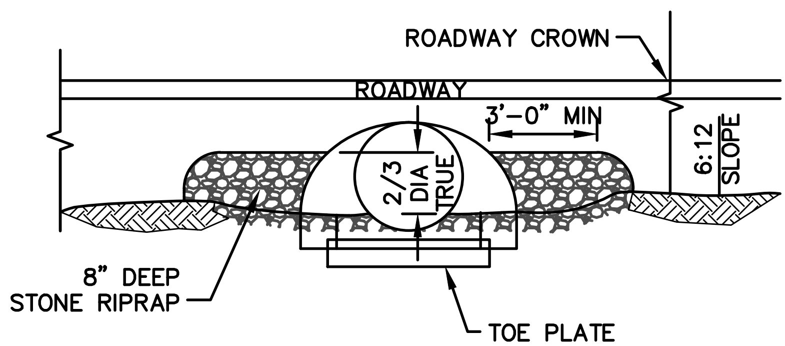
BMP DETAIL

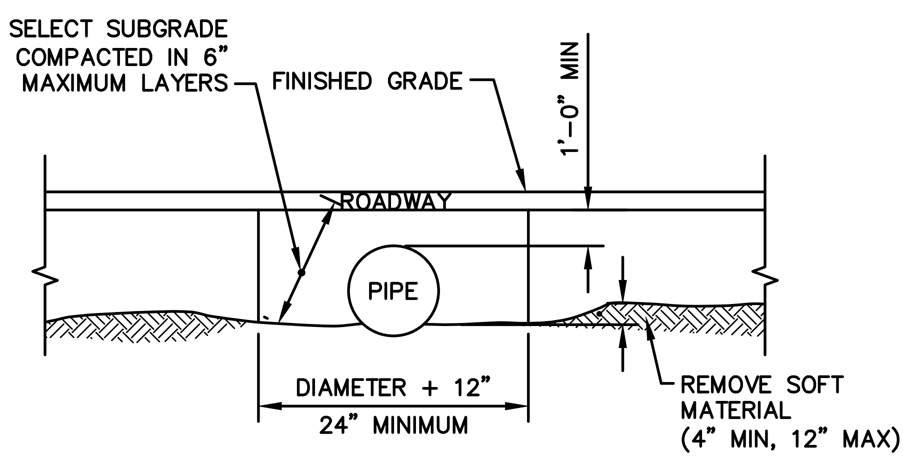
SCALE: NONE



CROSS SECTION



SECTION 'A–A'
(SAME BOTH ENDS)



SECTION 'B–B'

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CM-9
TEMPORARY CONSTRUCTION CULVERT (1 OF 2)

File: Temp_Constr_Culvert.dwg

BMP DETAIL

SCALE: NONE

NOTES:

1. CULVERT DESIGN AND LAYOUT SHALL BE COORDINATED WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST (NGES).
2. CROWN ROADWAY 1/2 INCH PER FOOT.
3. LAY THE CULVERT STRAIGHT AND AS NEARLY AS POSSIBLE ALONG THE EXISTING STREAM BED AND WITH THE INVERTS AT OR SLIGHTLY BELOW BED ELEVATION.
4. CORRUGATED METAL PIPE IS TO BE GALVANIZED STEEL, OR ALUMINIZED STEEL (TYPE 2), WITH BOLTED CONNECTORS.
5. DIAMETERS SHALL BE AS PER THE PROJECT DRAWINGS AND THE SPECIFICATION. THE PIPE GAGE SHALL BE AS FOLLOWS:

DIAMETER (INCHES)	GAGE
12" – 15"	.004"
18" – 24"	.079"
30" – 36"	.109"

6. INSTALLATION OF CULVERTS LARGER THAN 36 INCH DIAMETER SHALL REQUIRE SPECIAL ENGINEERING DESIGN.
7. SELECT SUBGRADE SHALL BE A GRANULAR MATERIAL AS DESCRIBED IN NYSDOT SPECIFICATION ITEM 203–2.02C, OR AS APPROVED BY A NGES.
8. STONE RIPRAP SHALL BE AS DESCRIBED IN NYSDOT SPECIFICATION ITEM 203–2.02D, WITH 8 INCH MAXIMUM SIZE, OR AS APPROVED BY A NGES. EXCEPT WHERE PROTECTED BY STONE, ALL EMBANKMENT SLOPES ARE TO BE STABILIZED, MULCHED AND SEEDED AS PER PROJECT SPECIFICATIONS.
9. OUTLET SHOULD BE CONFIGURED NOT TO CREATE HYDRAULIC JUMP OR PLUNGE POOL.
10. INSTALL EROSION CONTROLS ADJACENT TO THE CULVERT ENDS TO PROTECT THE WATERWAY FROM ROADWAY DEBRIS.

BMP PICTURE

CM-9
TEMPORARY CONSTRUCTION CULVERT (2 OF 2)

BMP PICTURE

NOTE:

1. PICTURE SHOWS VIEW OF ACCESS WAY STABILIZATION ADJACENT TO A WETLAND.
2. COORDINATE STABILIZATION DESIGN AND PRODUCT WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

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BMP PICTURE


NO ACCESS – WETLAND/STREAM CROSSING MATS REQUIRED

NO ACCESS – A.) PROJECT LIMITS E.G. ROW LIMITS
B.) HISTORICAL/CULTURAL
C.) ENVIRONMENTALLY SENSITIVE E.G. THREATENED & ENDANGERED
D.) OTHER

APPROVED ACCESS

File: Construction_Signage.dwg

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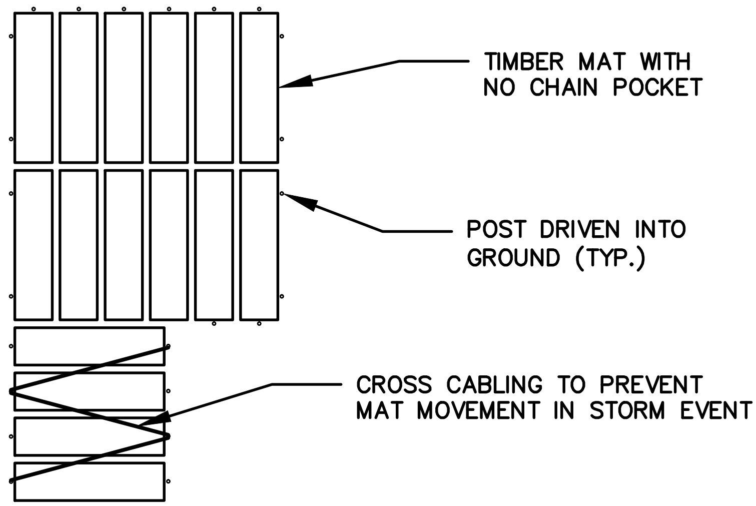
CM-11
CONSTRUCTION SIGNAGE

BMP DETAIL 1

SCALE: NONE



TYPICAL PLAN VIEW

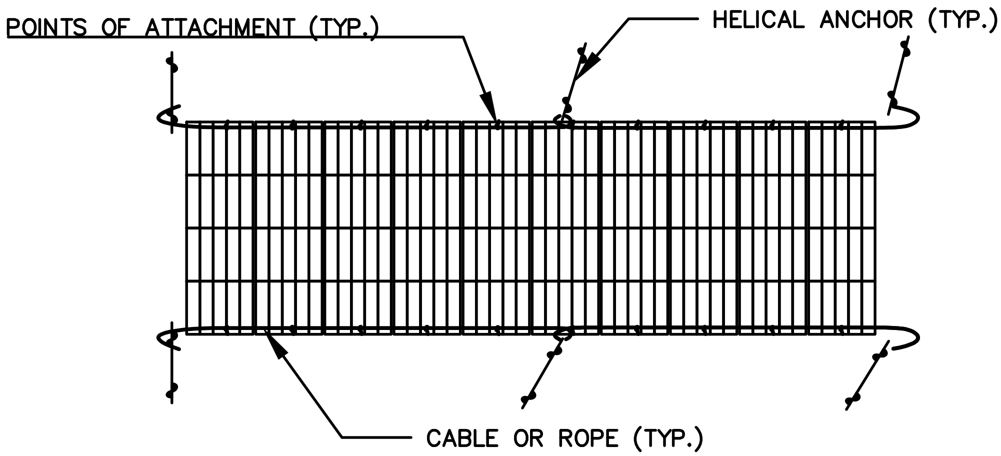
NOTES:

1. EXAMPLES OF ANCHORING ONLY. MATTING CONTRACTOR SHALL PROPOSE THE METHOD OF ANCHORING BASED ON FIELD CONDITIONS.
2. ANCHORING METHOD TO BE APPROVED BY THE NATIONAL GRID ENVIRONMENTAL SCIENTIST AND TRANSMISSION LINE CONSTRUCTION SUPERVISOR.

BMP DETAIL 2

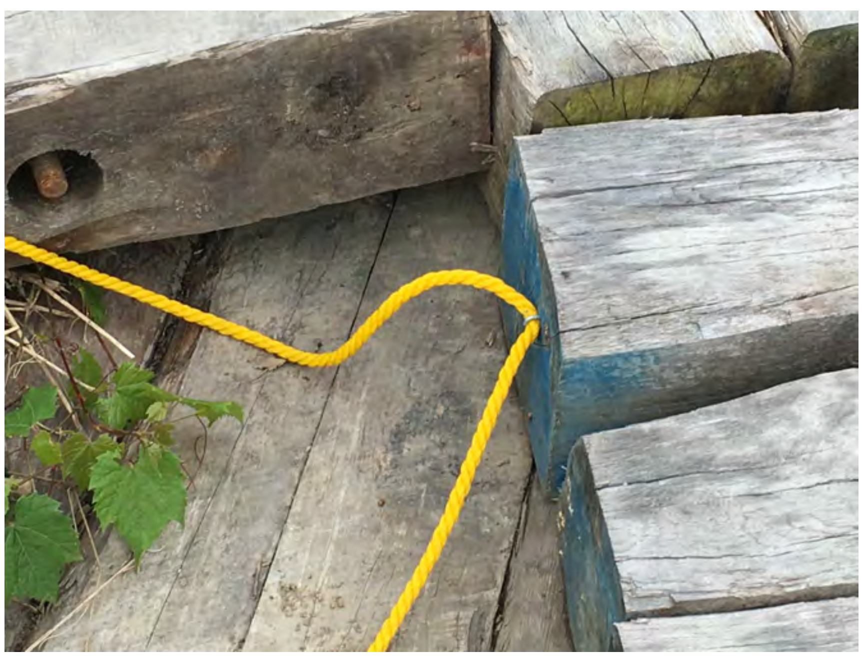
NOTES:

1. TYPICAL HELICAL ANCHOR AND CABLE CONFIGURATION FOR MAT CONTAINMENT IN FLOODPLAINS/LAND SUBJECT TO FLOODING.
2. TYPICAL POINTS OF ATTACHMENT HEAVY STAPLES, EYE BOLTS OR OTHER SUITABLE HARDWARE TO SECURE ATTACHMENT OF MAT TO LINEAR CABLE. IF CHAIN POCKETS ARE PRESENT IN THE MATS CABLE OR ROPE CAN BE LOOPED THROUGH RODS.



BMP PICTURE 1

BMP PICTURE 2



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CM-12
EXAMPLE OF CONSTRUCTION MAT ANCHORING (2 OF 2)

BMP DETAIL

SCALE: NONE

WIRE BACKED SILT FENCE

MUTUAL INDUSTRIES WIRE BACKED SILT FENCE
PART # 1776–14–24
36" X 100'
36" MISF 1776 FABRIC
24" 14GA WIRE MESH
OPENING OF MESH 2" X 4"
FABRIC HOG RINGED EVERY 12"–18" ALONG THE TOP OF THE FENCE

ROLL WEIGHT 40 LBS

32 ROLLS PER PALLET

NOTES:

1. PRODUCT TO BE MUTUAL INDUSTRIES' WIRE BACKED SILT FENCE OR APPROVED EQUAL BY NATIONAL ENVIRONMENTAL SCIENTIST.
2. COORDINATE INSTALLATION METHOD AND LOCATION WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

File: Reinforced_Silt_Fence.dwg

*** PICTURE AND DETAIL PROVIDED BY MUTUAL INDUSTRIES**
APPROVED BY: VICE PRESIDENT, ENVIRONMENTAL SERVICES

AA-1
REINFORCED SILT FENCE *

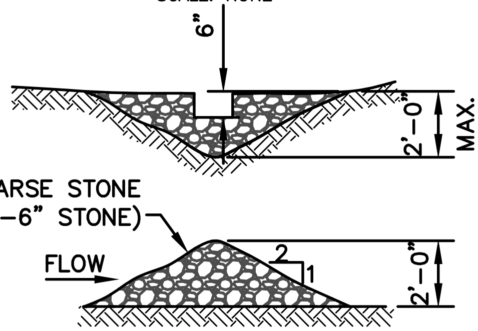
BMP PICTURE

NOTE:

1. PICTURE SHOWS SEDIMENT FILTER WITHIN A WETLAND.

BMP DETAIL

SCALE: NONE



STONE CHECK DAM

NOTES:

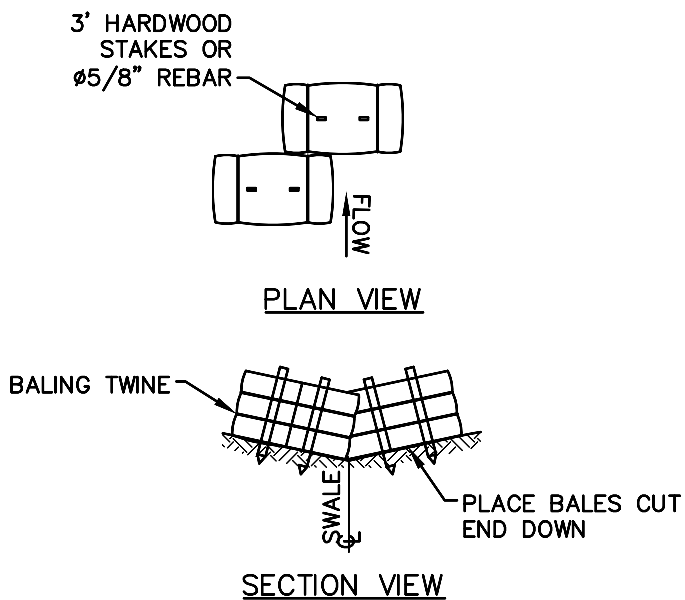
1. USE CHECK DAMS TO SLOW WATER FLOWS AND AS SMALL SEDIMENT TRAPS IN DITCHES ALONG ACCESS ROADS.
2. CLEAN SEDIMENT AND REPLACE DAMS AS NECESSARY.
3. THE CENTER OF THE CHECK DAM MUST BE AT LEAST 6" LOWER THAN THE OUTER EDGES.
4. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
5. MAX. SPACING: TOE OF THE UPSTREAM DAM IS SAME ELEVATION AS TOP OF DOWNSTREAM DAM.
6. STONE SHALL BE FREE OF FINE PARTICLES TO PREVENT TURBID DISCHARGES.

BMP PICTURE

NOTE: A SMALLER STONE SIZE IS SHOWN IN THIS PICTURE.

BMP DETAIL

SCALE: NONE



NOTES:

1. USE CHECK DAMS TO SLOW WATER FLOWS AND AS SMALL SEDIMENT TRAPS IN DITCHES ALONG ACCESS ROADS.
2. CLEAN SEDIMENT AND REPLACE DAMS AS NECESSARY.
3. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

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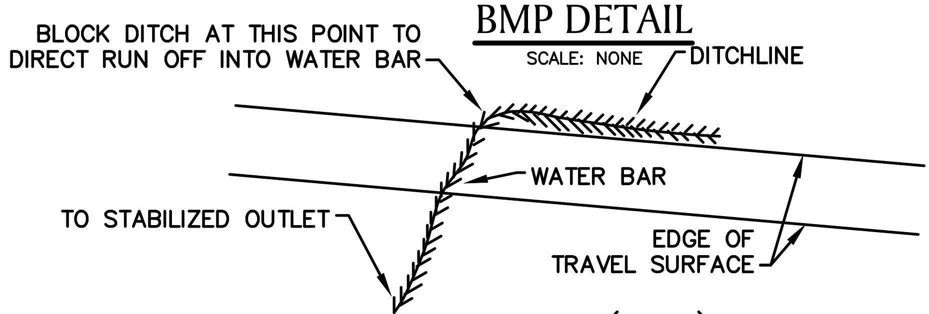
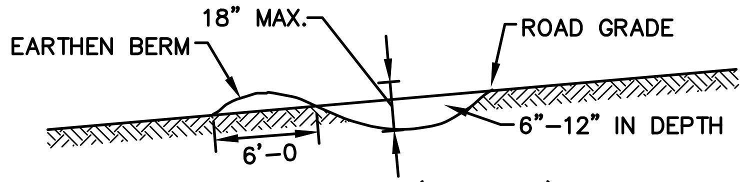
BMP DETAIL

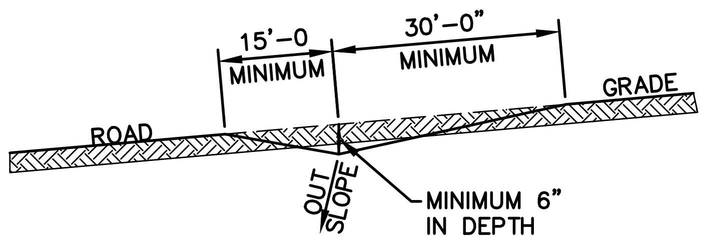
SCALE: NONE



WATERBAR (PLAN)



WATERBAR (SECTION)



DISCHARGE (SECTION)

NOTE:

1. LINE WITH 2"–6" STONE UNDERLAIN BY GEOTEXTILE FILTER FABRIC, KEYED INTO ROAD SURFACE AT LEAST 10 FEET EACH SIDE OF WATERBAR.
2. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

File: Waterbar.dwg

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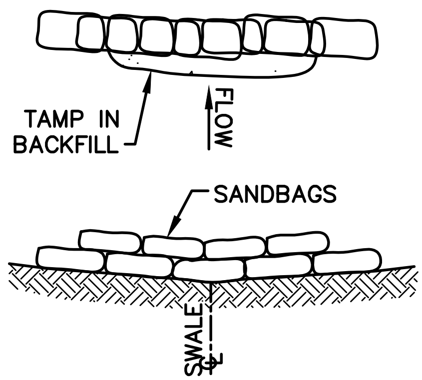
AA-5
WATERBAR

BMP DETAIL

SCALE: NONE



SANDBAG
CHECK DAM

NOTES:

1. USE CHECK DAMS TO SLOW WATER FLOWS AND AS SMALL SEDIMENT TRAPS IN DITCHES ALONG ACCESS ROADS.
2. CLEAN SEDIMENT AND REPLACE DAMS AS NECESSARY.
3. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

NOTE:

1. PICTURE DOES NOT DEPICT "TAMP IN BACKFILL"

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BMP PICTURE

NOTE:

1. EXACT SIZE, LOCATION AND DESIGN IS DEPENDANT ON SITE CONDITIONS, AND LOCAL AND STATE REGULATIONS. COORDINATE THIS BMP WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST PRIOR TO CONSTRUCTION.

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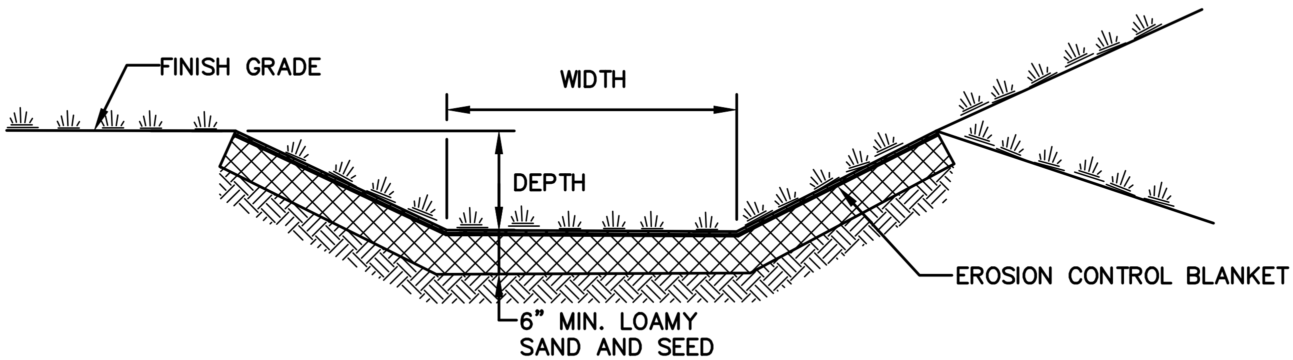
AA-7
EARTH DIKE

File: Earth_Dike.dwg

BMP DETAIL

SCALE: NONE



NOTES:

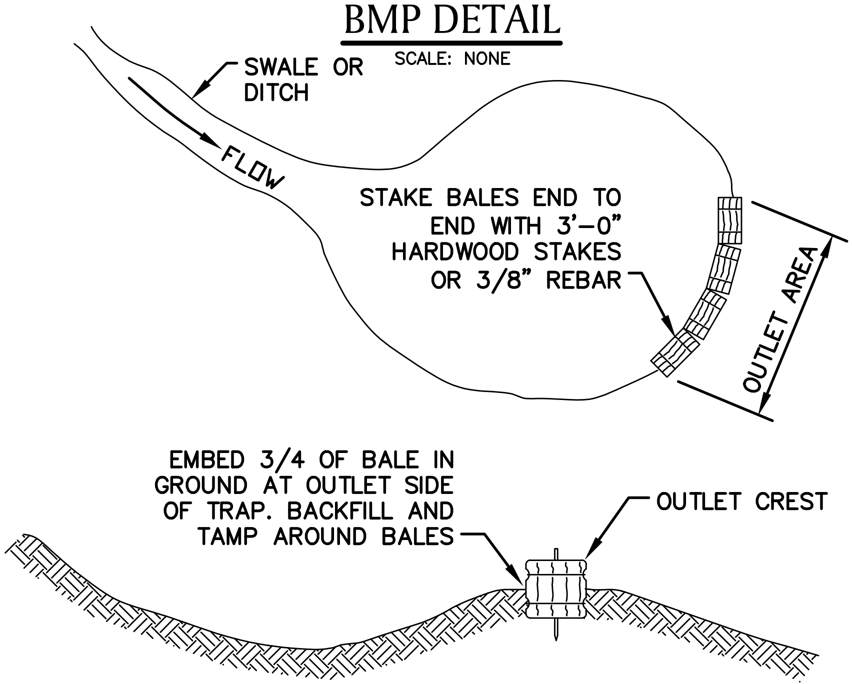
1. WIDTH AND DEPTH OF SWALE, AND EROSION CONTROL BLANKET TYPE TO BE COORDINATED WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. REFER TO DETAILS SEC-10 AND SEC-11 FOR SEED MIXTURE OPTIONS.

BMP PICTURE

AA-8
DRAINAGE SWALE AND
LINED DITCH

BMP DETAIL

SCALE: NONE



TYPICAL PROFILE

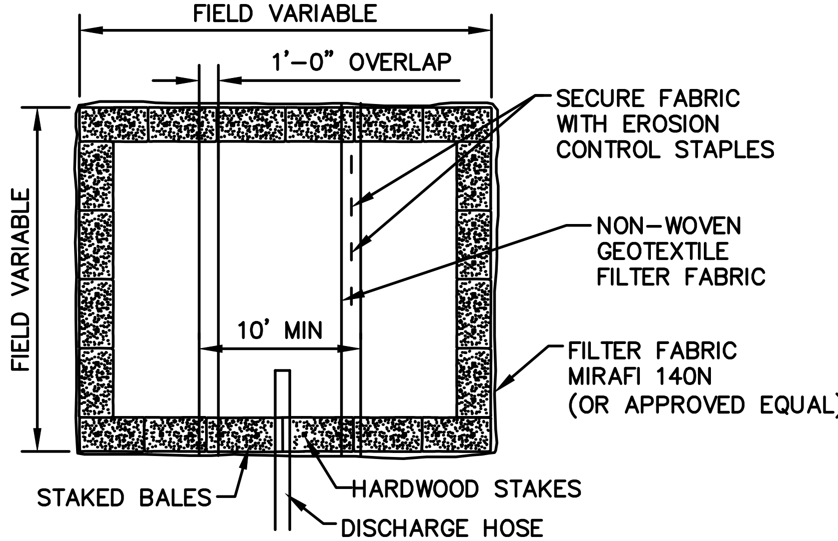
NOTES

1. SIZE, SHAPE AND PROFILE OF SEDIMENT WILL VARY ACCORDING TO ANTICIPATED FLOW VOLUME AND SURROUNDING TERRAIN AND SHALL BE COORDIANTED WITH THE NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. THE BASIN SHALL BE CUT BELOW THE GROUNDLINE. FILL SHALL NOT BE USED TO HOLD WATER UNLESS ROLLED AND COMPACTED.
3. OUTLET AREA IS TO REMAIN FREE OF EXCAVATION SPOILS.
4. OUTLET CREST ELEVATION SHALL BE LOWER THAN INLET ELEVATION AND AT LEAST 1'-0" BELOW THE TOP OF THE BASIN.ARMOUR SLOPES >8% IN OUTLET AREA WITH STONE OF APPROPRIATE SIZE TO PREVENT SCOUR.
5. ARMOUR SLOPES >8% IN OUTLET AREA WITH STONE OF APPROPRIATE SIZE TO PREVENT SCOUR.

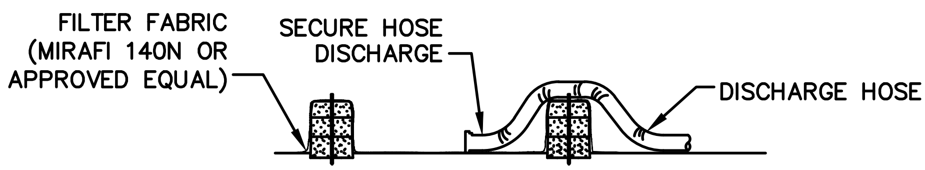
BMP PICTURE

BMP DETAIL

SCALE: NONE



PLAN VIEW



CROSS–SECTION

NOTES:

1. NUMBER OF BALES MAY VARY DEPENDING ON SITE CONDITIONS,
2. THE BASIN TO BE SIZED TO PREVENT DISCHARGE WATER FROM OVERTOPPING BASIN.
3. KEEP AS FAR FROM WETLANDS AS PRACTICAL.
4. CLEAN AND REMOVE AS SOON AS DEWATERING IS COMPLETE.

BMP PICTURE

AA-10
DEWATERING BASIN
(SMALL SCALE)

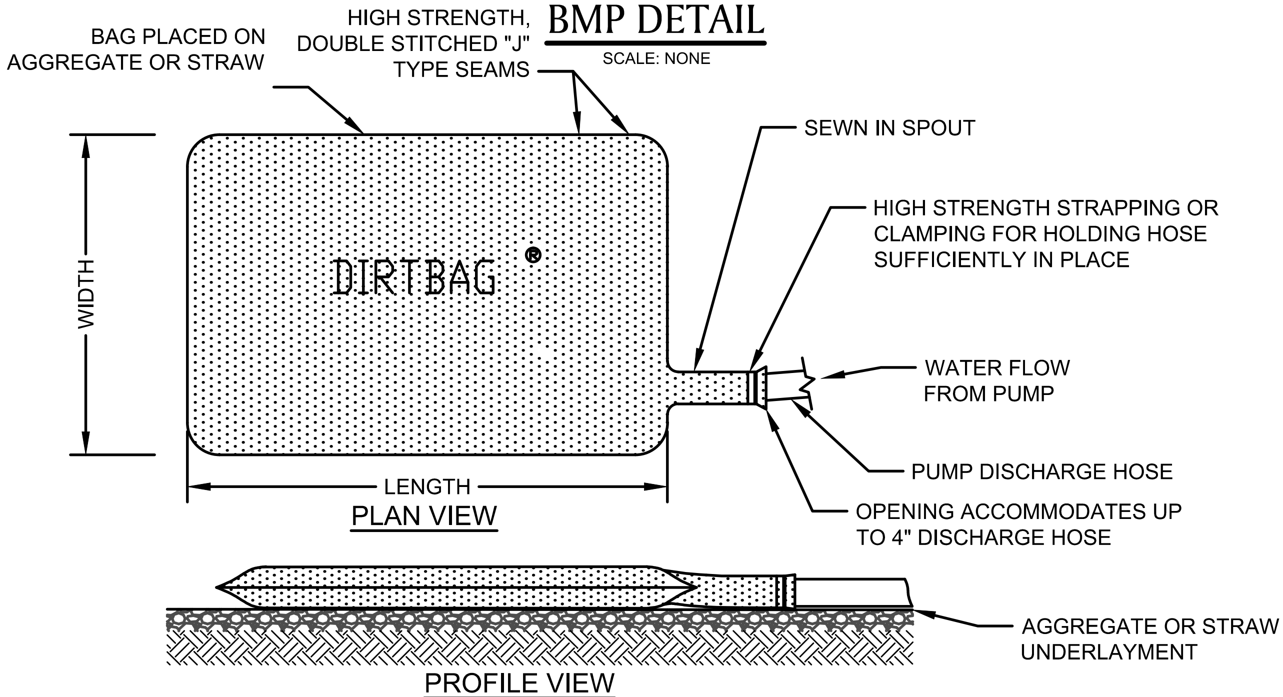
BMP PICTURE

NOTE:

1. EXACT SIZE, LOCATION AND DESIGN IS DEPENDANT ON SITE CONDITIONS, AND LOCAL AND STATE REGULATIONS. COORDINATE THIS BMP WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST PRIOR TO CONSTRUCTION.

BMP DETAIL

SCALE: NONE



NOTE:
ONCE PUMPING COMMENCES, THE DIRT BAG SHALL BE MONITORED FREQUENTLY TO ASSURE THAT THE CONNECTIONS ARE SECURELY FASTENED AND THE RATE OF WATER DELIVERY TO THE STRUCTURE IS LOW ENOUGH TO PREVENT UNFILTERED WATER FROM FLOWING FROM THE HOSE CONNECTIONS OR BAG.

BMP PICTURE

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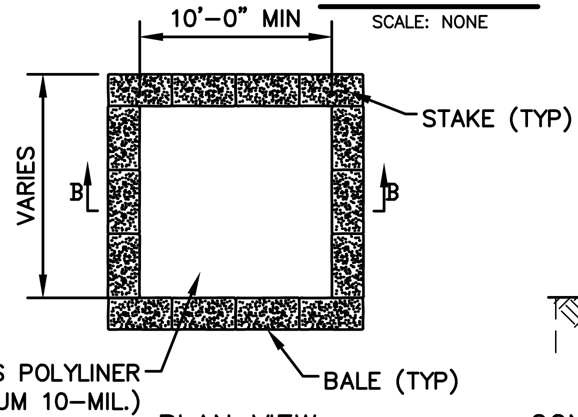
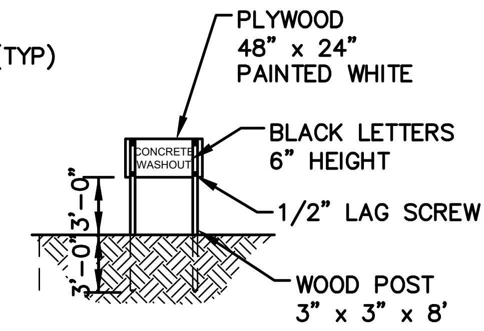
BMP DETAIL

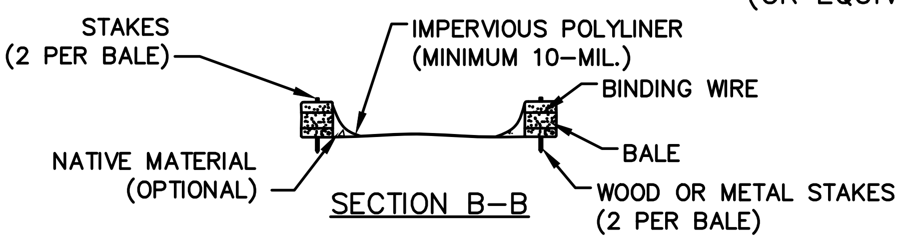
SCALE: NONE



PLAN VIEW
TYPE "ABOVE GRADE"
WITH BALES



CONCRETE WASHOUT
SIGN DETAIL
(OR EQUIVALENT)



SECTION B–B

NOTES:

1. NUMBER OF BALES MAY VARY DEPENDING ON SITE CONDITIONS. COORDINATE SIZE AND LOCATION OF CONCRETE WASTE SUMP WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. KEEP AS FAR FROM DRAINAGE CHANNELS AND WETLAND AREAS AS PRACTICAL.
3. SUMPS TO BE CLEANED AND WASTE CONCRETE REMOVED AND PROPERLY DISPOSED OF UPON COMPLETION OF WORK.
4. SEE ADDITIONAL NOTES ON DETAIL AA–14.

BMP PICTURE

File: Conc_Waste_Sump.dwg

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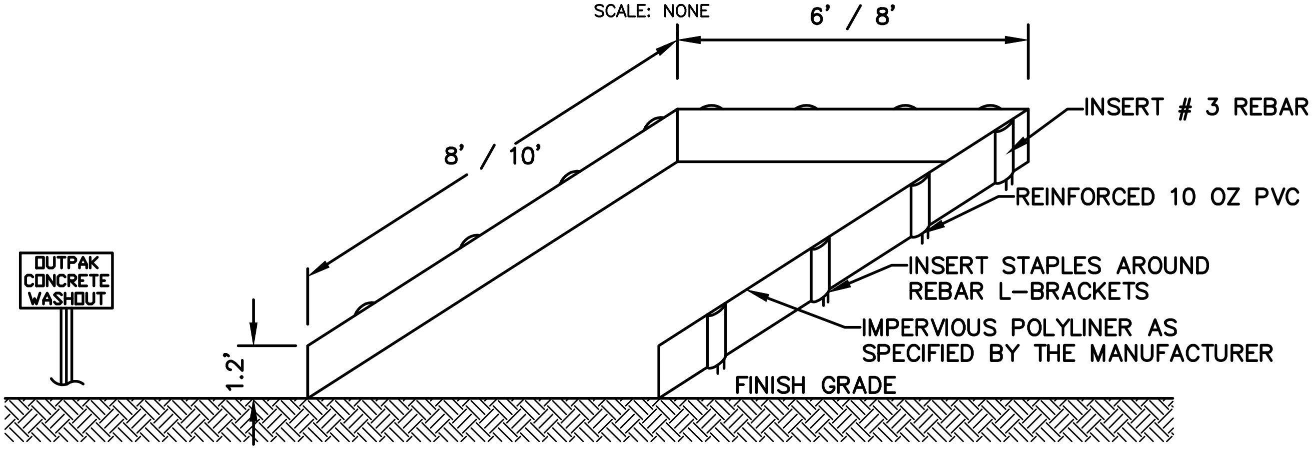
AA-13
CONCRETE WASTE SUMP

BMP DETAIL

SCALE: NONE



CROSS SECTION

NOTES:

1. PRODUCT TO BE OUTPAK PVC CONCRETE WASHOUT OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. THE CONCRETE WASHOUT AREA SHALL BE INSTALLED PRIOR TO ANY CONCRETE PLACEMENT.
3. SIGNS SHALL BE PLACED AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CONCRETE WASHOUT.
4. THE CONCRETE WASHOUT AREA WILL BE REPLACED AS NECESSARY TO MAINTAIN CAPACITY FOR WASTE CONCRETE AND OTHER LIQUID WASTE.
5. WASHOUT RESIDUE SHALL BE REMOVED FROM THE SITE AND DISPENSED OF AT AN APPROVED WASTE SITE.
6. DO NOT MIX EXCESS AMOUNTS OF FRESH CONCRETE OR CEMENT ON-SITE.
7. DO NOT WASH OUT CONCRETE TRUCKS INTO STORM DRAINS, OPEN DITCHES, STREETS, OR STREAMS.
8. AVOID DUMPING EXCESS CONCRETE IN NON-DESIGNATED DUMPING AREAS.
9. LOCATE WASHOUT AREA AT LEAST 50' FROM STORM DRAIN, OPEN DITCHES, OR WATERBODIES. COORDINATE LOCATION WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
10. WASH OUT WASTES INTO THE OUTPAK WASHOUT WHERE THE CONCRETE CAN SET, BE BROKEN UP, AND THEN DISPOSED OF PROPERLY.
11. A SECURE, NON-COLLAPSING, NON-WATER COLLECTING COVER MUST BE PLACED OVER CONCRETE WASHOUT PRIOR TO PREDICTED WET WEATHER TO PREVENT ACCUMULATION AND OVERFLOW OF PRECIPITATION.

BMP PICTURE

*** PICTURE AND DETAIL PROVIDED BY OUTPAK WASHOUT**
APPROVED BY: VICE PRESIDENT, ENVIRONMENTAL SERVICES

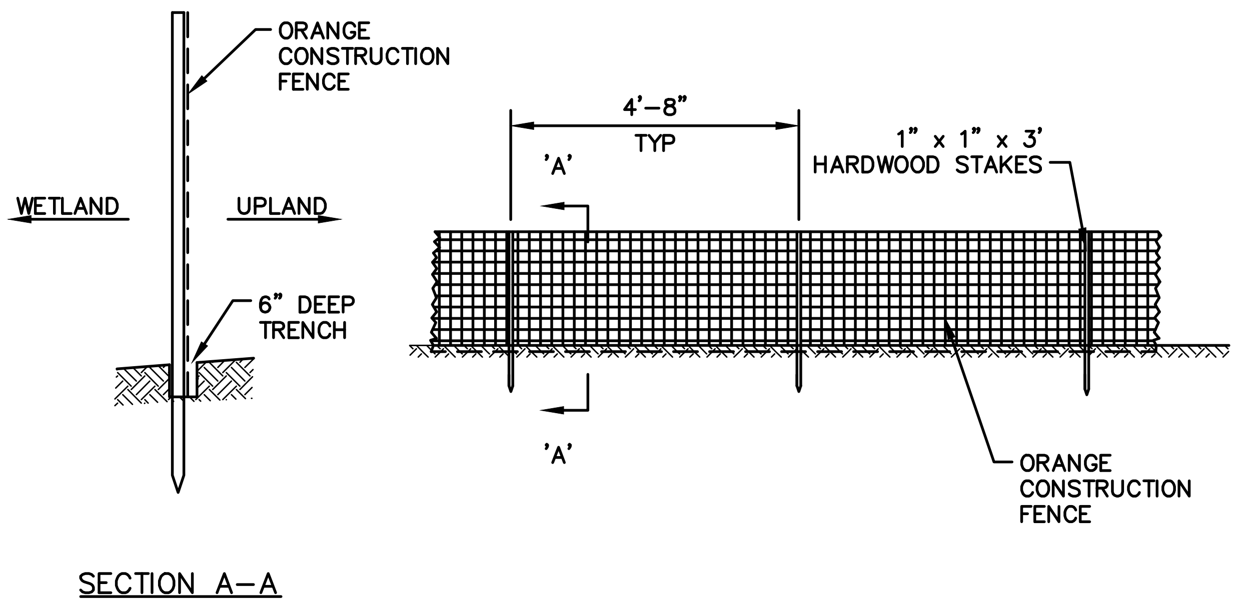
AA-14
OUTPAK CONCRETE WASHOUT *

SUBJECT
Access, Maintenance and Construction Best Management Practices

Reference
EP No. 3 - Natural Resource Protection (Chapter 6)

BMP DETAIL

SCALE: NONE



BMP PICTURE

File: Barrier_Fence.dwg

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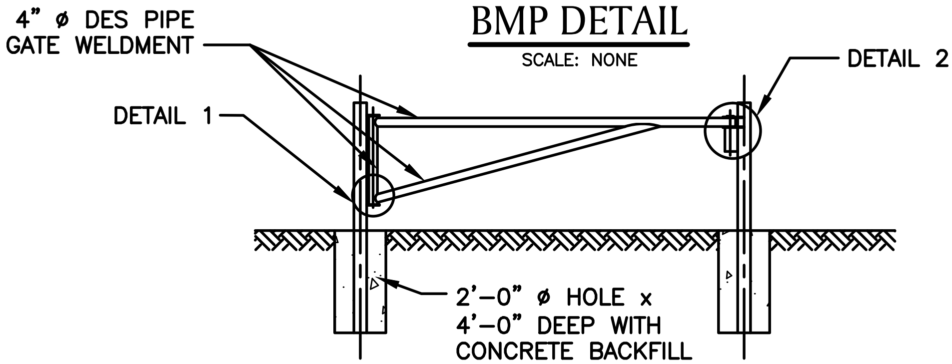
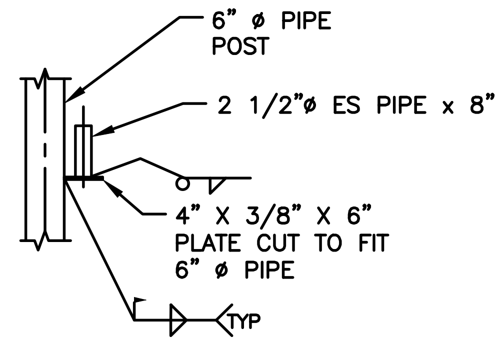
AA-15
BARRIER FENCE
(CONSTRUCTION FENCE)

BMP DETAIL

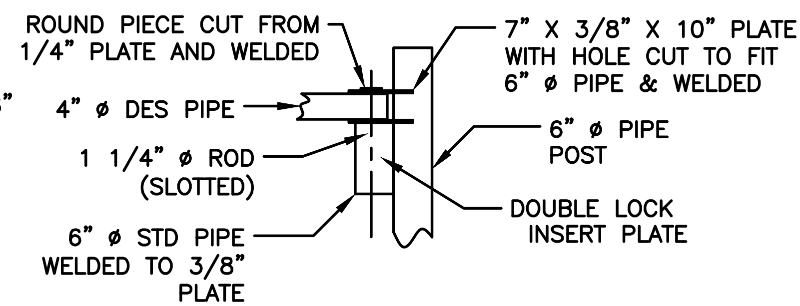
SCALE: NONE





DETAIL 1

SIMILAR DETAIL AT TOP



DETAIL 2

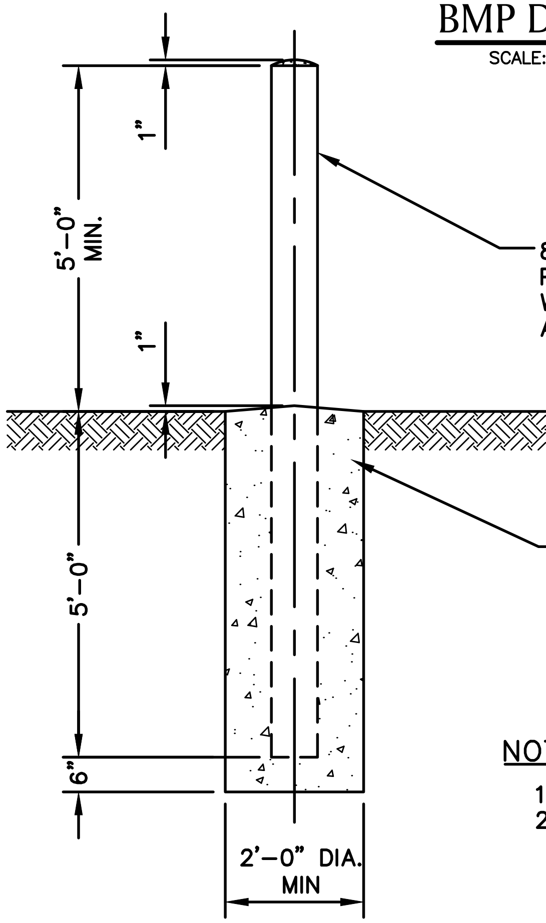
NOTES:

1. ALL GATE STEEL PIPES SHALL BE IN ACCORDANCE WITH ASTM A–501, PLATES SHALL BE ASTM A–36.
2. ALL STEEL PIPES SHALL BE PRIMED WITH ZINC–CHROMATE PRIMER AND FINISHED WITH AN APPROVED OSHA "SAFETY YELLOW" TOP COAT COMPATIBLE WITH THE PRIMER AND FOR EXTERIOR EXPOSURE.
3. REFLECTORS SHALL BE SPACED AT 3 FEET ALONG THE LENGTH OF THE CROSSBAR AND BRACE
4. BACKFILL AT POSTS TO BE COMPACTED.

BMP PICTURE

BMP DETAIL

SCALE: NONE



NOTES:

1. ALL CONCRETE TO BE 2500 P.S.I. MINIMUM.
2. COORDINATE LOCATIONS WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

BMP

Definition

The control of dust resulting from land-disturbing activities.

Purpose

To prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety problems.

Conditions Where Practice Applies

On construction roads, access points, and other disturbed areas subject to surface dust movement and dust blowing where off-site damage may occur if dust is not controlled.

Design Criteria

Construction operations should be scheduled to minimize the amount of area disturbed at one time. Buffer areas of vegetation should be left where practical. Temporary or permanent stabilization measures shall be installed. No specific design criteria is given; see construction specifications below for common methods of dust control.

Water quality must be considered when materials are selected for dust control. Where there is a potential for the material to wash off to a stream, ingredient information must be provided to the local permitting authority.

Construction Specifications

A. Non-driving Areas – These areas use products and materials applied or placed on soil surfaces to prevent airborne migration of soil particles.

Vegetative Cover – For disturbed areas not subject to traffic, vegetation provides the most practical method of dust control (see Section 3).

Mulch (including gravel mulch) – Mulch offers a fast effective means of controlling dust. This can also include rolled erosion control blankets.

Spray adhesives – These are products generally composed of polymers in a liquid or solid form that are mixed with water to form an emulsion that is sprayed on the soil surface with typical hydroseeding equipment. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations for the specific soils on the site. In no case should the application of these adhesives be made on wet soils or if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators and others working with the material.

B. Driving Areas – These areas utilize water, polymer emulsions, and barriers to prevent dust movement from the traffic surface into the air.

Sprinkling – The site may be sprayed with water until the surface is wet. This is especially effective on haul roads and access routes.

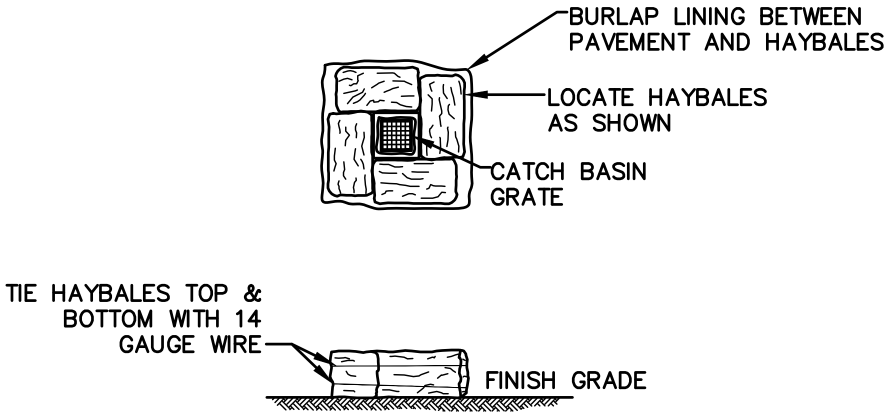
Polymer Additives – These polymers are mixed with water and applied to the driving surface by a water truck with a gravity feed drip bar, spray bar or automated distributor truck. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations. Incorporation of the emulsion into the soil will be done to the appropriate depth based on expected traffic. Compaction after incorporation will be by vibratory roller to a minimum of 95%. The prepared surface shall be moist and no application of the polymer will be made if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators working with the material.

Barriers – Woven geotextiles can be placed on the driving surface to effectively reduce dust throw and particle migration on haul roads. Stone can also be used for construction roads for effective dust control.

Windbreak – A silt fence or similar barrier can control air currents at intervals equal to ten times the barrier height. Preserve existing wind barrier vegetation as much as practical.

BMP DETAIL

SCALE: NONE



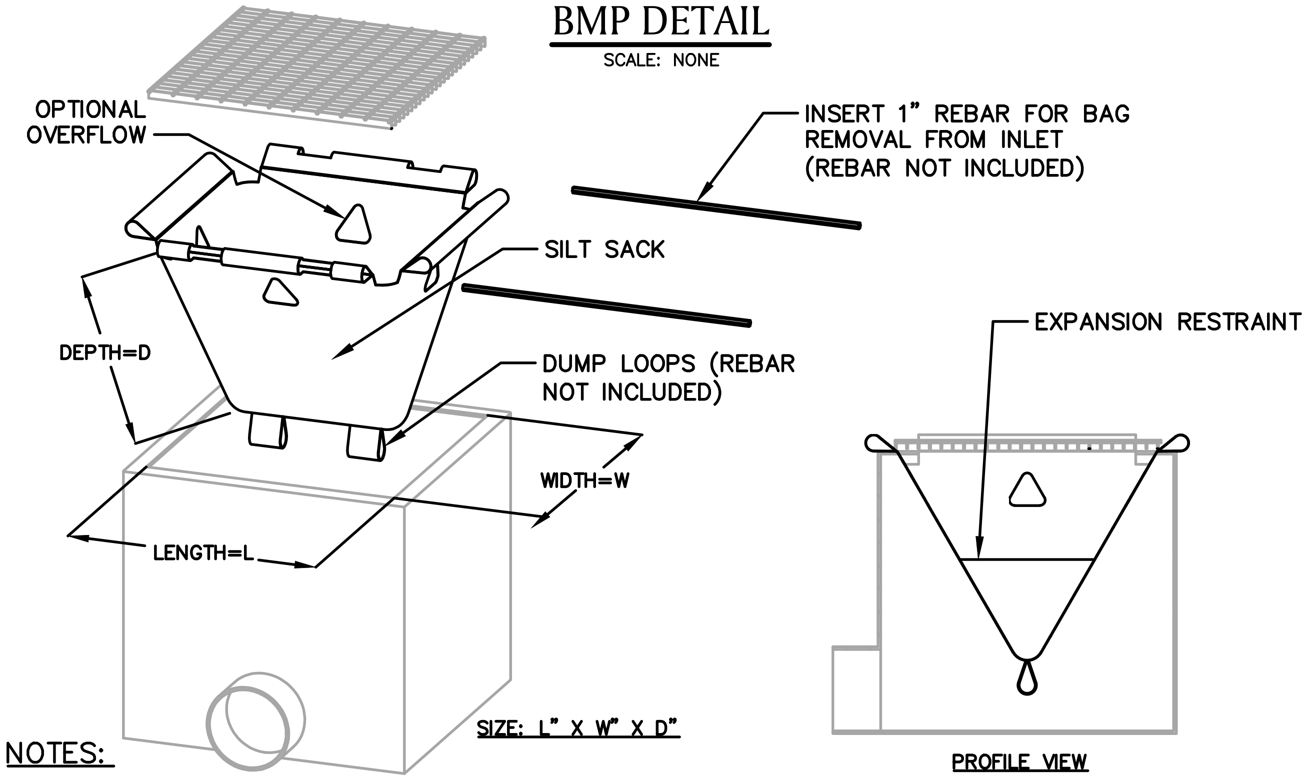
NOTES:

1. SURROUND STREET DRAINAGE STRUCTURE INLET WITH HAY BALES PRIOR TO CONSTRUCTION AND MAINTAIN UNTIL CONSTRUCTION IS COMPLETED. ACCUMULATED SEDIMENTS SHALL BE REMOVED.
2. HAYBALES PLACED ON PAVEMENT SHALL HAVE BURLAP PLACED BETWEEN PAVEMENT AND HAYBALE

BMP PICTURE

BMP DETAIL

SCALE: NONE



NOTES:

1. PRODUCT TO BE SILT SACK OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. THE USE OF A SILT SACK OPTIONAL OVERFLOW AND OVERALL DIMENSIONS ARE TO BE COORDINATED WITH A NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

File: SILT SACK.dwg

*** DETAIL PROVIDED BY ACF ENVIRONMENTAL**

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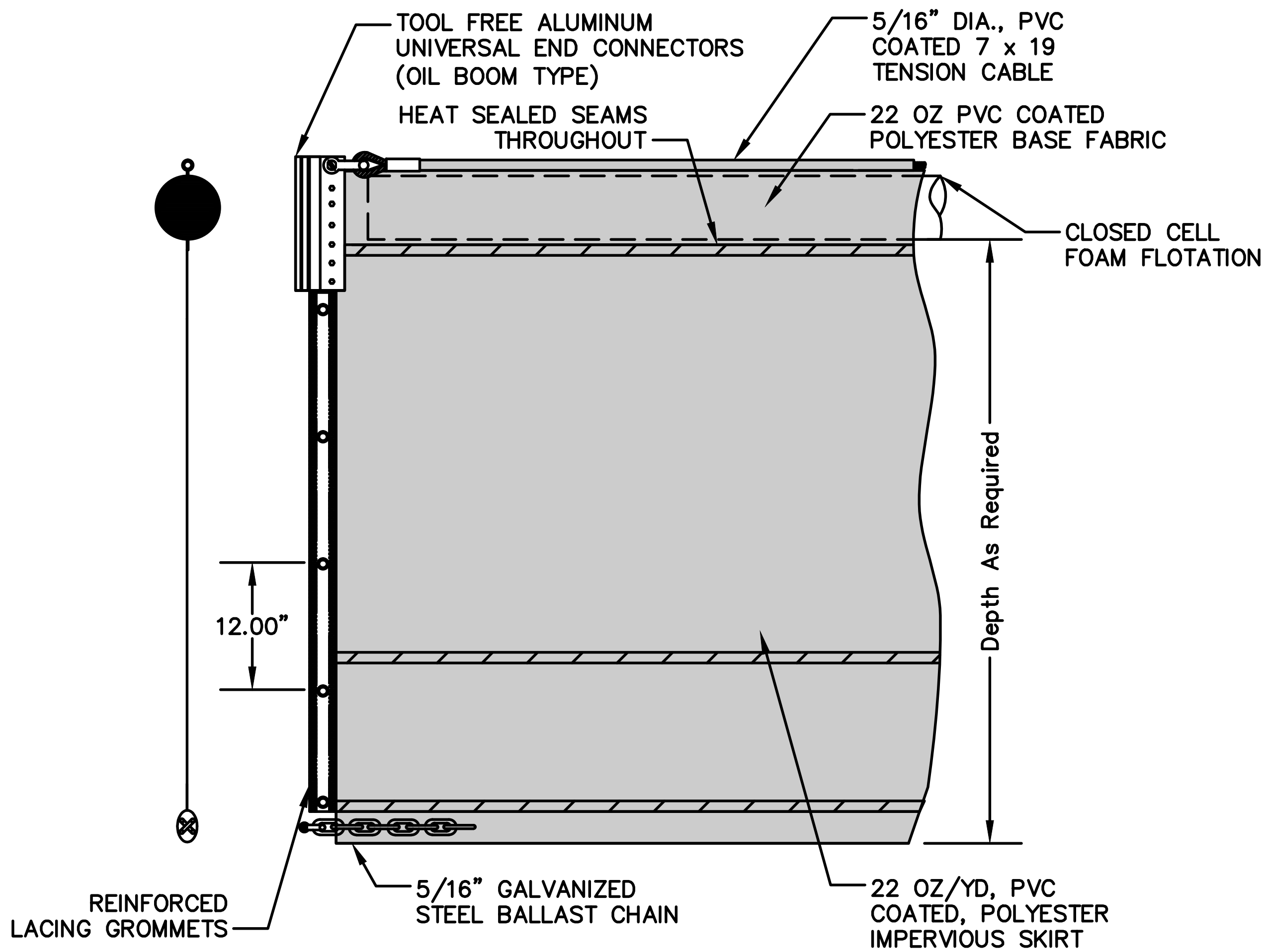
AA-20
SILT SACK *

BMP DETAIL

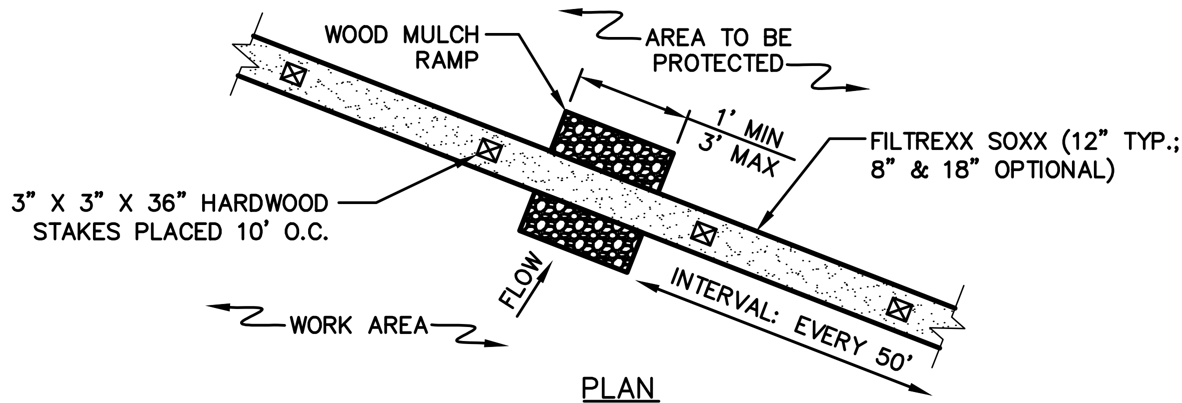
SCALE: NONE



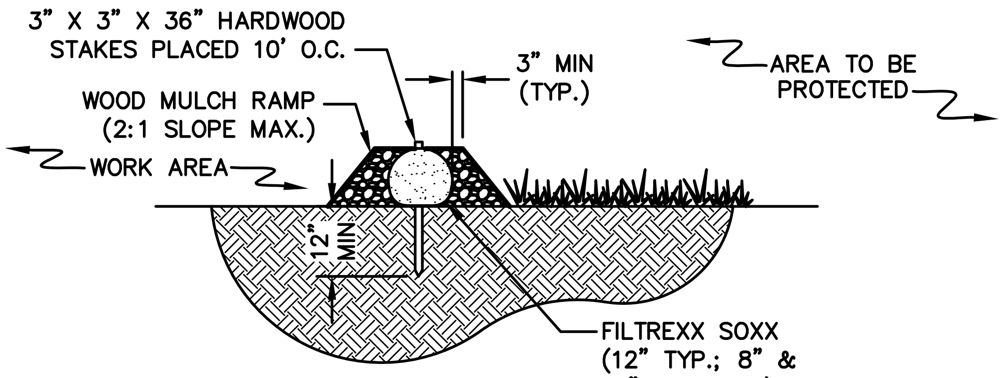
BMP PICTURE

BMP DETAIL

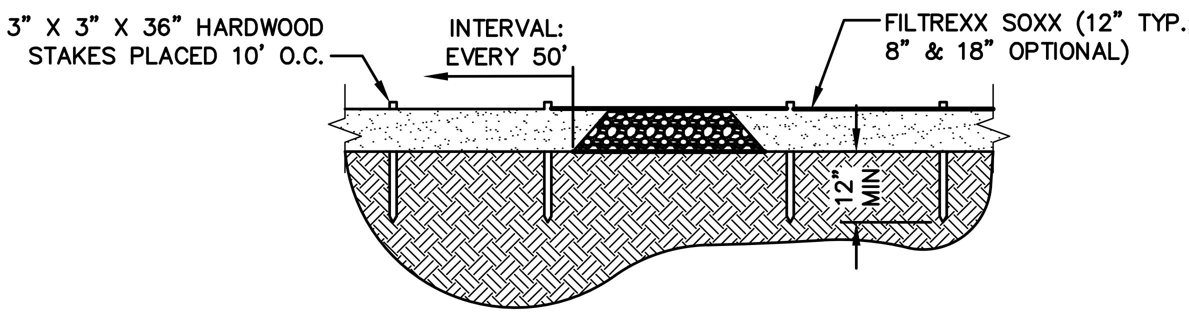
SCALE: NONE



PLAN



SECTION



PROFILE

NOTES

1. PRODUCT TO BE FILTREXX SILT SOXX OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. ALL MATERIAL TO MEET FILTREXX SPECIFICATIONS.
3. FILTER MEDIA FILL TO MEET APPLICATION REQUIREMENTS.
4. NON–MONOFILAMENT CONTAINMENT MATERIAL SHOULD BE KNITTED PHOTODEGRADABLE OR BIODEGRADABLE MATERIAL, WITH OPENING SIZES BETWEEN 1/8" – 1/4".
5. COMPOST MEDIA SHOULD HAVE PARTICLE SIZE WHERE 99% < 2", 50% > 1/2".
6. COMPOST MATERIAL TO BE DISPOSED OF ON–SITE, OR IN ACCORDANCE WITH ENVIRONMENTAL PERMITS AS APPROVED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
7. WOOD MULCH RAMP IS OPTIONAL DEPENDING ON SUBSTRATE/SITE CONDITIONS, AND TO BE APPROVED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP # AA-22
SILTSOXX AMPHIBIAN & REPTILE CROSSING #1 (1 OF 2)

BMP PICTURE

SALAMANDER AND SNAKE CROSSING #1

ALTERNATE WOOD MULCH RAMP SILTSOXX NOTES:

1. SILTSOXX, BY FILTREX INTERNATIONAL, OR APPROVED EQUAL PRODUCT SHALL BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER'S GUIDELINES.
2. BMP SHOULD ONLY BE UTILIZED IN AREAS WHERE RARE SALAMANDER AND SNAKE HABITAT OCCURS, OR AT THE DIRECTION OF THE NATIONAL GRID ENVIRONMENTAL SCIENTIST.

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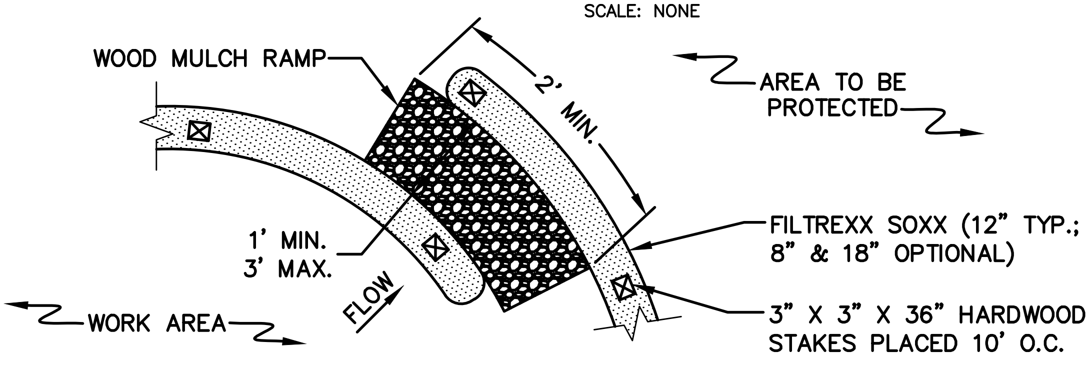
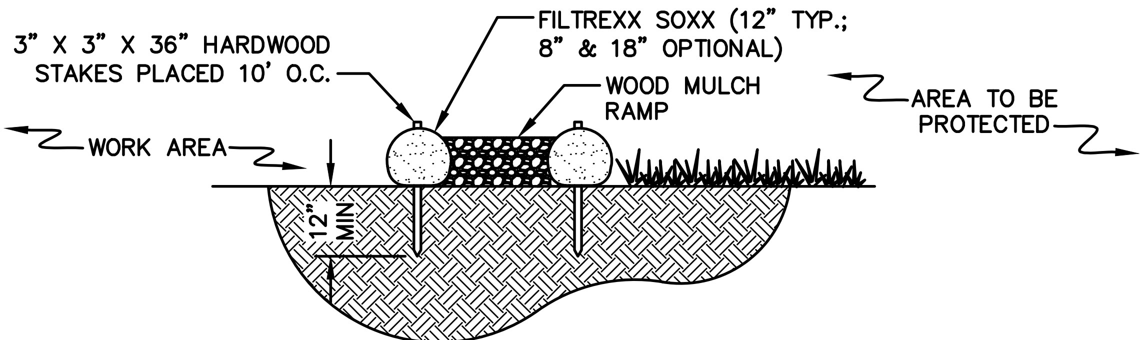
BMP DETAIL

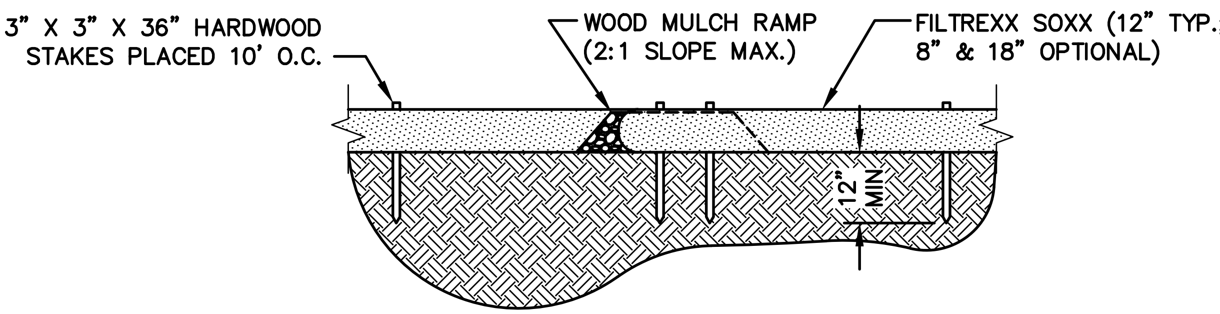
SCALE: NONE



PLAN



SECTION



PROFILE

NOTES

1. PRODUCT TO BE FILTREXX SILT SOXX OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. ALL MATERIAL TO MEET FILTREXX SPECIFICATIONS.
3. FILTER MEDIA FILL TO MEET APPLICATION REQUIREMENTS.
4. NON-MONOFILAMENT CONTAINMENT MATERIAL SHOULD BE KNITTED PHOTODEGRADABLE OR BIODEGRADABLE MATERIAL, WITH OPENING SIZES BETWEEN 1/8" – 1/4".
5. COMPOST MEDIA SHOULD HAVE PARTICLE SIZE WHERE 99% < 2", 50% > 1/2".
6. COMPOST MATERIAL TO BE DISPOSED OF ON-SITE, OR IN ACCORDANCE WITH ENVIRONMENTAL PERMITS AS APPROVED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
7. WOOD MULCH RAMP IS OPTIONAL DEPENDING ON SUBSTRATE/SITE CONDITIONS, AND TO BE APPROVED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
8. GAPS TO BE SPACED EVERY 50 FT, IF POSSIBLE GIVEN WETLAND PERMIT CONDITIONS.

File: Alternate_Siltsoxx.dwg

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BMP # AA-23
SILTSOXX AMPHIBIAN & REPTILE CROSSING #2 (1 OF 2)

BMP PICTURE

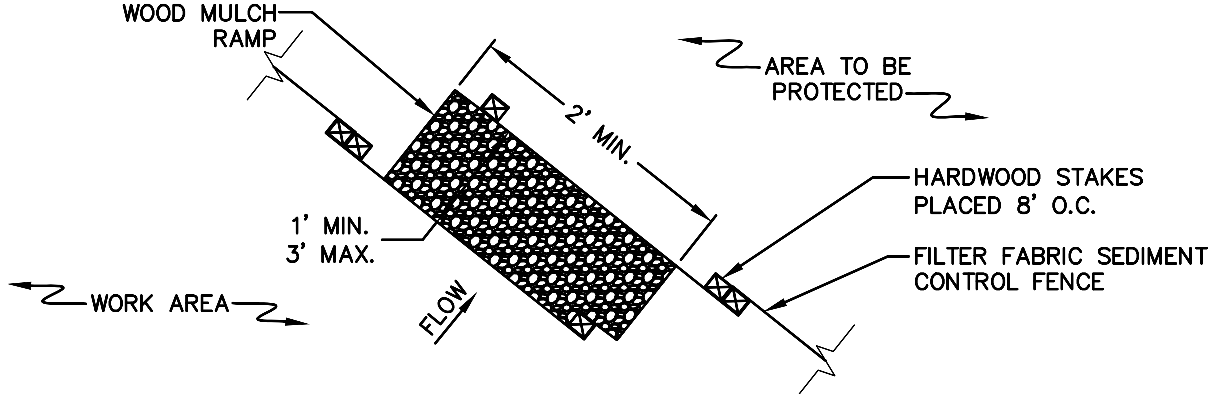
SILTSOXX AMPHIBIAN & REPTILE CROSSING #2

ALTERNATE WOOD MULCH RAMP SILTSOXX NOTES:

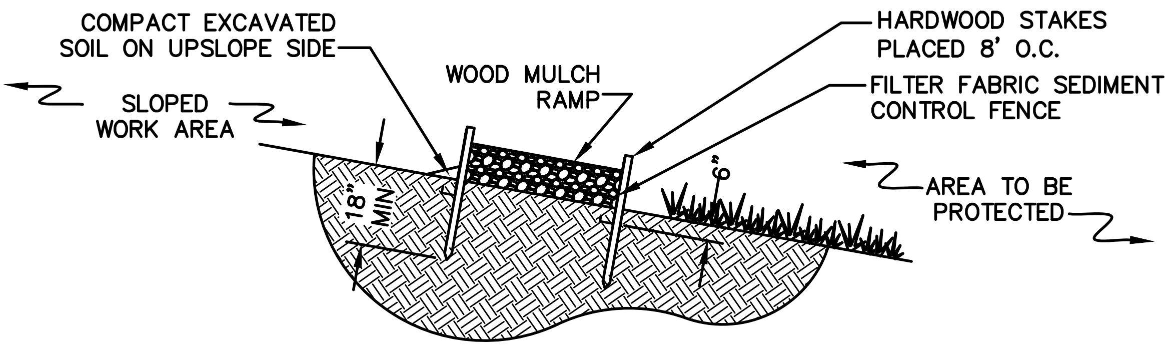
1. SILTSOXX, BY FILTREX INTERNATIONAL, OR APPROVED EQUAL PRODUCT SHALL BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER'S GUIDELINES.
2. BMP SHOULD ONLY BE UTILIZED IN AREAS WHERE RARE SALAMANDER AND SNAKE HABITAT OCCURS OR AT THE DIRECTION OF THE NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP DETAIL

SCALE: NONE



PLAN



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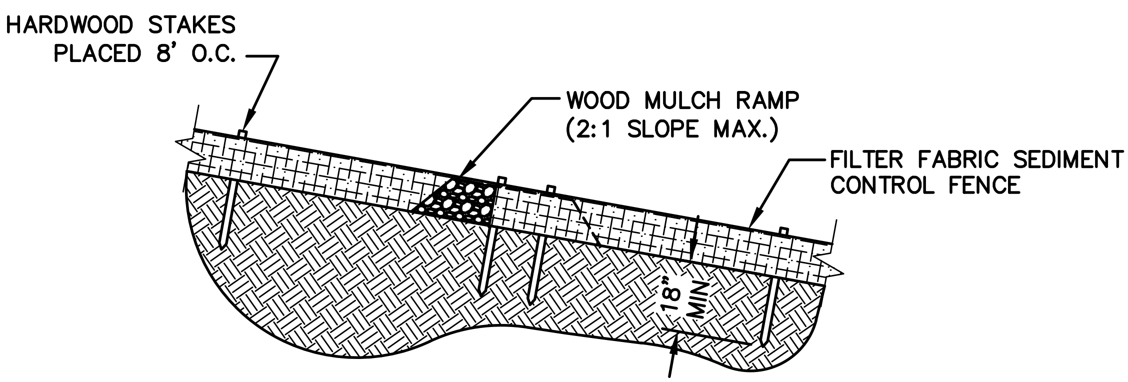


PROFILE

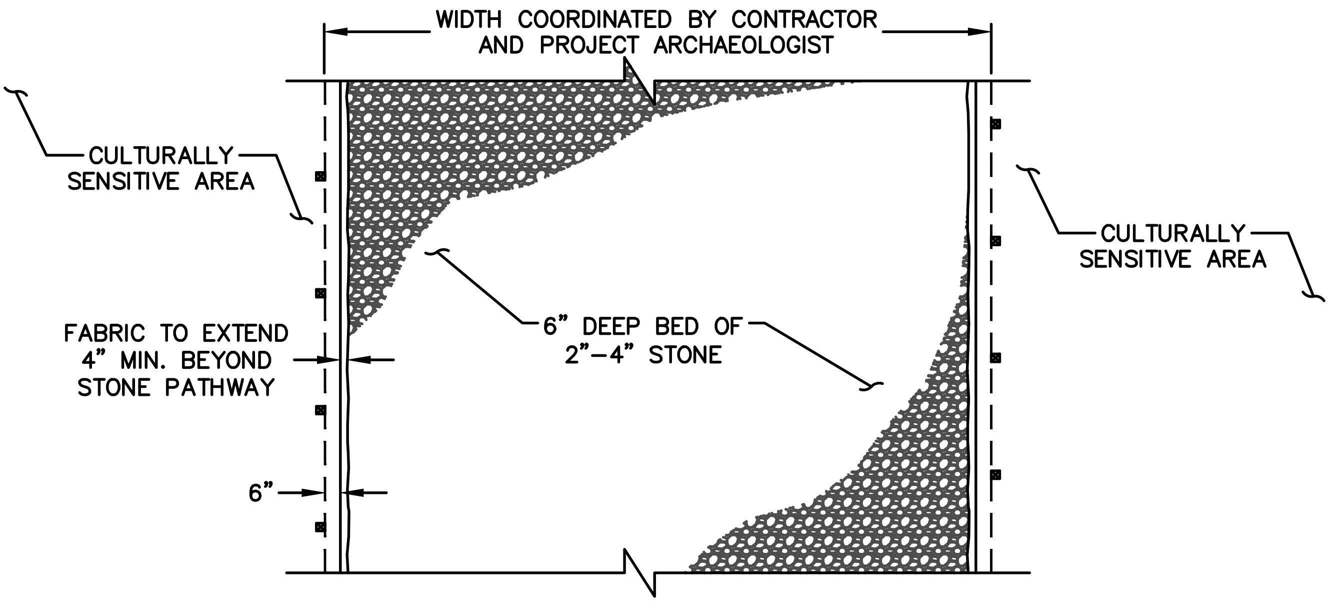
NOTES

1. IN AREAS WHERE SLOPES OR RUN–OFF VOLUME PROHIBIT USE OF SILTSOXX, CROSSINGS CAN BE PROVIDED THROUGH TRENCHED SILT FENCE.
2. INTALL SILT FENCE TO SPECIFICATIONS IN EG303 APPENDIX 7 "SEC–2 SEDIMENT CONTROL FENCE."
3. WOOD MULCH RAMP IS OPTIONAL DEPENDING ON SUBSTRATE/SITE CONDITIONS, AND TO BE APPROVED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
4. GAPS TO BE SPACED EVERY 50 FT, IF POSSIBLE GIVEN WETLAND PERMIT CONDITIONS.

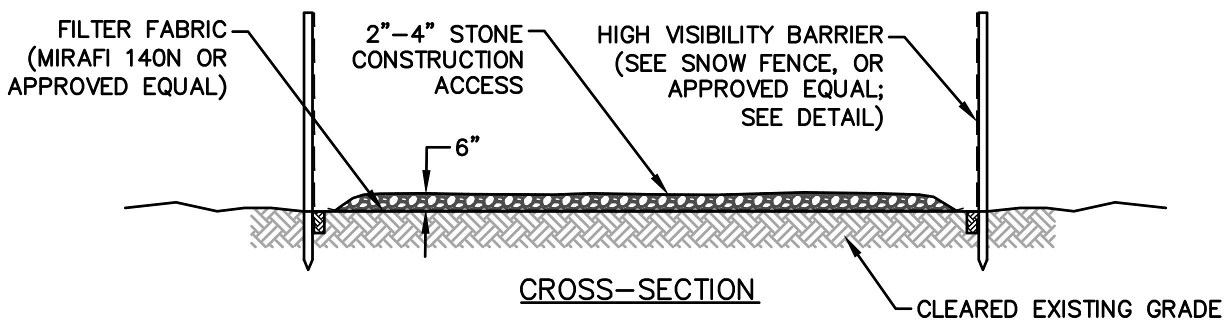
BMP # AA-24
SILT FENCE AMPHIBIAN & REPTILE CROSSING #3

BMP DETAIL

SCALE: NONE



PLAN VIEW



CROSS–SECTION

NOTES:

1. ARCHAEOLOGICAL SITE BOUNDARIES, AS DEFINED BY INTENSIVE ARCHAEOLOGICAL SURVEY AND SITE AVOIDANCE AND PROTECTION PLANS, WILL BE DEMARCATED BY STAKING BY THE PROJECT ARCHAEOLOGIST.
2. GEOTEXTILE AND STONE MAY REMAIN IN PLACE FOLLOWING CONSTRUCTION IF PERMANENT PROTECTION IS NECESSARY AND DEPENDENT ON EASEMENT RIGHTS.
3. WHERE APPROVED BY THE PROJECT–SPECIFIC SAPP, CONSTRUCTION MATTING MAY BE ADDED OVER, OR IN PLACE OF, THE FABRIC AND STONE.
4. INSTALLATION AND REMOVAL OF FABRIC AND STONE, EROSION CONTROLS, AND/OR CONSTRUCTION MATTING WILL BE MONITORED BY THE PROJECT ARCHAEOLOGIST AT EACH LOCATION(S).
5. INSTALLATION OF THESE MEASURES WILL BE CONDUCTED WITH LOW–GROUND PRESSURE VEHICLES WHERE FEASIBLE.
6. WHERE REQUIRED BY THE PROJECT–SPECIFIC SAPP, TEMPORARY, HIGH VISIBILITY PROTECTIVE FENCING (E.G., SNOW FENCE OR PLASTIC FENCE) WILL BE ERECTED ALONG THE SITE BOUNDARIES OUTSIDE OF THE WORKSPACE WITHIN THE ROW IN ORDER TO PREVENT VEHICLES FROM TRAVELING THROUGH THOSE SITE AREAS DURING CONSTRUCTION. THE PROTECTIVE FENCE WILL BE POSTED WITH "NO TRESPASSING" SIGNS, SO THAT THE SITES CAN BE AVOIDED BY ALL CONSTRUCTION RELATED ACTIVITIES. THE FENCING WILL BE REMOVED UPON COMPLETION OF THE PROJECT. THE INSTALLATION AND REMOVAL OF FENCING WILL BE MONITORED BY THE PROJECT ARCHAEOLOGIST.

BMP PICTURES

BMP # AA-25
CULTURAL AVOIDANCE (2 OF 2)

APPENDIX 5
CERTIFICATION FORM FOR INVASIVE SPECIES CONTROL

Certain permit conditions, therefore a Condition of Contracts for the Prime Contractor, any Subcontractors, and any equipment or mat vendors for ***National Grid Projects*** shall be required to Certify their equipment[7] {each piece of equipment used on site} as 'clean'[8].

____ (*name of firm*) hereby Certifies that

____ (*make, model, and/or type*)

____ (*equipment ID tag or #)* meets the following

1. before entry on to the job site, has been sufficiently cleaned to remove all accumulated mud, debris, plant fragments, and detritus that could harbor seeds, roots, or plant fragments of so-called invasive plant species; and

2. that the above piece of equipment has neither been off-loaded nor operated in the interval between cleaning and delivery to the jobsite.

3. that equipment deployed in areas of invasive species (as identified in project plans) shall be cleaned prior to redeployment.

_________________________________ (*signed*) ________________ (*dated*)

_________________________________ (*printed name*) __________________________________ (*title*)

_________________________________ (*Firm*)

The signed original of this form {one for each piece of equipment (or lot[9] of mats)} is to be given to the NG Construction Supervisor assigned to the project.

[7] Equipment may include, but is not limited to bulldozers, excavators, backhoes, bucket trucks (tracked or wheeled), pulling equipment, concrete trucks, compressors, drilling equipment, and mats (composite, wood, or other materials).

[8] With regard to invasive species, the definition of clean means free of accumulated mud, debris, plant fragments, and detritus that could harbor seeds, roots, or plant fragments of so-called invasive plant species.

[9] Lot of mats is the number of mats that may be transported by one forwarder/truck at a time.

Appendix 6 – Snow Disposal Guidelines

See EG303NE_App6 published separately

APPENDIX 6
SNOW DISPOSAL GUIDELINES

Finding a place to dispose of collected snow poses a challenge. While we are all aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into water bodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that should be taken to minimize the impacts of snow disposal on public health and the environment.

- **DO NOT** dump snow into any water body, including rivers, the ocean, reservoirs, ponds, or wetlands. In fact, a buffer of at least 50 feet between any snow disposal area and any the high-water mark of any surface water should be kept. A silt fence or equivalent barrier should be securely placed between the snow storage area and the high-water mark. In addition to water quality impacts and flooding, snow disposed in surface waters can cause navigational hazards when it freezes into ice blocks.
- **DO NOT** dump snow within a wellhead protection area (e.g., a Zone II), in a high or medium-yield aquifer, or within 75 feet of a private well, where road salt may contaminate water supplies**. Ask an Environmental Department representative for guidance in determining if a proposed disposal area is located within one of these sensitive areas.**
- Avoid disposing of snow on top of storm drain catch basins or in storm water drainage swales or ditches. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.
- All debris in a snow storage area should be cleared from the site and properly disposed of no later than May 15 of each year the area is used for snow storage.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, disposal of snow that is not obviously contaminated with road salt, sand, and other pollutants may be allowed near (within 50 feet) or even in certain water bodies under certain conditions.

In these dire situations, **notify the Environmental Department** so that the local Conservation Commission and the appropriate MassDEP Regional Service Center (in MA), RI DEM Office of Water Resources – RIPDES

Program (in RI), NH Department of Environmental Services – NHDES (in NH) and VT Department of Environmental Conservation - VT DEC (in VT) can be contacted before disposing of snow in a water body.

In emergency situations and after consulting an Environmental Department representative the following guidance should be followed:

- Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
- Do not dispose of snow in saltmarshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, wellhead protection areas, or other environmentally sensitive areas.
- Do not dispose of snow where trucks may cause shoreline or stream bank damage or erosion.

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APPENDIX 4-2 N12/M13 DCT SEPARATION PROJECT: ELECTRIC AND MAGNETIC FIELD ASSESSMENT

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Electrical Engineering and
Computer Science Practice

Electric Field, Magnetic Field, Audible Noise, and Radio Noise Assessment

National Grid N12/M13N Line Separation and Reconductor Project

This document has been reviewed for Critical Energy Infrastructure Information (CEII), July 2022

Electric Field, Magnetic Field, Audible Noise, and Radio Noise Assessment

National Grid N12/M13N Line Separation and Reconductor Project

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July 14, 2022

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Acronyms and Abbreviations

A	Ampere
AN	Audible Noise
dB	Decibels
EFSB	Energy Facilities Siting Board
EMF	Electric and magnetic fields
EPA	Environmental Protection Agency
G	Gauss
Hz	Hertz
ICES	International Committee on Electromagnetic Safety
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers
kHz	Kilohertz
kV	Kilovolt
kV/m	Kilovolt per meter
L_{dn}	Day-night level
MW	Megawatt
MVAR	Megavolt-ampere reactive
Project	National Grid N12/M13N Line Separation and Reconductor Project
mG	Milligauss
RN	Radio Noise
ROW	Right-of-way
V/m	Volt per meter

Limitations

At the request of New England Power Company, d/b/a National Grid, Exponent modeled the levels of electric fields, magnetic fields, audible noise, and radio noise associated with existing transmission lines between the Pottersville Switching Station and Sykes Road Substation, as well as with the proposed line separation and reconductoring of these transmission lines. This report summarizes work performed to date and presents the findings resulting from that work. In the analysis, we have relied on geometry, material data, usage conditions, specifications, and various other types of information provided by the client. We cannot verify the correctness of this input data and rely on the client for the data's accuracy. National Grid has confirmed to Exponent that the summary contained herein, of data provided to Exponent is not subject to Critical Energy Infrastructure Information restrictions. Although Exponent has exercised usual and customary care in the conduct of this analysis, the responsibility for the design and operation of the project remains fully with the client.

The findings presented herein are made to a reasonable degree of engineering and scientific certainty. Exponent reserves the right to supplement this report and to expand or modify opinions based on review of additional material as it becomes available, through any additional work, or review of additional work performed by others.

The scope of services performed during this investigation may not adequately address the needs of other users of this report, and any re-use of this report or its findings, conclusions, or recommendations presented herein are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.

Executive Summary

National Grid (NG) proposes to separate, rebuild and reconductor the existing N12/M13 115-kV double-circuit line located between the Pottersville Switching Station and the Sykes Road Substation, a distance of approximately 1.9 miles. The Project is located entirely within the state of Massachusetts.

Existing and proposed transmission lines along the proposed route are sources of 60 Hertz (Hz) electric and magnetic fields (EMF), audible noise (AN), and radio noise (RN). To characterize Project-related changes to EMF, AN, and RN levels, Exponent, Inc (Exponent) modeled these aspects of transmission line operation for three representative cross sections of the right-of-way (ROW) along the Proposed Route for existing and proposed configurations.

Calculated EMF levels before and after the project were far below guideline levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and International Committee for Electromagnetic Safety (ICES) in all portions of the route. At average loading, magnetic-field levels were calculated to increase by 2.5 mG on one edge of the ROW (over the Taunton River), but in all other portions of the route ROW-edge magnetic field levels were calculated to decrease as a result of the project. Similarly, electric-field levels were calculated to decrease or not change by more than 0.1 kV/m at the edges of the ROW of the post-project route.

AN levels will decrease as a result of the Project and in fair weather conditions before or after the project AN levels were calculated to be below the threshold of human hearing (0 dB). RN levels were similarly calculated to decrease from already very low levels to be about 100-fold (40 decibels) lower than the Institute of Electrical and Electronics Engineers guideline level (IEEE, 1971) for RN from a transmission line.

Note that this Executive Summary does not contain all of Exponent's technical evaluations, analyses, conclusions, and recommendations. Hence, the main body of this report is at all times the controlling document.

Introduction

The National Grid (NG) N12/M13N Line Separation and Reconductor Project (the Project) involves separating and reconductoring approximately 1.9 miles of transmission lines between the Pottersville Switching Station and the Sykes Road Substation in the state of Massachusetts.

Along the 1.9-mile portion of the Project between Pottersville and Sykes Road, the existing N12 and M13 transmission lines are supported on double-circuit lattice towers. The Project proposes to separate the two lines and construct them on individual structures located within the existing right-of-way (ROW).

Route and Configuration of the Project

The Project has been divided into three representative cross sections (Cross Sections 1-1 to 3-3), each representing a configuration of the existing and post-project transmission lines along the Project route. Figure 1, below shows the proposed route of the Project as well as the representative cross sections where electric and magnetic fields (EMF), audible noise (AN) and radio noise (RN) were modeled.

Cross section 1-1 represents the Project route from the Pottersville Substation crossing over the Taunton River, a distance of about 0.7 miles. The existing N12 and M13 lines are supported by double-circuit lattice structures on this portion of the route. The Project proposes to leave the six existing 795 kcmil ACSR conductors of the N12 and M13 lines on these structures in place and redesignate them as the N12 line with the two respective A, B, and C conductors bussed together to become a single circuit with two conductors per phase. New transmission line structures will be constructed within the existing ROW to support the 115 kV single-circuit M13N line with 1622 ACCR/TW conductors.

Cross section 2-2 represents the Project route from the east bank of the Taunton River to approximately 0.1 miles west of the Sykes Road Substation, a distance of about 1.1 miles. The existing N12 and M13 lines are supported on 115 kV double-circuit lattice structures at the center of an 80-foot ROW, but will be separated onto single-circuit structures 20 and 23 feet from the center of the ROW, respectively.

Cross section 3-3 represents the short portion of the Project route just prior to the transmission lines entering the Sykes Road Substation, a distance of about 0.1 miles. The existing N12 line is constructed on 115-kV structures with 46 feet from the northern edge of a 150-foot wide ROW. and the M13 line is currently supported by 115 kV H-frame structures 52 feet from the southern ROW edge. The Project proposes to replace the existing 115 kV single-circuit structures supporting the N12 line with new 115 kV single-circuit structures on the same centerline and new 1582 ACCC conductors. The rebuilt M13 line will be constructed with 1582 ACCC conductors on single-circuit monopoles 46 feet from the southern ROW-edge

Average loading of the N12 line is projected by NG to increase by approximately 5% compared to pre-project loading levels and average loading of the M13N line is projected by NG to increase by approximately 1%. Additional details regarding the modeling configurations are provided in Appendix C.

Figure 1. Proposed route showing the locations of Cross Sections 1-1 to 3-3.

Electrical Environment

Transmission lines are sources of 60 Hertz (Hz) EMF and of corona phenomena, including audible noise (AN) and radio noise (RN). To characterize the potential effect of the proposed construction on the existing levels of EMF, AN, and RN, Exponent modeled the levels of these parameters under existing and proposed conditions. The following is a brief description of these phenomena.

Electric and Magnetic Fields

Any source of electricity, such as transmission lines, distribution lines, or any device that uses electricity, such as household appliances and equipment in our homes and workplaces, produces both electric fields and magnetic fields. Most electricity in North America is transmitted as alternating current (AC) at a frequency of 60 Hz (i.e., it changes direction and magnitude in a continuous cycle that repeats 60 times per second). The fields from these AC sources are commonly referred to as power-frequency or extremely low frequency EMF.

Electric Fields

Electric fields are created by the voltage on the conductors of transmission lines. The strength of Project-related electric fields in this report is expressed in units of kilovolts per meter (kV/m), which is equal to 1,000 volts per meter (V/m). The strength of an electric field diminishes with increasing distance from the source, and in the case of transmission lines the decrease is typically in proportion to the square of the distance from the conductors, so the electric-field level decreases rapidly with distance. In addition, grounded conductive objects—including fences, trees, shrubbery, and buildings—block electric fields.

Magnetic Fields

Magnetic fields are created by current that flows in transmission line conductors. The strength of Project-related magnetic fields in this report is expressed as magnetic flux density in units of milligauss (mG), where 1 Gauss = 1,000 mG. Magnetic fields, unlike electric fields, are not blocked by most common objects; however, similar to electric fields, the strength of magnetic fields diminishes with increasing distance from the source. In the case of transmission lines, magnetic fields also generally decrease with distance from the conductors in proportion to the square of that distance.

Magnetic fields differ from electric fields because they depend on the current flowing in a conductor, rather than voltage. The demand for electricity can vary during the day, throughout a week, or over the course of months and years, so the magnetic-field level produced by transmission lines can also vary. Therefore, the level of current flow—expressed in units of amperes—on transmission lines is often expressed as an annual average (a good predictor of the magnetic field on any randomly selected day of the year) and annual peak load (the highest magnetic-field level that might occur for a few hours or days during the year). Forecasted annual average as well as peak current flows are used for modeling magnetic fields.

Audible and Radio Noise

When the electric field at a localized portion of the conductor surface exceeds the breakdown strength of air, a tiny amount of energy is released in the form of conductor vibration, light, audible noise (AN), and radio noise (RN) in a process known as corona. Transmission lines operating at 115-kV and lower generally do not have significant corona and hence minimal AN and RN.

Assessment Criteria

Electric and Magnetic Fields

While the federal government has no regulations regarding EMF, including levels from transmission lines, the Massachusetts Energy Facilities Siting Board (EFSB) assesses EMF levels from transmission lines on a case-by-case basis with a focus on practical options to reduce magnetic fields along transmission ROWs. This practice is also consistent with the recommendations of the WHO (WHO, 2007).

EMF levels can also be evaluated in the context of relevant health-based exposure limits recommended by scientific organizations. These exposure limits are included in guidelines developed to protect health and safety and are based upon reviews and evaluations of relevant health research. These guidelines include exposure limits for the general public recommended by the International Committee on Electromagnetic Safety (ICES) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) to address health and safety issues. The ICES and ICNIRP have each published limits of exposure to EMF, which are summarized Table 1 below.

Audible and Radio Noise

Levels of AN and RN from AC transmission lines are compared to guidelines developed by other governmental and professional organizations such as the Environmental Protection Agency (EPA) and Institute of Electrical and Electronics Engineers (IEEE). The guideline levels for these phenomena are also summarized in Table 1 below.

Summary of Assessment Criteria

The reference values listed in Table 1 were used as criteria for the evaluation of potential line designs and their potential effects on the electrical environment around transmission lines. These are not exposure limits, and exposures to higher EMF levels are allowed if the underlying basic restrictions on fields in the body are not exceeded.

Table 1. Environmental assessment Basic Restrictions on EMF exposure and Guidelines for AN and RN Relevant to AC transmission lines

Electrical Parameter	Limit	Agency providing guideline	Comment
Electric field	4.2 kV/m	ICNIRP (2010)	Whole body exposure to 60-Hz fields: general public
	5 kV/m 10 kV/m*	ICES (2019)	Whole body exposure to 60-Hz fields: general public
Magnetic field	2,000 mG	ICNIRP	Whole body exposure to 60-Hz fields: general public
	9,040 mG	ICES	
Audible noise	55 dBA†	EPA (1974)	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use
Radio noise	61 (dBµV/m)‡	IEEE (1971)	Measured at 15 meters (~50 feet) horizontally from the conductor in fair weather

* This is an exception for persons within transmission line ROWs.
† The nighttime limit is reduced by 10 dB.
‡ The 1 MHz measurement frequency in IEEE (1971) was changed to 500 kHz by IEEE Radio Noise Measurement Standard 430-1986. The guideline has therefore been adjusted for frequency (calculations performed at 500 kHz) and receiver (-2 dB for 9 kHz bandwidth receiver) to update the guideline to present methods of measurement and calculation (500 kHz with CISPR receiver).

Methods

Based upon information provided by NG, Exponent calculated AC electric fields, magnetic fields, AN, and RN using computer algorithms developed for AC transmission lines by the Bonneville Power Administration, an agency of the U.S. Department of Energy (BPA, 1991). The inputs to the program include data regarding voltage, current flow, phasing, and conductor configurations.

In the model, simplifying assumptions are made in order to make the calculations more tractable for a large number of transmission line conductors and to yield conservative values. Each conductor is modeled as infinite in length at a fixed height above a flat earth (also assumed infinite in extent) and is assumed to be parallel to all other conductors. The conductor height above ground is taken at the point of lowest sag to ensure that the presented values are representative of the highest field levels that may be encountered beneath the line.[1] Although these assumptions simplify the calculations, they do not decrease the accuracy of the model and have been shown to accurately predict electric-field and magnetic-field levels measured near transmission lines (Chartier and Dickson, 1990; Perrin et al., 1991). Both electric (in units of kV/m) and magnetic (in units of mG) field levels are calculated at a height of 1 meter (3.28 feet) above ground and are reported as the root mean square value of the field in accordance with IEEE Std. C95.3.1-2021 and IEEE Std. 644-2019.

The BPA computer algorithms also calculate AN and RN from AC transmission lines, based upon empirical formulae developed from measurements made near high-voltage AC transmission lines (Chartier and Stearns, 1981; Chartier, 1983). These formulae for corona-generated AN and RN have also been compared to measurements throughout the United States and are shown to be accurate for replicating measured results (IEEE Committee Report, 1982; Olsen et al., 1992). The AN was calculated at a height of 5 feet above ground, corresponding roughly to ear level, and results are reported in units of dBA. Calculations of RN were made

[1] There are variations in the transmission line clearance height above ground due to the sag of the transmission lines over variable-height terrain, but EMF levels beneath the transmission lines will be lower where the clearance of the lines above ground is higher.

assuming a receiving antenna height of 1 meter (3.28 feet) above ground and a frequency of 500 kHz in accordance with IEEE Std. 430-1986 (IEEE, 1986) and are reported in units of dBµV/m.

Phase optimization

Where two AC transmission line circuits are located on the same ROW, the specific arrangement of the conductors of each circuit will have an effect on the calculated levels of electric fields, magnetic fields, AN, and RN. Therefore, Exponent performed a phase-optimization analysis. In a phase optimization analysis, all possible phasing configurations of the AC lines are analyzed for each cross section. Particular phase configurations of the transmission line circuits are identified to minimize AC magnetic-field levels at the ROW edge. The optimal phase configuration was identified which minimizes the magnetic-field level at the edge of the ROW.[2] Phase optimization is one of the ways to minimize EMF levels consistent with recommendations to apply low cost measures (WHO, 2007). Exponent's optimization analysis was used by NG to evaluate the constructability of various scenarios and was incorporated into the design of the transmission lines. The existing and post-project optimal phase configuration of the Project is shown in Figure C-1 to Figure C-3 of Appendix C.

[2] There is a tradeoff between minimizing the magnetic field level at the ROW edge and the highest magnetic field level on the ROW. There is also a tradeoff between minimizing the magnetic-field levels and minimizing the AN and RN.

Results and Discussion

The calculated pre-construction (existing) and post-construction (proposed) EMF levels are discussed below for the three representative cross sections (1-1 to 3-3) of the Project route.[3]

The discussion below focuses on changes in EMF levels as a result of the Project operating at average loading conditions rather than peak loading conditions that might apply only for a few hours or days in a year. Tabular summaries of EMF levels for both average and peak loading conditions of each of the three segments of the Project are presented in Appendix A, Table A-1 to Table A-3 respectively. Graphs of calculated EMF levels for these representative cross sections are provided in Appendix B, Figure B-1 to Figure B-3 for the magnetic field and Figure B-4 to Figure B-6 for the electric field.

AN levels will decrease as a result of the Project. In fair weather conditions, before or after the project, AN levels were calculated to be below the threshold of human hearing (0 dB). RN levels were similarly calculated to decrease from already very low levels to be at least 100 fold (≥ 40 decibels) lower than the Institute of Electrical and Electronics Engineers guideline level (IEEE, 1971) for RN from a transmission line. AN and RN levels are therefore not discussed further below.

Magnetic Fields

Magnetic-field levels at the edge of the ROW are generally calculated to decrease as a result of the project. The magnetic field level increased by 2.5 mG (from 5.0 to 7.5 mG) on one side of the ROW in Segment 1-1 at the crossing of the Taunton River and otherwise decreased at all ROW-edges (by up to 34 mG). The calculated magnetic-field levels associated with the transmission lines for the existing and proposed configurations were all below the ICNIRP Reference Level of 2,000 mG and the ICES Exposure Reference Level of 9,040 mG for the general public across the entire width of the ROW. At ROW edges, both the existing and proposed magnetic-field levels were calculated to be approximately 91 mG or less.

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[3] For RN levels, the location of interest to evaluate compliance with applicable guideline levels is 50 feet from the outside conductor, not the ROW edge.

As discussed above, magnetic field levels decrease quickly with distance from the transmission lines; at 100 feet from the ROW edges, the magnetic-field level at average loading is 10 mG or less for all existing configurations and 7.4 mG or less for all proposed configurations. At peak loading, calculated magnetic-field levels are somewhat higher but remain far below ICNIRP or ICES limits at all locations on the ROW. Calculated magnetic-field values for all sections are summarized in Appendix A, Table A-1 (average loading) and Table A-2 (peak loading).

Electric Fields

The calculated electric-field levels at the edges of the ROW are calculated to decrease or to not change by more than 0.1 kV/m as a result of the project and at all locations along the route are below the ICNIRP Reference Level of 4.2 kV/m and the ICES Exposure Reference Level of 5 kV/m for the general public across the entire width of the ROW. At ROW edges, both the existing and proposed electric-field levels were calculated to be approximately 1.1 kV/m or less. Calculated electric-field values for all sections are summarized in Appendix A, Table A-3.

Audible and Radio Noise

The larger conductor proposed for the project will result in lower AN and RN levels for all portions of the route. In particular, in fair weather conditions both before or after the project, AN levels were calculated to be below the threshold of human hearing (0 dB). In foul weather, AN levels will be 25 dB higher; however the wind and rain that typically occur during foul weather are themselves likely to generate levels of AN (41-63 dBA) that far exceed the levels of AN from the transmission line and would likely mask the noise from the transmission lines during these conditions (Miller, 1978).

RN levels were similarly calculated to decrease from already very low levels to be at least 100 fold (40 decibels) lower than the 61 dBμV/m Institute of Electrical and Electronics Engineers guideline level (IEEE, 1971) for RN from a transmission line. In foul weather RN levels would be approximately 17 dB higher but still far below the referenced guideline levels.

Summary

This report has summarized calculations of the EMF, AN, and RN associated with existing and proposed transmission lines on the Project route between the Pottersville Switching Station and Sykes Road Substation in the state of Massachusetts. These calculations have been performed using methods that are accepted within the scientific and engineering community and which have previously been found to match well with measurements. All calculated EMF levels at average loading for existing and proposed transmission lines are below reference levels for the general public published by ICNIRP and ICES. All calculated AN and RN levels for existing and proposed transmission lines are below reference levels for the general public by the EPA and IEEE, respectively.

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Appendix A

Summary Tables of Calculated EMF

Table A-1. Calculated magnetic field levels (mG) at average loading.

Cross Section	Loading Configuration	Distance from Centerline of ROW				
		North ROW Edge -100 ft	North ROW Edge	Max on ROW	South ROW Edge	South ROW Edge +100 ft
1	Pre-Project	5.9	9.8	11	5.0	2.8
	Post-Project (2025)	3.6	8.0	12	7.5	3.4
2	Pre-Project	8.3	89	141	91	8.4
	Post-Project (2025)	3.6	76	156	86	3.7
3	Pre-Project	10	78	215	59	9.2
	Post-Project (2025)	7.4	63	228	25	5.1

Table A-2. Calculated magnetic field levels (mG) at peak loading.

Cross Section	Loading Configuration	Distance from Centerline of ROW				
		North ROW Edge -100 ft	North ROW Edge	Max on ROW	South ROW Edge	South ROW Edge +100 ft
1	Pre-Project	6.8	11	12	5.7	3.2
	Post-Project (2025)	4.1	9.1	14	8.5	3.9
2	Pre-Project	9.5	102	161	105	9.6
	Post-Project (2025)	4.1	87	178	98	4.3
3	Pre-Project	12	89	246	67	11
	Post-Project (2025)	8.4	72	260	29	5.9

Table A-3. Calculated electric field levels (kV/m)

Section Number	Condition	Distance from Centerline of ROW: North ROW Edge -100 ft	North ROW Edge	Max on ROW	South ROW Edge	South ROW Edge +100 ft
1	Pre-project	0.1	0.1	0.1	<0.1	<0.1
	Post-project	0.1	0.2	0.2	0.1	0.1
2	Pre-project	<0.1	1.1	1.6	1.1	<0.1
	Post-project	<0.1	0.8	1.9	1.0	<0.1
3	Pre-project	<0.1	0.7	2.0	0.6	<0.1
	Post-project	<0.1	0.8	2.0	<0.1	<0.1

Appendix B

Graphical Profiles of Calculated EMF

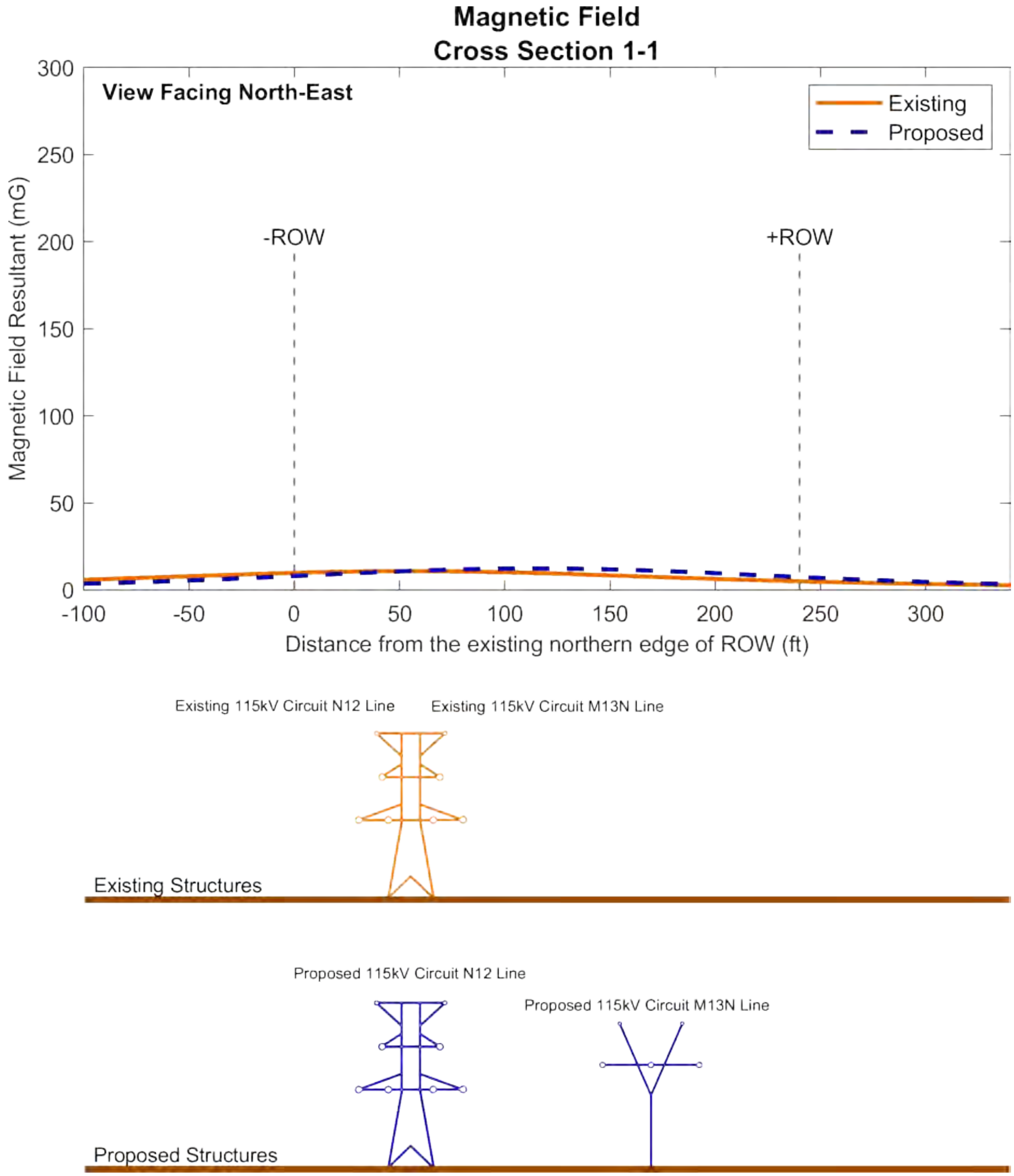

Figure B-1. Calculated magnetic-field profile (average loading) across Cross Section 1-1.

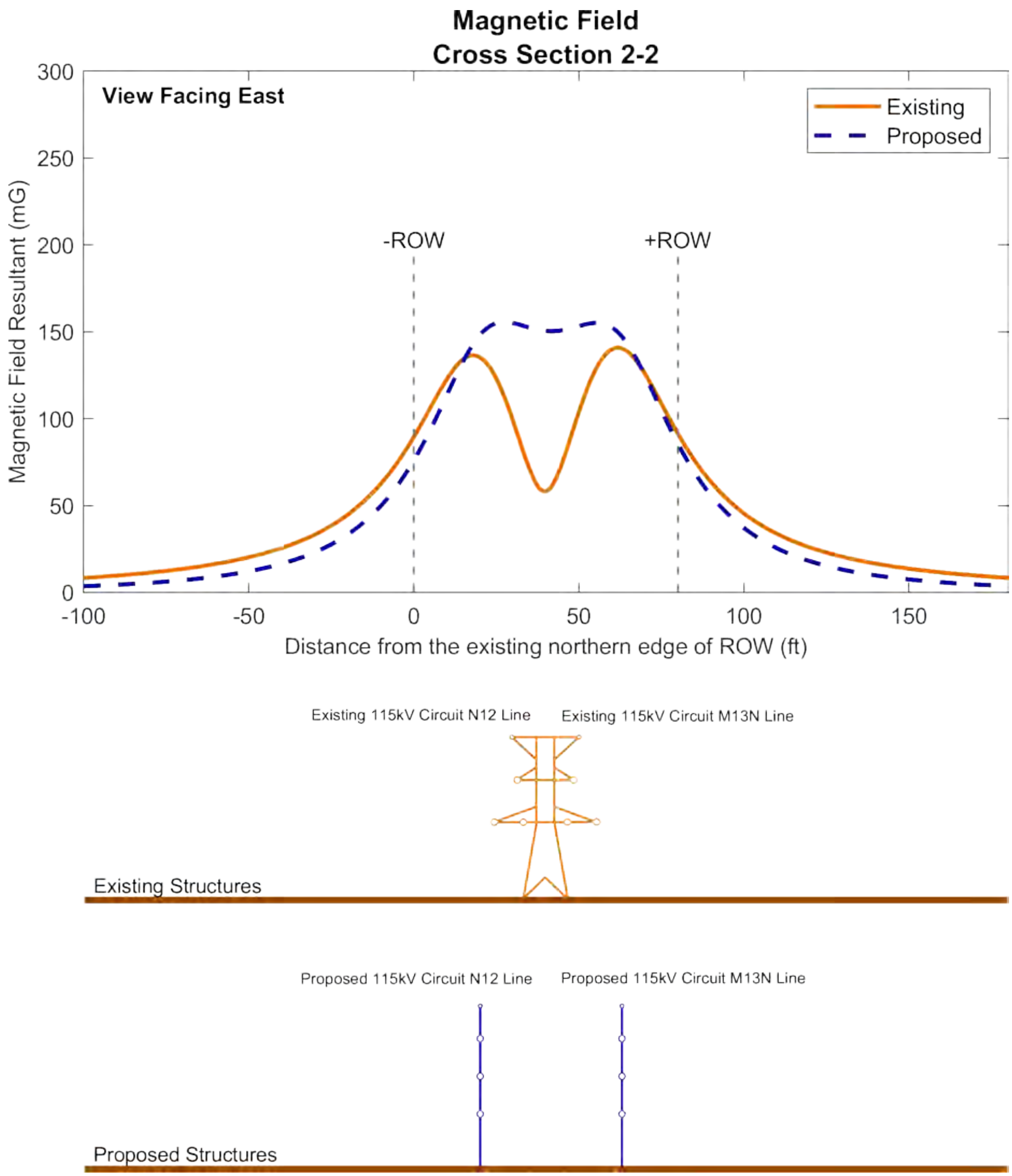

Figure B-2. Calculated magnetic-field profile (average loading) across Cross Section 2-2.

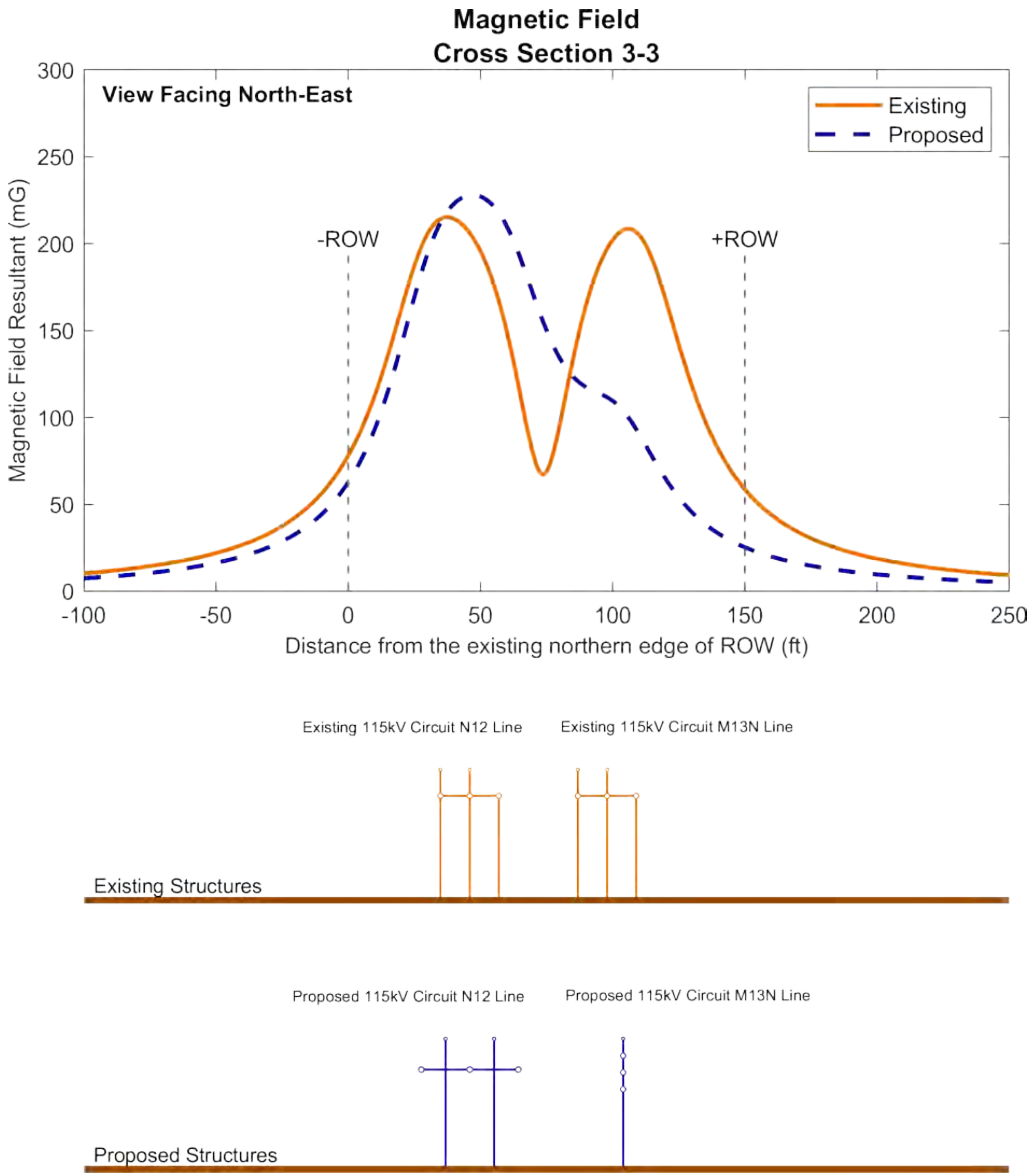

Figure B-3. Calculated magnetic-field profile (average loading) across Cross Section 3-3.

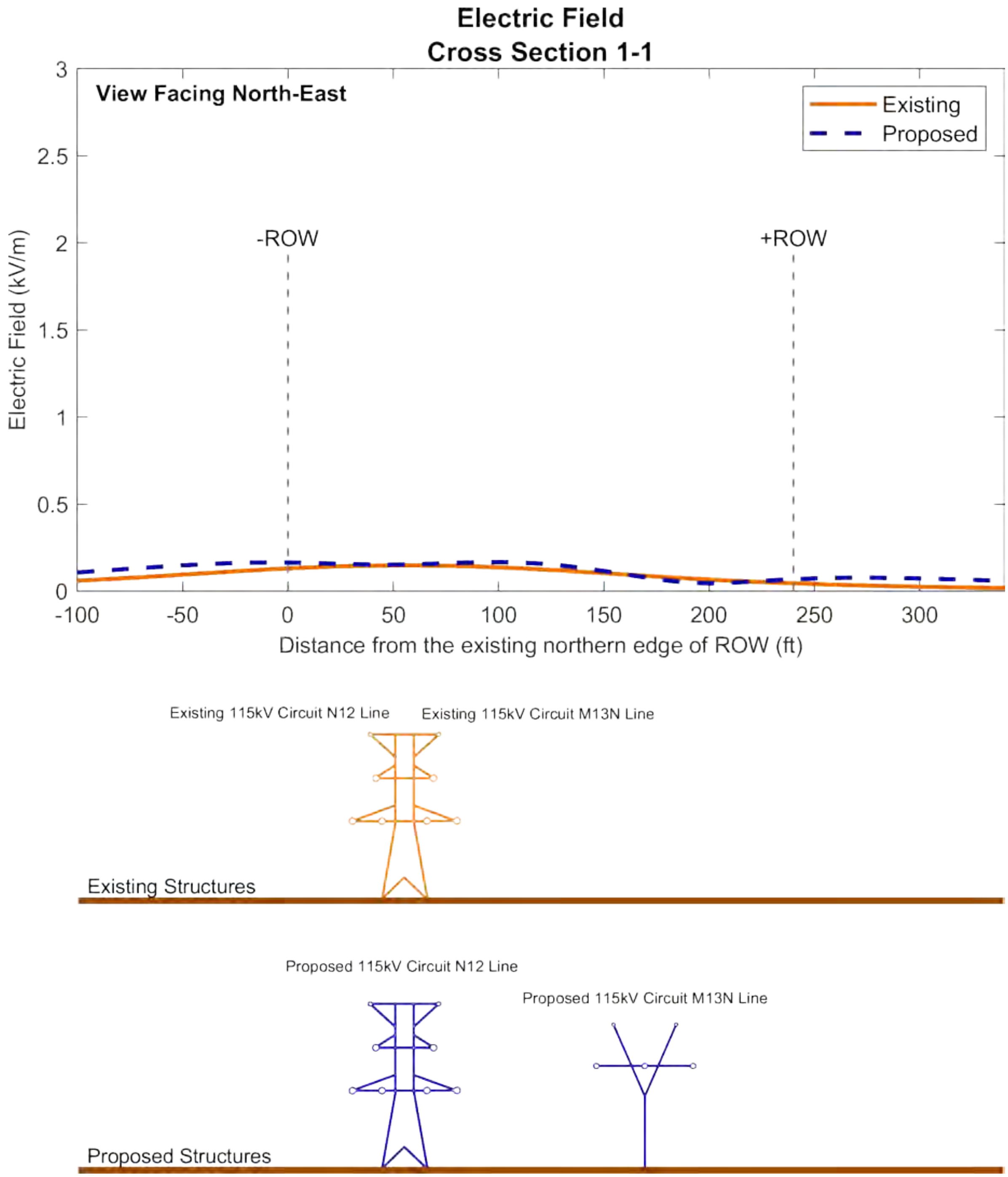

Figure B-4. Calculated electric-field profile across Cross Section 1-1.

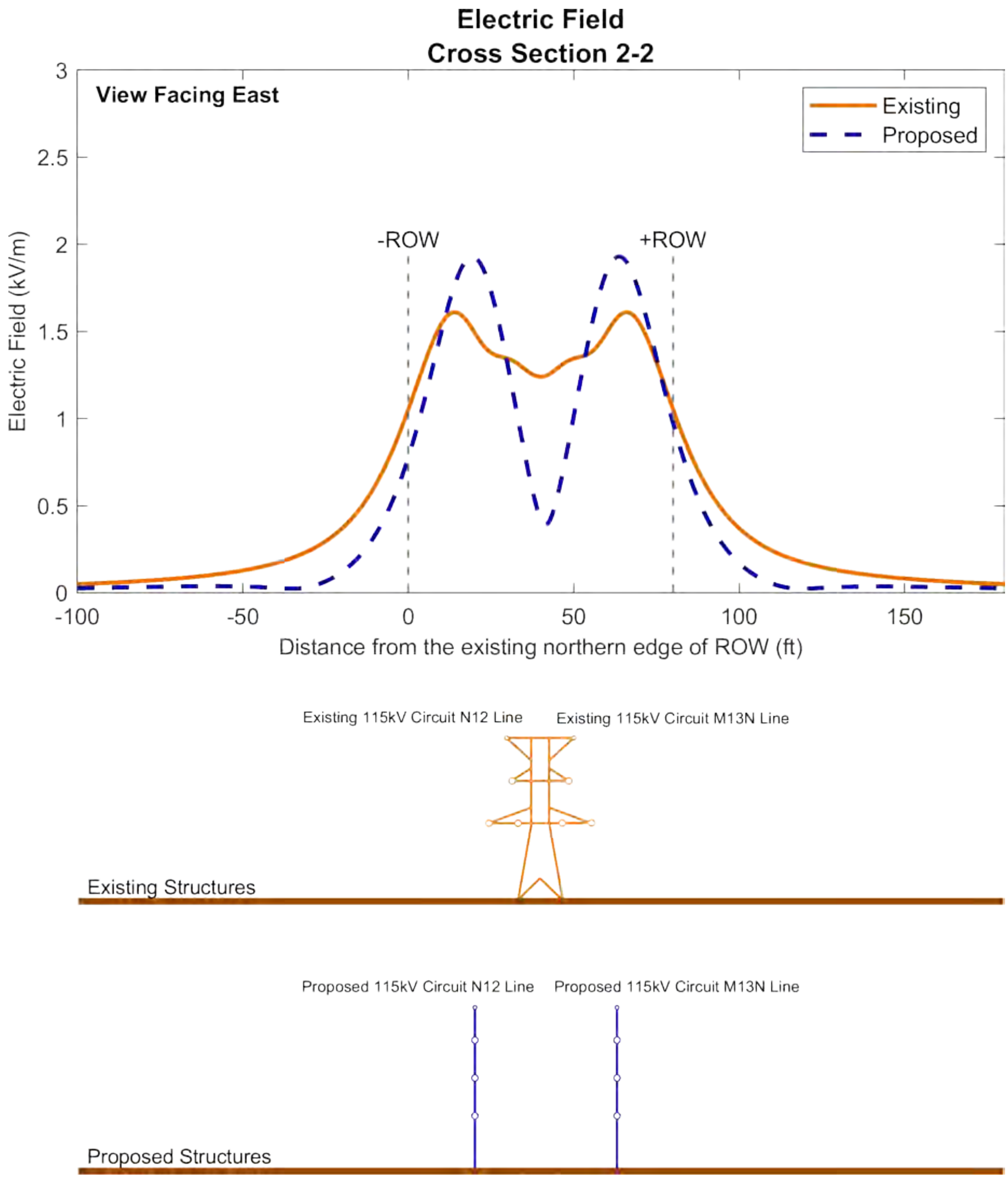

Figure B-5. Calculated electric-field profile across Cross Section 2-2.

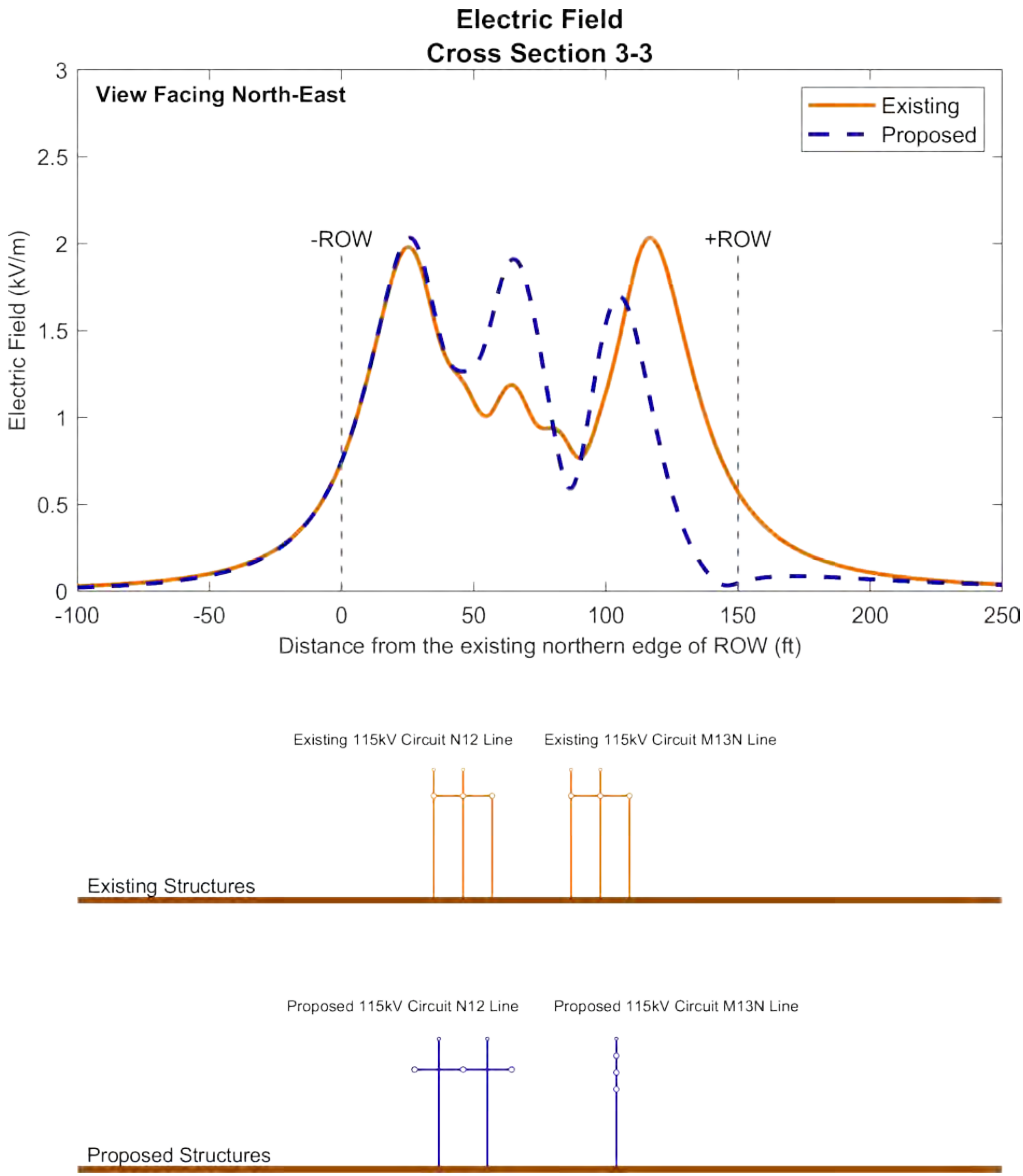

Figure B-6. Calculated electric-field profile across Cross Section 3-3.

Appendix C

Summary of Configuration by Cross Section, Circuit Loading, and Conductor Phase

In existing cross sections 1-1 and 2-2 both transmission lines N12 and M13 are supported on double-circuit structures. In cross section 1-1 the structure centerline is located approximately 55.5 feet from the northern edge of a 240-foot ROW. In cross section 2-2 the structure is centered on an 80-foot ROW. In existing cross section 3-3, the N12 and M13N lines are each supported on separate transmission structures, with the N12 line generally located north of the ROW center and the M13N line located south of the ROW center. For all existing cross sections, the N12 and M13N lines are constructed with three-phase 795 kcmil ACSR conductors at a voltage of 115 kV.

National Grid proposes to separate the N12 and M13N lines from the single structure configuration in existing cross sections 1-1 and 2-2. Proposed cross section 1-1 will maintain the N12 line on the existing transmission structure with the six existing conductors to remain in place and with A, B, and C, 795 kcmil ACSR conductors bussed together for the rebuilt N12 line. The M13N line will be relocated onto new transmission structures located south of ROW center. The rebuilt M13N line will be constructed with 1622 kcmil ACCR conductors, and the existing copperweld shieldwire of the M13N line will be replaced with optical ground wire (OPGW).

Proposed cross section 2-2 relocates both N12 and M13N lines onto new transmission structures within the existing ROW. Proposed cross section 3-3 relocates the N12 and M13N lines from separate existing transmission structures onto proposed transmission structures.

For cross sections 2-2 to 3-3, the existing 795 kcmil ACSR conductors of both N12 and M13N lines will be replaced with 1582 kcmil ACCC conductors. The existing alumoweld shieldwires of both lines will be replaced with steel for the N12 line and both steel and OPGW for the M13N line.

Table C-1. Loading summary of all modeled transmission lines*

Line Number	Start Location	End Location	Voltage (kV)	Pre-Project				Post-Project (2025)			
				Average		Peak		Average		Peak	
				MW	MVar	MW	MVar	MW	MVar	MW	MVar
M13	Pottersville Substation	Sykes Road Substation	115	143.6	-40.9	168.7	-29.2	145.2	-42.3	170.3	-30.5
N12	Pottersville Substation	Sykes Road Substation	115	138.1	-42.2	161.9	-31.5	144.6	-47.4	169.7	-36.8

* Power flows in the direction from the start location to the end location

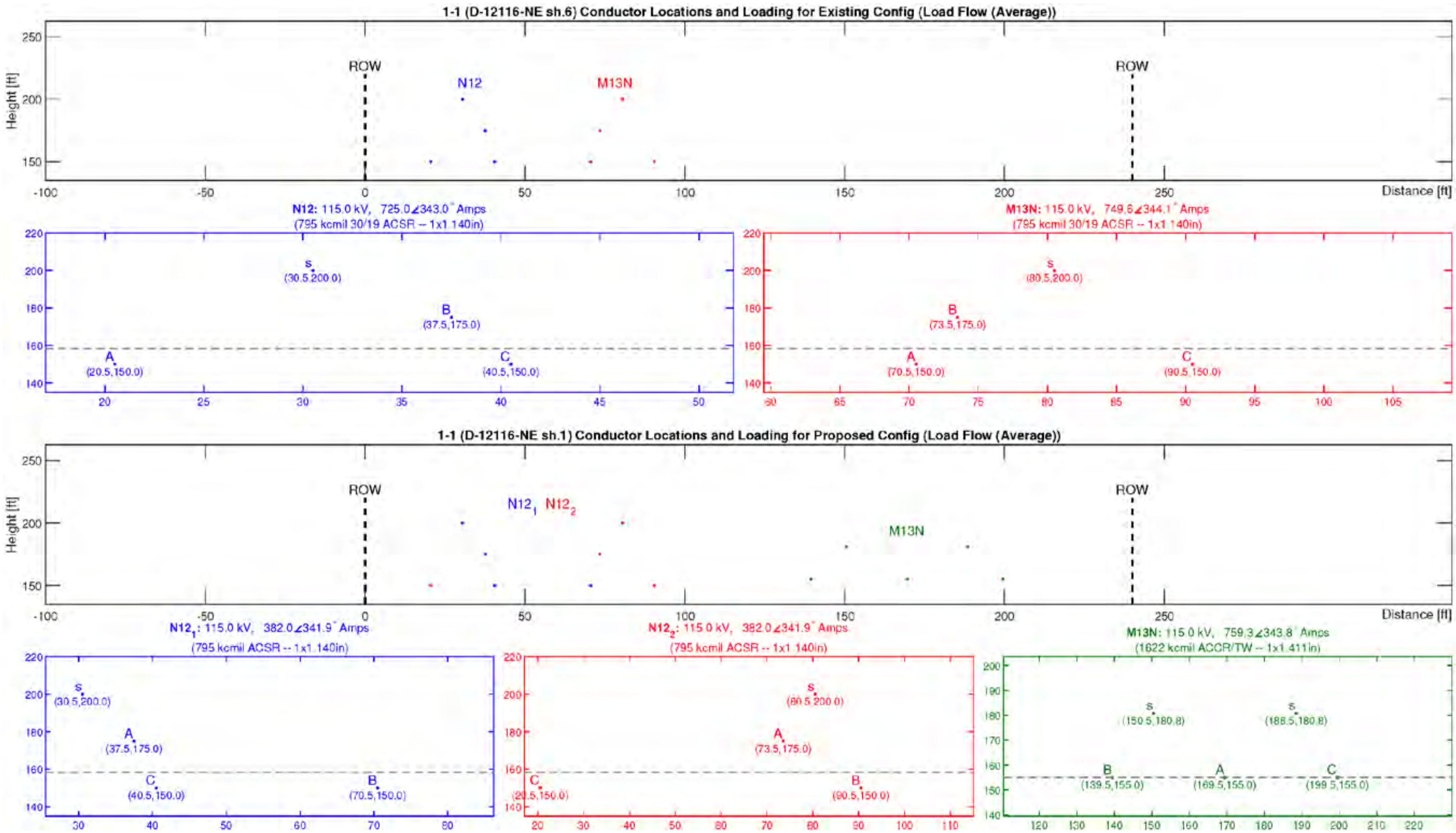

Figure C-1. Visualization of the Circuit conductor locations and phases for Cross Section 1-1

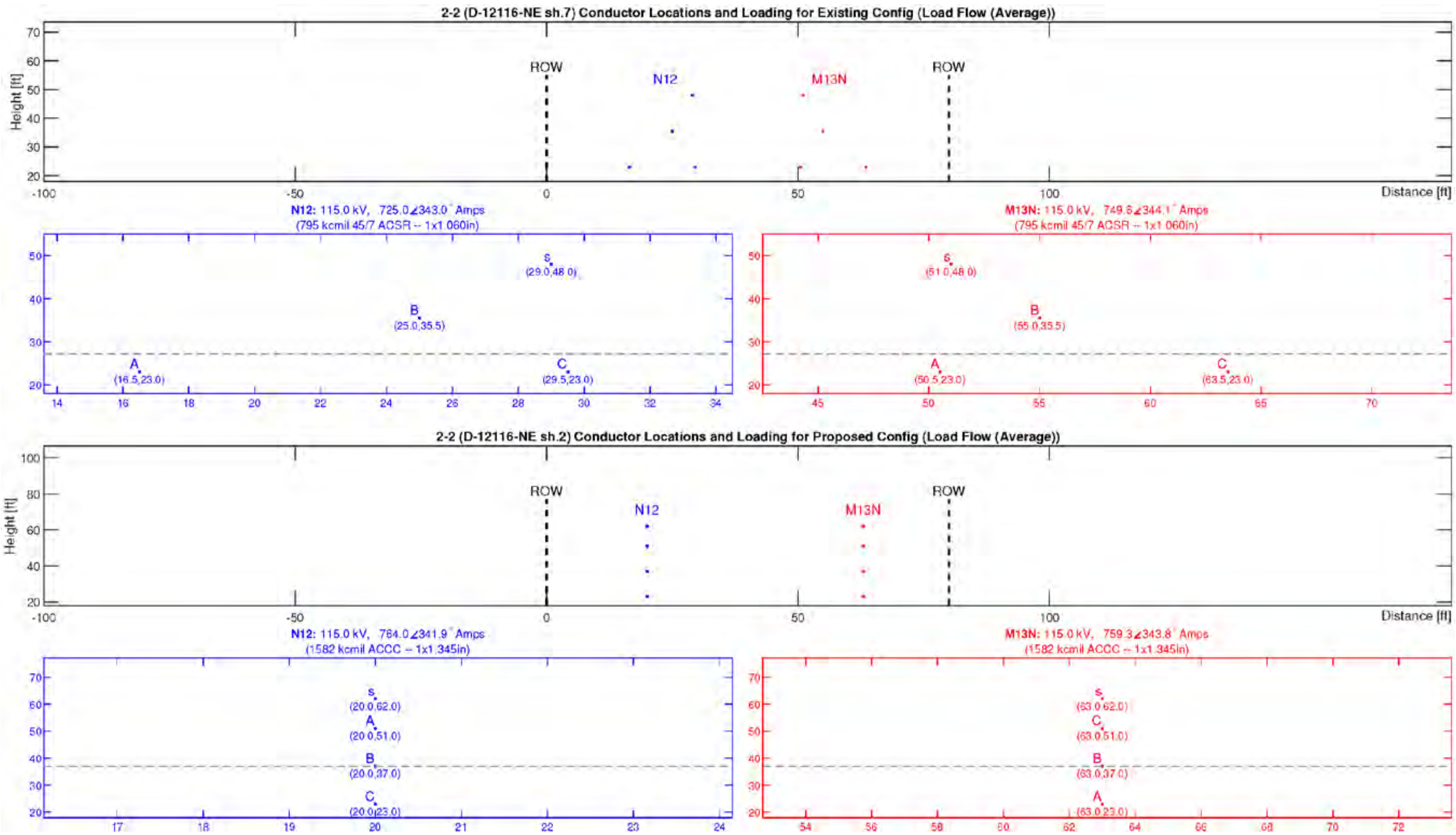

Figure C-2. Visualization of the Circuit conductor locations and phases for Cross Section 2-2

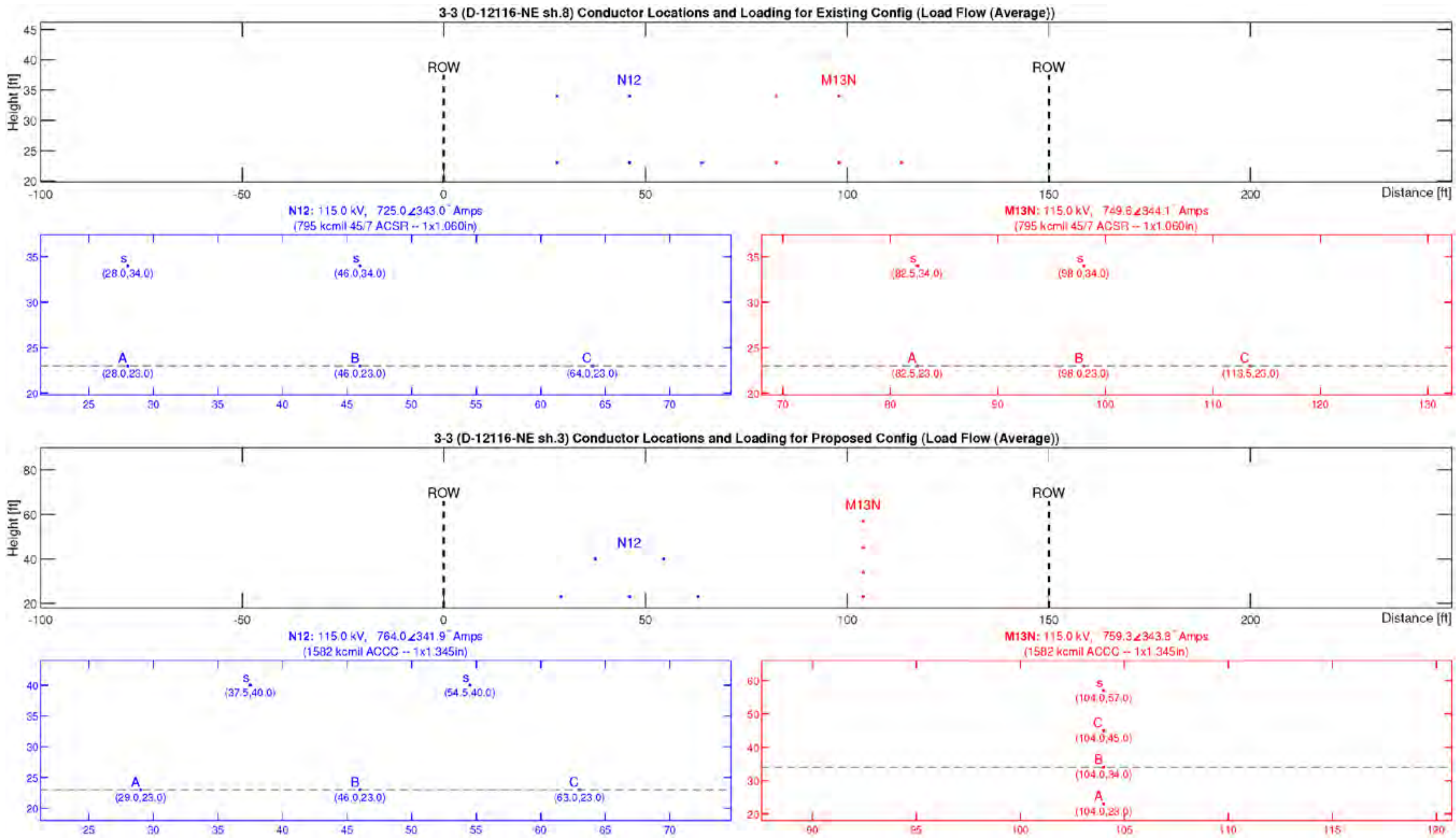

Figure C-3. Visualization of the Circuit conductor locations and phases for Cross Section 3-3