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Newport Area (Aquidneck Island) Transmission Solution Study Report

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Prepared by:
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April 2015

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Executive Summary

1.1 Needs Assessment Results and Problem Statement

The Southeastern Massachusetts and Rhode Island (SEMA-RI) Area Needs Assessment (N-1) presented to the Planning Advisory Committee (PAC) on February 19, 2014 identified potential thermal and voltage issues on the Somerset Area including the transmission facilities between Dexter and Jepson Substations. National Grid performed a sensitivity study (the “Study”) of the relevant Greater Rhode Island (GRI) projects on Aquidneck Island with the request for a new 69/13.8 kV Substation in the city of Newport, RI and related distribution system arrangements.

This report presents an advanced solution from the larger SEMA-RI scope, the transmission solutions in this report addresses the needs of the local transmission supply to Aquidneck Island. Aquidneck Island consists of the Towns of Portsmouth and Middletown, and the City of Newport in Rhode Island. The transmission system supplying Aquidneck Island consists of three 69 kV lines: 61, 62 and 63. Lines 61 and 62 originate at the Dexter #36 Substation located in Portsmouth, RI and terminate at the Jepson #37 Substation in Portsmouth RI. A single 69 kV line, line 63, extends further south from Jepson Substation into Newport, RI. This line feeds a US Navy-owned Substation, located within the Newport Naval Base (Navy #1), and the Gate II #38 Substation owned by National Grid.

In order to assess the voltage and thermal performance of the transmission system local to Aquidneck Island the following projects were modeled:

- New 115 kV line between Brayton Point and Somerset (RSP 791)
- New 115 kV line between Somerset and Bell Rock (RSP 914)
- Bell Rock Substation expansion (RSP 917)

The above projects are being re-evaluated by the SEMA-RI Study, which is studying a broader transmission system area. The above projects were modeled as a proxy to mitigate the larger network needs in the Somerset/Bell Rock area and do not mitigate the thermal needs on Aquidneck Island.

There is a Local System Plan (LSP) project with a projected in-service date of June 2018, which is also modeled. These LSP projects consist of a proposed 69/13.8 kV Substation in the City of Newport, RI which mitigate distribution and sub-transmission supply line loading issues on Aquidneck Island. The Study also assumes upgrades in the distribution system which will shift load supplied from the 23 kV system out of Gate II to the 13.8 kV system supplied by Jepson Substation.

The following summarizes the project needs based on the sensitivity analysis performed using the forecasted 2022 summer peak with Forward Capacity Market Cleared DR and projected EE. Asset condition issues were evaluated and given due consideration with respect to ultimately selecting a recommended solution, recognizing that these issues could significantly impact the scope and cost of the resulting projects:

- Potential N-1 thermal issues were observed on the 115-69 kV transformers at Dexter Substation for any of the contingencies that take out either the 56 MVA paralleled transformers or the 100 MVA transformer.
- Potential N-1 thermal issues were observed on the 69 kV Lines 61, 62 for contingencies that take out either line out of service.

- Potential N-1 thermal issues were observed for the 69 kV ring at Jepson Substation for breaker failures 3764 and 3766 at Jepson. These breaker failures take out one of the 69 kV lines, opening the ring and forcing flow through the remaining path that connects the load serving transformers and the 69 kV Line 63 that supplies Navy Substation and Gate II.
- Known asset condition issues on the 69 kV, 23 kV and 4 kV yards at Jepson #37, assessments done over the past decade have recommended upgrading and/or replacing due to failure history or a lack of available spare parts.
- Control house at Jepson #37 has no space to add the controls and relaying for any new 69 kV equipment, and upgrade of an obsolete remote terminal unit (RTU).
- Secondary oil containment for three transformers does not meet current standards.
- Jepson #37 is within the 100 year flood plain and is directly adjacent to Sisson Pond and entirely within Zone A[1] Watershed Protection Overlay.

1.2 Recommended Solution

National Grid conducted a sensitivity study (the "Study") to evaluate the transmission system on Aquidneck Island, which includes 115 and 69 kV Pool Transmission Facilities (PTF) owned by National Grid.

The Study considered relevant Greater Rhode Island projects, the new Newport Substation as a common item, as well as upgrades on the distribution system which will shift load supplied from the Gate II 23 kV system to the 13.8 kV system supplied by Jepson Substation.

The following two alternative solutions were analyzed for this Study:

1. Reinforce Dexter Substation, reconductor the 61/62 lines and rebuild Jepson Substation at 69 kV, refer to Figure 5-3
2. Convert 61/62 lines and Jepson Substation to 115 kV, refer to Figure 5-4

Based on the thermal and superior performance beyond the study horizon, the recommended solution is Alternative Solution 2, which is to convert the 61/62 lines and Jepson Substation to 115 kV operation. Analysis indicates that converting the 69 kV to 115 kV operation (alternative 2) results in superior system performance beyond the study horizon able to accommodate a larger amount of future load growth without the need to undertake future additional transmission upgrades between Dexter and Jepson Substations.

Alternative Solution 1 costs $1.0 million more than Alternative Solution 2. Additionally Alternative Solution 1 results in limited voltage performance beyond the study horizon and only defers the need to further reinforce the transmission system between Dexter and Jepson Substations. The limited voltage performance beyond the study horizon is due to critical N-1 scenarios at Dexter 115 kV; specifically three breaker failures at Dexter that would take out one of the 115 kV lines to Dexter and the parallel transformers that supply the 61 or 62 69 kV lines. National Grid would need to undertake future additional transmission upgrades between Dexter and Jepson Substations in order to mitigate the critical contingencies. These upgrades could take the form of (1) rebuilding and upgrading the 61 and 62 Lines from 69 kV to 115 kV, which would involve replacing the 69 kV structures with 115 kV

[1] The Zone A is critical to the protection of surface and subsurface water supplies and requires a high degree of protection from incompatible land uses.

structures. The future rebuild and upgrade of the 61 and 62 lines to 115 kV would introduce complex cutovers at the newly rebuilt Jepson Substation requiring numerous outages in order to operate part of the Substation at 115 kV and at 69 kV. (2) Constructing an additional (third) 69 kV transmission line between Dexter and Jepson Substations. Due to space constraints on the existing right-of-way, a third line could not be constructed overhead on the existing Dexter-Jepson right-of-way.

The recommended solution to resolve the identified needs is to (1) relocate the Jepson Substation to a new site and rebuild it at 115 kV (air insulated) to address both the asset condition and thermal issues, (2) rebuild and upgrade/convert the 61 and 62 Lines from 69 kV to 115 kV between Dexter and Jepson Substations and (3) reconfigure Dexter Substation by removing the 115-69 kV transformation and adding 115 kV motor-operated load break switches and a circuit switcher to supply the existing 115 – 13.8 kV transformer. The estimated cost for this option is $39.2 million at a tolerance of -25/+50 % with an expected in-service date of December 2019.

1.3 NERC Compliance Statement

In accordance with NERC TPL Standards, this assessment provides:

- A written summary of plans to address the system performance issues described for the Needs listed on Sections 1.1 and Section 2 of this report.
- A schedule for implementation as shown in Section 8.3, Page 41

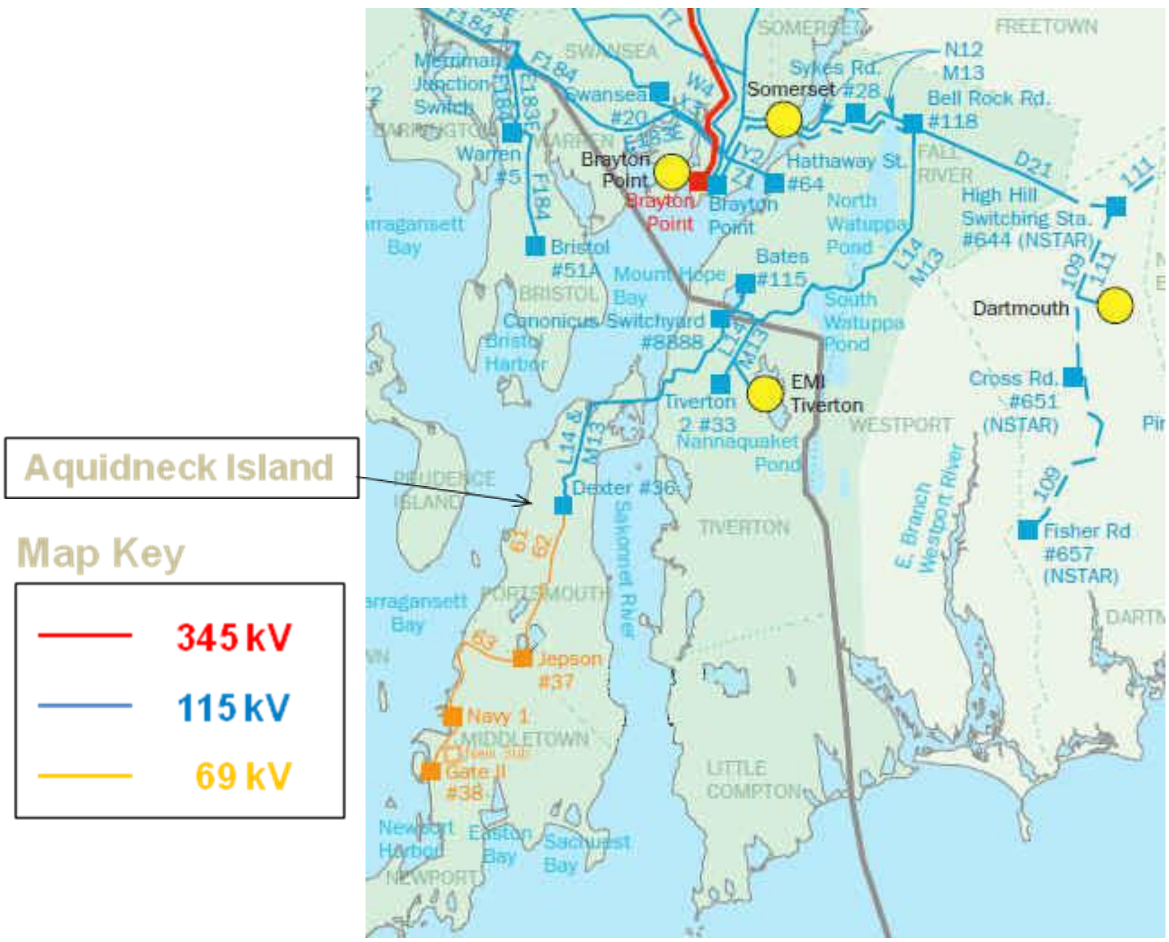
This assessment documents the continuing need for the identified system facilities.

Section 2
Needs Assessment Results Summary

2.1 Introduction

The Southeastern Massachusetts and Rhode Island (SEMA-RI) Area Needs Assessment (N-1) presented to the Planning Advisory Committee (PAC) on February 19, 2014[2] identified potential thermal and voltage issues on the Somerset Area including the transmission facilities between Dexter and Jepson Substations. National Grid performed a sensitivity study (the “Study”) of the relevant Greater Rhode Island (GRI) projects on Aquidneck Island with the request for a new 69/13.8 kV Substation in the city of Newport, RI and related distribution system arrangements. The Study also recognizes upgrades in the distribution system which will shift load supplied from the Gate II 23 kV system out of Gate II to the 13.8 kV system supplied by Jepson Substation.

Narragansett Electric Company has a need for a new 69/13.8 kV Substation in the City of Newport, RI (Local System Plan (LSP) Project) to mitigate distribution and sub-transmission supply line loadings issues.



[2] https://smd.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/ceii/mtrls/2014/feb192014/a8_sema_ri_needs_assessment.pdf

Figure 2-1 Geographic Map of the Study Area

National Grid has identified a need to modernize and preferably, relocate its Jepson Substation. There are asset condition issues on the 69 kV, 23 kV and 4 kV yards at Jepson #37, there is no space in the control house to add the controls for any new 69 kV breaker, add a failure scheme for the current 69 kV ring bus or upgrade an obsolete RTU. Equipment at this Substation is up to 60 years old, and it is increasingly difficult to purchase spare parts when they are needed for maintenance. In Addition, the Jepson Substation is located within the 100-year flood plain, raising reliability and environmental concerns.

In light of these findings and of existing concerns about the reliability of electric service on Aquidneck Island, National Grid conducted a stand-alone review of the transmission system serving Aquidneck Island.

2.2 Needs Assessment Review

In order to assess the voltage and thermal performance of the transmission system local to Aquidneck Island the following projects were modeled:

- New 115 kV line between Brayton Point and Somerset (RSP 791)
- New 115 kV line between Somerset and Bell Rock (RSP 914)
- Bell Rock Substation expansion (RSP 917)

The above projects are being re-evaluated by the SEMA-RI Study, which is studying a broader transmission system area. The above projects were modeled as a proxy to mitigate the larger network needs in the Somerset/Bell Rock area and do not mitigate the thermal needs on Aquidneck Island.

Based on the forecasted 2022 summer peak (CELT 2013) with FCM cleared DR and projected EE, analysis shows that the existing Dexter configuration, the 69 kV 61 and 62 lines and Jepson #37 are limited under N-1 contingency scenarios. Figure 2-2 shows the worst N-1 contingency loading with the new Newport Substation, and the existing Dexter #36 and Jepson #37 configurations.

[redacted]

Assessments of the physical condition of the existing Jepson #37 within the past decade have recommended upgrading and/or replacing equipment in the 23 kV and 69 kV yards, due to failure history or a lack of available spare parts. The following asset condition issues need to be mitigated:

- 69 kV Yard:
  - The 69 kV breakers are 50 and 60 year old oil type breakers and have air systems that have not functioned reliably in the past.
  - The 69 kV structure has pin-type insulators, which have a higher failure rate than other designs. Additionally, this structure has an obsolete style switch for which replacement parts are no longer available.
  - There is insufficient space in the control house to add a failure scheme for the current 69 kV ring bus or to upgrade obsolete remote terminal unit (RTU) equipment.
- 23 kV Yard:
  - Four of the 23 kV breakers are over 60 years old, and three additional 23 kV breakers are over 40 years old. It is increasingly difficult to obtain parts and technical support for this equipment, particularly for the oldest breakers.
  - The 23 kV bus also uses approximately 100 pin type insulators. Further, the arrangement of this bus has substandard clearances and working space per current standards.
  - The 23 kV bus voltage is regulated by an obsolete LTC control scheme that must operate three separate Load Tap Changing transformers in parallel. This scheme has repeatedly malfunctioned and has been disabled on numerous occasions.
  - Secondary oil containment for three transformers does not meet current standards.
- 4 kV Yard:
  - 1960's vintage 23/4.16 kV station with mostly original equipment
  - Obsolete design with single set of regulators supplying both feeders
  - Entire bay no longer meets current clearance requirements
  - No EMS

- The existing Substation site also experiences routine flooding due to the installation of a spill prevention control and countermeasure (SPCC) berm. Although the SPCC berm was designed to contain spills at the Substation, it also retains water during rain events.

In addition to these documented issues, a portion of the Jepson Substation is located within the one percent annual chance flood area (100 year flood plain) and a Zone A Water shed Project Overlay District, and is directly adjacent to Sisson Pond.

The following table provides a summary of trouble events since year 2000:

History of Trouble Events Since Year 2000			
	Number of Events 2000 – 2005	Number of Events 2005 – 2010	Number of Events 2010 – 2015
69 kV Oil Circuit Breakers	7	5	7
23 kV Oil Circuit Breakers	1	9	4
23 kV Load Tap Changers	9	14	22
69 – 23 kV Transformers	1	3	0
23 kV Bus	1	1	0
23 kV Capacitors	0	10	5
23 – 4 kV Transformers	1	1	1
13 kV Oil Circuit Reclosers	6	2	4
4 kV Oil Circuit Reclosers	1	1	1
Total of Events	47	77	76

2.3 Year of Need Analysis

The Critical Load Level Analysis indicates the following need years:

- The need to resolve thermal issues on the 61 and 62 Lines as a result of the 61 and 62 line contingencies is in the past.
- The need to resolve thermal issues on the 69 kV ring at Jepson as a result of the 61 or 62 line contingencies is in the past.
- The need to resolve the thermal issues on the 115-69 kV transformers at Dexter is 2016.

Section 3
Solution Study Assumptions

3.1 Analysis Description

To address the potential overload issues identified on the SEMA-RI Area Needs Assessment (N-1) presented to the PAC on February 19, 2014 on Dexter #36, the 61 and 62 Lines, as well as the thermal and asset condition issues at Jepson #37, National Grid developed alternatives that involve reinforcing the 69 kV system as well as further extending the 115 kV from Dexter #36 to Jepson #37.

National Grid conducted a System Impact Study (the "Study") to evaluate the transmission system on Aquidneck Island which includes 115 kV and 69 kV Pool Transmission Facilities (PTF) owned by National Grid, with a projected in-service date of December 2019.

The following two alternative solutions were analyzed for this Study:

1. <u>Reinforce the 69 kV (refer to Figure 5-3):</u>
    a. Reconstruct the 61 and 62 Lines at 69 kV
    b. Relocate and rebuild Jepson Substation to address both asset condition and thermal concerns
    c. Reinforce Dexter Substation by reconfiguring the 115 kV and replacing the existing 115-69 kV transformers with four 115-69 kV transformers.
2. <u>Convert the 61 and 62 Lines and Jepson Substation to 115 kV</u> (refer to Figure 5-4):
    a. Rebuild and Upgrade the 61 and 62 Lines to 115 kV.
    b. Relocate and rebuild Jepson Substation to address asset condition issues and thermal concerns
    c. Remove the existing 115-69 kV equipment from the Dexter Substation to support the 61 and 62 Line upgrades.

The primary objective of this Study was to assess the impact of the two alternative solutions on the reliability, and operating characteristic of the National Grid transmission system. National Grid conducted thermal, voltage and short circuit analysis on the two alternative solutions to assess the steady state impact to the transmission system. Sensitivity analysis was performed to assess the voltage performance of the two alternative solutions beyond the study horizon. The stability analysis will be conducted as part of the PPA analysis for the recommended interconnection.

The Power Technologies, Inc. PSS™E Power Flow package, version 33.3 was used for the analysis.

3.2 Steady State Model Assumptions

3.2.1 Study Assumptions

Per direction of ISO-NE a 2022 summer peak from the SEMA-RI Study group was used to perform analysis. All I.3.9 approved projects as of March 2014, including updated GSRP, RIRP and IRP components of NEEWS were included in the base cases. Two generators unit out of service were assumed in the basecases. Each alternative solution was then evaluated for N-1 conditions for the 2022 summer peak (90/10) load level adjusted with 100% passive and 75% active Demand Response cleared through the FCA-7 auction, including 100% EE forecast for the remaining years 2017 through 2022.

3.2.2 Source of Power Flow Models

The steady state base power flow Study cases utilized a 2022 summer peak west-east case from the SEMA-RI Study working group.

3.2.3 Transmission Topology Changes

All I.3.9 approved projects as of March 2014, including updated GSRP, RIRP and IRP components of NEEWS were included in the base cases.

3.2.4 Generation Assumptions (Additions & Retirements)

Generator capacities will be based on the 2013 Forward Capacity Auction 7 (FCA 7). Tiverton and Dighton were assumed out of service per the two-unit out assumption as defined on the ISO-NE's Planning Manual.

3.2.5 Explanation of Future Changes Not Included

N/A

3.2.6 Forecasted Load (including assumptions concerning energy efficiency, interruptible loads, etc.)

The steady state load levels were based on the 2013 New England Capacity, Energy, Load, and Transmission (CELT) report published by ISO-NE in May 2013.

Projected peak load of 166.5 MVA was used for the combined loading of Dexter #36, Jepson #37, Navy 1, proposed Newport and Gate Substation. Table 3-2 shows the load modeling details with the FCM Cleared DR reductions. Unity Power Factor on the low side of the transformers was assumed. 5 MW of spot load was assumed in the analysis.

Table 3-2 Load Modeling details including load transfers to new Substation

Substation	Pre_ Project Loading (MVA)	Post-Project Loading (MVA)
Dexter (13.8 kV)	26.9	26.9
Jepson (13.8 kV)	51.4	51.4
Jepson 23 kV	13.6	13.6
Navy 13.8 kV	22.8	22.8
Newport (13.8 kV)	22.8	22.8
Gate II (23 kV)	29.0	29.0
Total	166.5	166.5

Note: Above loading includes 5 MVA of spot load at Jepson 13.8 kV

3.2.7 Load Levels Studied

The steady state load levels were based on the 2013 New England Capacity, Energy, Load, and Transmission (CELT) report published by ISO-NE in May 2013. Using the NEPOOL 2013 CELT report, the steady state analysis was tested at 90/10 summer peak load level (100% of 90/10 forecast).

The CELT report predicts an extreme weather New England summer peak load of 34, 105 MW in the year 2022.

Case summaries for each of the load levels and conditions studied are included in Appendix C.

3.2.8 Load Power Factor Assumptions

Unity power factor represented on the transformer low side was assumed for the loads in the Study area.

3.2.9 Transfer Levels

A summary of interface transfer levels for all relevant defined interfaces for the base case as well as each alternative solution studied are shown at the end of Table 3-3 on the following section.

3.2.10 Generation Dispatch Scenarios

One dispatch scenario was created for summer peak load levels:

- Tiv+Dig: Tiverton & Dighton OFF

Each of the two alternative solutions was evaluated using the above dispatch utilizing the Network Resource Capability (NRC) Pmax generation profile.

The base case dispatch scenarios are shown in Table 3-3 below.

Table 3-3 Steady State Generation Dispatch Summary

Name	Bus Number	Zone Number	Capacity in MW (NRC 50°F)	18smpk Pre (MW)	18smpk Dexter115 (MW)	18smpk Jepson115 (MW)
Southeast Massachusetts Generation						
[redacted]		1140	244	244	244	244
[redacted]		1140	244	244	244	244
[redacted]		1140	137	OSS	OSS	OSS
[redacted]		1140	108	OSS	OSS	OSS
[redacted]		1140	136	OSS	OSS	OSS
[redacted]		1140	107	OSS	OSS	OSS
[redacted]		1140	649	OSS	OSS	OSS
[redacted]		1140	441	OSS	OSS	OSS
[redacted]		1140	OOS	OOS	OOS	OOS
[redacted]		1043	573	573	573	573
[redacted]		1043	563	563	563	563
[redacted]		1044	126	20	20	20
[redacted]		1044	108	17	17	17
[redacted]		1044	126	20	20	20
[redacted]		1044	108	17	17	17
[redacted]		1254	27	27	27	27
[redacted]		1254	22	22	22	22
[redacted]		1254	87	87	87	87

Name	Bus Number	Zone Number	Capacity in MW (NRC 50°F)	18smpk Pre (MW)	18smpk Dexter115 (MW)	18smpk Jepson115 (MW)
[redacted]	[redacted]	1053	36	36	36	36
[redacted]	[redacted]	1053	28	28	28	28
[redacted]	[redacted]	1053	21	21	21	21
[redacted]	[redacted]	1160	163	OSS	OOS	OOS
[redacted]	[redacted]	1140	82	82	82	82
[redacted]	[redacted]	1140	69	69	69	69
[redacted]	[redacted]	1043	8	OSS	OOS	OSS
[redacted]	[redacted]	1063	58	58	58	58
[redacted]	[redacted]	1063	17	17	17	17
[redacted]	[redacted]	1033	52	52	52	52
[redacted]	[redacted]	1033	28	28	28	28
[redacted]	[redacted]	1063	53	53	53	53
[redacted]	[redacted]	1063	53	53	53	53
[redacted]	[redacted]	1044	6	6	6	6
[redacted]	[redacted]	**ode Island Generation**				
[redacted]	[redacted]	1410	43	43	43	43
[redacted]	[redacted]	1410	43	43	43	43
[redacted]	[redacted]	1410	48	48	48	48
[redacted]	[redacted]	1410	108	108	108	108
[redacted]	[redacted]	1410	108	108	108	108
[redacted]	[redacted]	1410	104	104	104	104
[redacted]	[redacted]	1400	81	81	81	81
[redacted]	[redacted]	1400	81	81	81	81
[redacted]	[redacted]	1400	81	81	81	81
[redacted]	[redacted]	1400	81	81	81	81
[redacted]	[redacted]	1400	115	115	115	115
[redacted]	[redacted]	1400	114	114	114	114
[redacted]	[redacted]	1410	41	41	41	41
[redacted]	[redacted]	1410	24	24	24	24
[redacted]	[redacted]	1410	3	3	3	3
[redacted]	[redacted]	1410	3	3	3	3
[redacted]	[redacted]	1410	3	3	3	3
[redacted]	[redacted]	1410	3	3	3	3
[redacted]	[redacted]	1410	3	3	3	3
[redacted]	[redacted]	1410	3	3	3	3

Name	Bus Number	Zone Number	Capacity in MW (NRC 50°F)	18smpk Pre (MW)	18smpk Dexter115 (MW)	18smpk Jepson115 (MW)
[redacted]		1410	7	7	7	7
[redacted]		1410	185	185	185	185
[redacted]		1410	185	185	185	185
[redacted]		1410	185	185	185	185
[redacted]		1410	165	OSS	OOS	OOS
[redacted]		1410	86	OSS	OOS	OOS
Interface Transfers						
SEMA/RI				750	750	751
West-East				1658	1657	1656

3.2.11 Reactive Resource and Dispatch Assumptions

The existing capacitor banks on Aquidneck Island were modeled discrete pre-contingency, they were allowed to self adjust and then were locked post contingency, as these capacitors do not have automatic voltage control. The reactive resources outside Aquidneck Island were allowed to self adjust pre and post contingency.

3.2.12 Market Solutions Consideration

N/A

3.2.13 Demand Resource Assumptions

The CELT loads were adjusted for Active and Passive Demand Response (DR) cleared through the 2013 FCA-7 auction. FCA-7 covers a commitment period of June 1, 2016 to May 31, 2017.

The Study assumed the following values of DR across New England:

- 100% Passive DR: 1709.6 MW
- 75% Active DR: 634.4 MW
- Projected Energy Efficiency (EE): 1,096.3 MW
- FCA Non-Price Retirements (NPR) Requests are also modeled (Brayton Point, VT Yankee and Norwalk Harbor 1, 2, and 10

3.2.14 Description of Existing and Planned Protection and Control System Devices Included in the Study

N/A

3.2.15 Explanation of Operating Procedures and Other Modeling Assumptions

N/A

3.3 Stability Modeling Assumptions

3.3.1 Study Assumptions

The stability analysis will be performed on the recommended alternative solution during the ISO-NE Proposed Plan Application (PPA) analysis.

3.3.2 Load Levels Studied

N/A

3.3.3 Load Models

N/A

3.3.4 Dynamic Models

N/A

3.3.5 Transfer Levels

N/A

3.3.6 Generation Dispatch Scenarios

N/A

3.3.7 Reactive Resource and Dispatch Assumptions

N/A

3.3.8 Explanation of Operating Procedures and Other Modeling Assumptions

N/A

3.4 Short Circuit Model Assumptions

3.4.1 Study Assumptions

The Study case used originated from the 2017 MASTER CASE developed in July 2013.

3.4.2 Short Circuit Model

ASPEN Breaker Rating Module software was used to perform short circuit analysis. Circuit breakers at each Substation in the Study area were modeled with its connections to various elements, interrupting capability, interrupting time and contact parting time. Reclosing information was modeled for oil circuit breakers (when applicable) as these type of breakers need to be evaluated for potential derating due to automatic reclosing.

The program model calculates faults currents and X/R ratios for three-phase, phase-phase, phase-phase-ground and phase-ground faults at each Substation for all lines in and for line out situations. The program follows the IEEE C37.010 method of E/X calculation to incorporate AC and DC decrement effect multipliers to determine breaker fault duties.

3.4.3 Contributing Generation Assumptions (Additions & Retirements)

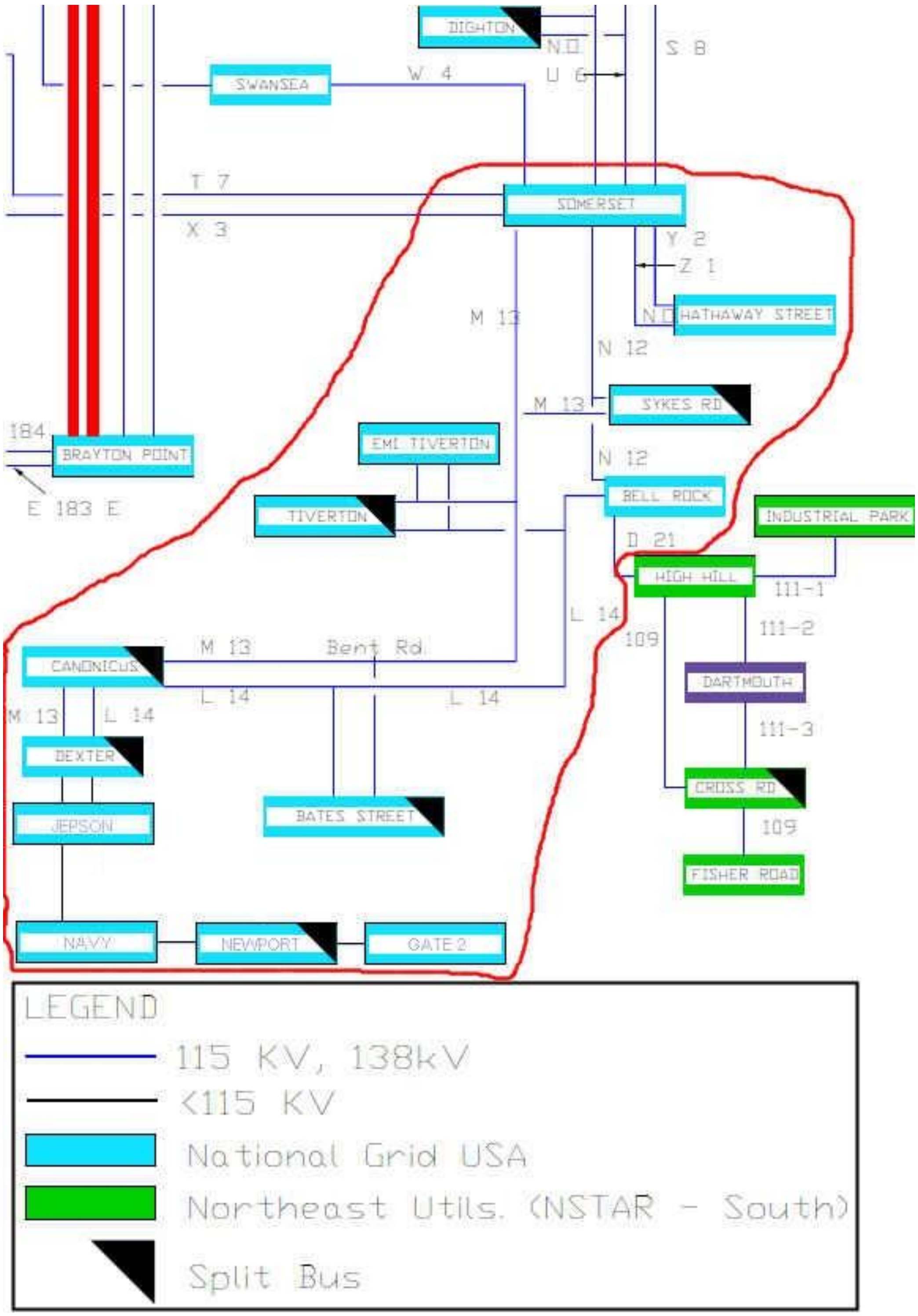
Testing methodology included all generation facilities online utilizing the Flat Start option with voltage starting at 1.03 per unit.

3.4.4 Generation and Transmission System Configurations

All proposed transmission and generation interconnection projects that have PPA approval and are FCM certified were included in the Study case.

3.4.5 Boundaries

Short circuit analysis was conducted to identify available fault duty at National Grid buses within the red boundary shown in Figure 3-1 below:



3.4.6 Other Relevant Modeling Assumptions

N/A

3.5 Other System Studies (such as transient network analysis, harmonic analysis, equipment assessments, etc.)

Sensitivity Analysis was performed using PSSE v33.3 in order to assess the voltage performance of the proposed alternative solutions beyond the Study horizon.

The 2022 summer peak cases developed for each alternative solution was used to perform the voltage performance analysis beyond the Study horizon. The Newport load was incremented in steps of 10 MW up to 50 MW; worst contingencies were analyzed at each incremental step.

The solution engine used was Fixed Slope decoupled Newton-Raphson and under pre-contingency (all lines-in) conditions, all regulating devices were allowed to regulate or adjust in order to represent conditions that would exist in the normal system in steady state. Similarly, under contingency conditions, all regulating devices were allowed to regulate except for Load Tap Changers.

3.6 Changes in Study Assumptions

N/A

Section 4
Analysis Methodology

4.1 Planning Standards and Criteria

Steady state thermal and voltage analyses examined system performance with the existing Dexter #36 and Jepson #37 configuration and the new Substation and the new 69 kV line between Jepson #37 and the new Substation in Newport, RI in order to establish a baseline for comparison. System performance was then re-evaluated with each alternative solution and compared with the previous baseline performance to demonstrate the impact on the adjacent transmission area. The acceptance criteria used for the Study are listed in sections Tables 4-1 and 4-2.

4.2 Performance Criteria

4.2.1 Steady State Criteria

The Study will be performed in accordance with:

- Northeast Power Coordinating Council (NPCC) *Directory 1 "Design and Operation of the Bulk Power Systems"*
- ISO New England Planning Procedure No. 3, "*Reliability Standards for the New England Area Bulk Power System*"
- National Grid Transmission Group Procedure (TGP) #28 – "Transmission Planning Guide for the National Grid USA Service Company"

4.2.2 Steady State Thermal and Voltage Limits

Transmission voltage levels must be maintained within a prescribed bandwidth to ensure proper operation of electrical equipment at both the transmission and customer voltage ranges. Equipment damage and widespread power outages are more likely to occur when transmission-level voltages are not maintained within pre-defined limits. Table 4-1 contains the voltage performance criteria that will be used in this analysis.

Table 4-1 Steady State Voltage Criteria

Transmission Owner	Voltage Level	Bus Voltage Limits (Per-Unit)	
		Normal Conditions	Emergency (Contingency) Conditions
National Grid	345 & 230 kV and above	0.98 to 1.05	0.95 to 1.05
	115 kV[1] and below	0.95 to 1.05	0.90 to 1.05
Maximum Percent Voltage Variation at Delivery Points			
Condition		345 & 230 kV (%)	115 kV[1] and below (%)
Post contingency & Automatic Actions		5.0	10.0
Switching of Reactive Sources or Motor Starts (All elements in service)		2.0 *	2.5 *
Switching of Reactive Sources or Motor Starts (One element out of service)		4.0 *	5.0 *

[1] Buses that are part of the bulk power system, and other buses deemed critical by Network Operations shall meet requirements for 345 kV and 230 kV buses.

[*] These limits are maximums which do not include frequency of operation. Actual limits will be considered on a case-by-case basis and will include consideration of frequency of operation and impact on customer service in the area.

Notes to Table 4-1:

a) Voltages apply to facilities, which are still in service post-contingency.
b) Site specific operating restrictions may override these ranges.
c) These limits do not apply to automatic voltage regulation settings, which may be more stringent.
d) These limits only apply to National Grid facilities.

4.3 Steady State Thermal Limits

New England electric utilities follow a planning philosophy whereby normal thermal ratings shall not be violated under all-lines-in conditions, and the applicable emergency rating shall not be violated under contingency conditions. Table 4-2 contains the thermal loading performance criteria that will be applied to transmission lines and transformers in this Study. The use of long-time emergency (LTE) thermal ratings for importing areas in planning studies recognizes the limited line switching, re-dispatch and system re-configuration options available to operators. The use of short-time emergency (STE) thermal ratings for exporting areas recognizes operator's ability to re-dispatch generation assets in an expeditious manner during system emergencies. These ratings provide adequate flexibility to system operations to address unique circumstances encountered on a day-to-day basis.

Table 4-2 Steady State Thermal Loading Criteria

System Condition	Time Interval	Maximum Allowable Facility Loading
Pre-Contingency (all lines in)	Continuous	Normal Rating
Post-Contingency	Less than 15 minutes after contingency occurs	Short Time Emergency (STE) Rating
	More than 15 minutes after contingency occurs	Long Time Emergency (LTE) Rating

4.3.1 Steady State Solution Parameters

Steady state analysis was performed with pre-contingency and post-contingency solution parameters identified in Table 4-3. Under pre-contingency (base case) conditions, all regulating devices were allowed to regulate or adjust in order to represent conditions that would exist in the normal system in steady state. Similarly, under contingency conditions, all regulating devices were allowed to regulate except for switched shunts within Aquidneck Island and phase angle regulators, which are normally operated in the manual mode. Aquidneck Island switched shunts were locked because these are not operated based on voltage control.

Table 4-3 Steady State Solution Parameters

Case	Area Interchange	Transformer LTCs	Phase Angle Regulators	Switched Shunts	DC Taps
Pre-Contingency	Disabled	Enabled	Disabled	Enabled	Enabled
Post-Contingency	Disabled	Locked	Disabled	Enabled, (*Aquidneck Island's were locked*)	Enabled

4.3.2 Stability Performance Criteria

N/A

4.3.3 Short Circuit Performance Criteria

The ASPEN software was used to perform this analysis on the two alternative solutions. The ASPEN Breaker Rating module was used to calculate the fault duties at breakers throughout the area in the vicinity of the project. The program calculated fault currents and X/R ratios for three-phase-to-ground, phase-phase-to-ground, single-phase-to-ground and phase-phase faults at each Substation bus on Aquidneck Island. The ASPEN assumptions and parameters used in this analysis are displayed below in Figure 4-1.

Figure 4-1 ASPEN Assumptions/Parameters

```
STANDARD: ANSI/IEEE
PREFAULT VOLTAGE PROFILE: FLAT BUS VOLTAGES. PREFAULT V=1.03 P.U.
GENERATOR IMPEDANCE: SUBTRANSIENT
IGNORE PHASE SHIFT ............................ [ ]
IGNORE LOADS .................................. [X]
IGNORE TRANSMISSION LINE G+jB ................. [X]
IGNORE SHUNTS WITH + SEQ IMPEDANCE ............ [X]
IGNORE TRANSFORMER LINE SHUNTS ................ [X]
MOV ITERATION ................................. [ ]
GENERATOR CURRENT LIMIT ....................... [ ]
CHECK 3PH FAULTS .............................. [X]
CHECK 2LN FAULTS .............................. [X]
CHECK 1LN FAULTS .............................. [X]
  USE 115% RATING OF SYMM. CURRENT BREAKERS ... [ ]
  USE 115% RATING OF TOTAL CURRENT BREAKERS ... [ ]
CHECK LL FAULTS ............................... [X]
TREAT ALL SOURCES AS "REMOTE" ................. [X]
SCALE CURRENT TO OPERATING KV ................. [ ]
USE K=1 FOR SYMM. CUR. BKR.  69.0KV AND ABOVE  [X]
USE K=1 FOR TOTAL CUR. BKR. 121.0KV AND ABOVE  [ ]
IGNORE ALL RECLOSING SETTINGS ................. [ ]
DEFAULT OPERATING KV TO PREFAULT VOLTAGE PU ... [ ]
USE ANSI X/R IN COMPUTING CURRENT MULTIPLIER .. [X]
  IN X-ONLY NETWORK WHEN X=0 USE X=0.0001P.U.
  IN R-ONLY NETWORK WHEN R=0 COMPUTE R USING METHOD 3
    WITH:  RC= 1P.U., X/R =80 FOR GENERATORS; =50 FOR XFORMERS; =15 FOR OTHERS
```

4.3.4 Other Performance Criteria (as appropriate)

N/A

4.4 System Testing

4.4.1 Steady State Contingencies/Faults Tested

Each base case was subjected to single contingencies such as the loss of a generator, transmission circuit or transformer and to the loss of multiple elements that might result from a single event such as a stuck circuit breaker or loss of any two circuits on a multiple-circuit tower line.

Table 4-4 below lists the contingencies type that were tested against each base case alternative solution indicating the NERC, NPCC and ISO-NE reliability criteria categories that each set of contingencies apply to.

Table 4-4 Steady State Contingencies Modeled

Contingency Type	NERC Type	NPCC D-1 Section	ISO PP-3 Section
Generator (Single Unit)	B1	5.4.1.a	3.1.a
Transmission Circuit	B2	5.4.1.a	3.1.a
Transformer (low-side ≥ 69 kV) and all GSUs	B3	5.4.1.a	3.1.a
Bus Section	C1	5.4.1.a	3.1.a
Breaker Failure	C2	5.4.1.e	3.1.e
Double Circuit Tower	C5	5.4.1.b	3.1.b

The set of contingencies analyzed for the steady state analysis was based on the ISO-NE's Model On-Demand database, the contingency deck was filtered to obtain contingencies between Somerset and High Hill Substations including the Newport, RI PSSE Zone 1420.

Tables detailing each of the contingencies tested are included in Appendix F.

Only N-1 applicable contingencies were tested as there are no applicable N-1-1 contingencies within Aquidneck Island.

4.4.2 Stability Contingencies/Faults Tested

N/A

4.4.3 Short Circuit Faults Tested

Short circuit analysis was performed on both alternative solutions with Greater Boston Projects, NEEWS IRP, Brayton Point – to – Somerset 115 kV line and Somerset – to – Bell Rock 115 kV line. The table below shows the buses tested.

Buses to Test in short Circuit Analysis
Bell Rock 115 kV
Dexter 115 kV
Dexter 69 kV
Gate II 69 kV
Existing Jepson 69 kV
New Jepson 115 kV
New Jepson 69 kV
Somerset 115 kV
Taunton 115 kV
Tiverton Power 115 kV

Section 5
Development of Alternative Solutions

The proposed solution to resolve the identified capacity and asset conditions needs is to rebuild Jepson on National Grid owned land across the street with a 115-69/23/13.8 kV Substation and convert the 61 and 62 Lines from 69 kV to 115 kV. Two alternative solutions were studied to determine if the existing Jepson Substation and the 61 and 62 lines could remain at 69 kV or if they needed to be converted to 115 kV.

The steady state thermal and voltage analysis for each alternative solution was then performed to evaluate the system performance with the existing configuration at Dexter and Jepson Substation in order to establish a baseline for comparison. The system performance was then re-evaluated with the two alternative solutions and compared with the previous baseline performance to demonstrate the impact of each alternative solution on the local transmission area reliability.

5.1 Preliminary Screen of Alternative Solutions

Any configuration that did not resolve the projected thermal, voltage, asset condition issues and that did not allow for future transmission expansion was dropped from further consideration.

5.2 Coordination of Alternative Solutions with Other Entities

Study coordination efforts were conducted with ISO-NE Planning management to discuss how to progress this Study outside of the larger and currently ongoing SEMA/RI Study. ISO-NE Planning management concurred with National Grid to allow us to bring a combined needs/solutions report forward as long as we can demonstrate that the needs and recommended solutions are separate and distinct from the larger SEMA/RI network. Through a conversation with ISO-NE Planning management, instructions were provided to assure that the solutions identified in this report would not affect the potential solutions for the SEMA/RI Study. This is one of the reasons why the RSP projects 791, 914 and 917 were modeled for this Study.

5.3 Description of Alternative Solutions

This report presents an advanced solution from the larger SEMA-RI scope, the transmission solutions in this report addresses the local transmission supply to Aquidneck Island, which consists of the City of Newport, Rhode Island, the Town of Middletown, RI and the Town of Portsmouth, RI. Figure 5-2 below shows a system diagram representation of the Study area.

[redacted]

The following two alternative solutions were analyzed for this Study:

1. Reinforce the 69 kV (refer to Figure 5-3):
    a. Rebuild and reconductor the 61 and 62 Lines at 69 kV (4.4 miles)
    b. Relocate and rebuild Jepson Substation to address both asset condition and thermal concerns
    c. Reinforce Dexter Substation by reconfiguring the 115 kV and replacing the existing 115-69 kV transformers with four 115-69 kV transformers.
2. Convert the 61 and 62 Lines and Jepson Substation to 115 kV (refer to Figure 5-4):
    a. Rebuild and convert the 61 and 62 Lines to 115 kV (4.4 miles)
    b. Relocate and rebuild Jepson Substation to address asset condition issues and thermal concerns

[redacted]

[redacted]

Section 6
Alternative Solution Performance Testing and Results

Both alternative solutions mitigate the asset condition issues; move Jepson Substation out of the 100 year flood plain and mitigate the thermal concerns within the Study horizon, however, Alternative Solution 2 results with a more robust performance beyond the Study horizon. Alternative Solution 2 is able to accommodate a larger amount of future load growth without the need to undertake future additional transmission upgrades between Dexter and Jepson Substations.

6.1 Steady State Performance Results

Each of the alternative solutions did not cause any N-0 thermal or voltage issues in the study year. The N-1 Steady State results show the pre-existing overload on section of line 63 between Jepson and Navy sub is not resolved for either alternative. Appendix G, Table 15-1 contains the N-1 Contingency Results. The conductor clearance limitations on two spans of the 63 line will be mitigated by relocating the conflicting distribution facilities.

6.1.1 N-0 Thermal and Voltage Performance Summary

Each of the alternative solutions did not cause any N-0 thermal or voltage issues.

6.1.2 N-1 Thermal and Voltage Performance Summary

The section of line 63 between Jepson and Navy Substation results in a pre-existing overload.

The pre-existing overload was not removed with either alternative solution, below are the results for this branch with Tiverton and Dighton assumed out of service in the base cases:

	Pre-Project		Alternative Sol. 1		Alternative Sol. 2	
	Contingency	% LTE	Contingency	% LTE	Contingency	% LTE
Line 63 Jepson - Navy LTE Rating: 78 MVA	BF_JPSN_3769	102	BF_JPSN_T5	103	BF_JPSN_M132	105
Jepson-Navy 23 kV LTE Rating: 88 MVA	LN_3763-1	91	LN_3763-1	94.3	TF_JPSN_T1	91

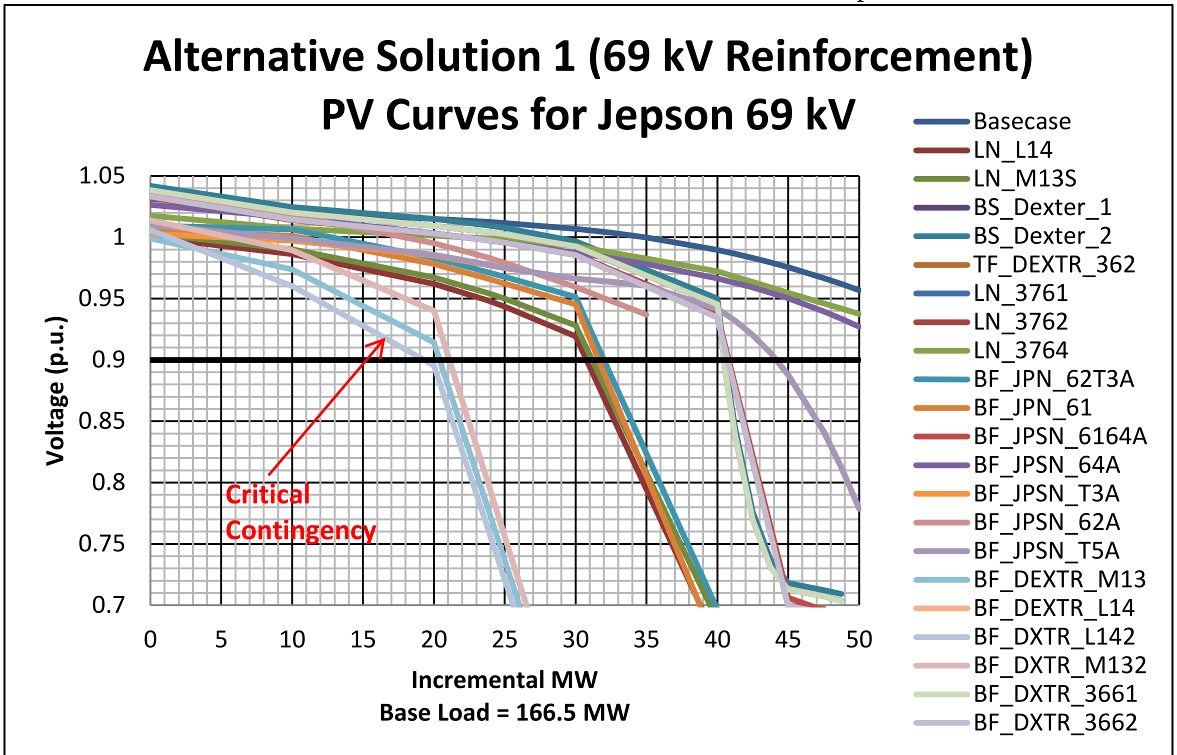
N-1 Voltage Results

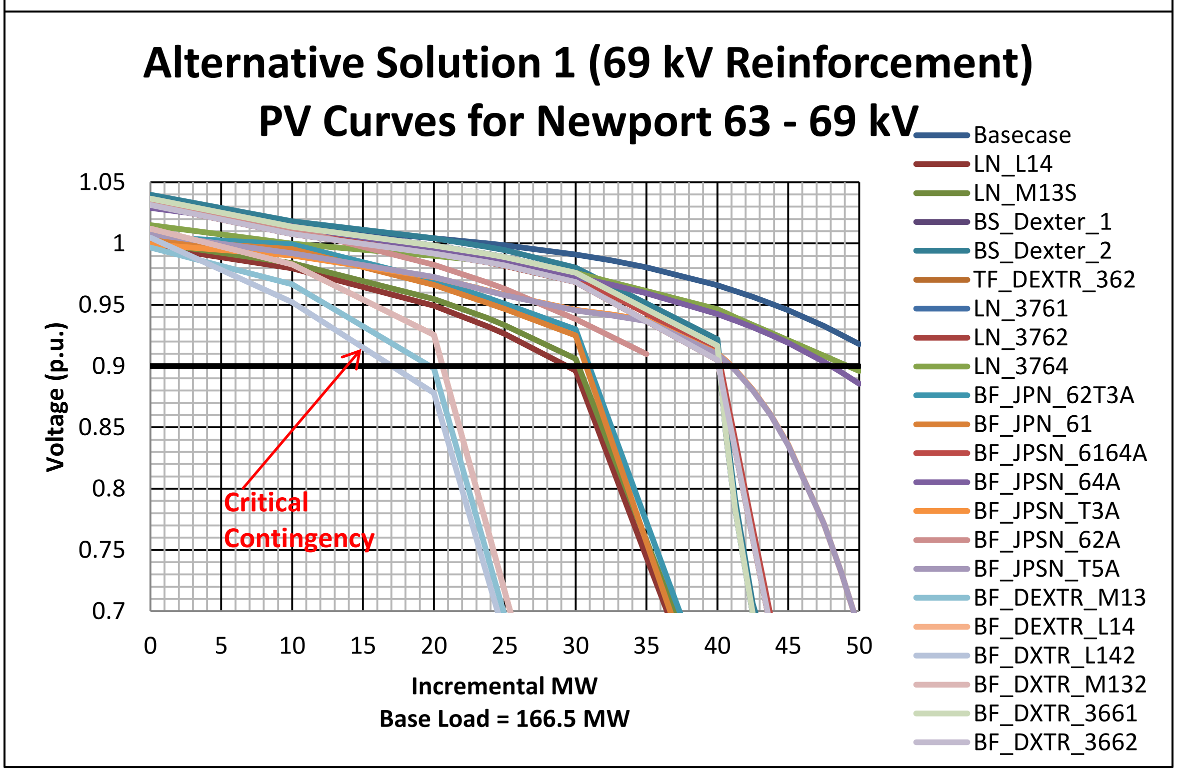
Both Alternatives solutions performed adequately within the study horizon; however, Alternative Solution 2 provides superior voltage performance beyond the study horizon. Alternative Solution 2 is able to accommodate a larger amount of future load growth without the need to undertake future additional transmission upgrades between Dexter and Jepson Substations.

To assess the robustness and voltage performance of each alternative solution, PV Analysis was performed using PSSE v33.5. The analysis was performed by allowing the LTCs and capacitors within Aquidneck Island to self adjust under all lines in conditions, contingency analysis was then performed with locked LTCs. Load growth beyond the study horizon was concentrated in the city of Newport, based on input from the distribution company.[3]

[3] Analysis considered a future 69 kV line from Jepson to Newport Substations since the 23 kV line from Jepson to Gate II would limit how much load would be backed up at Navy, Newport and Gate II Substations.

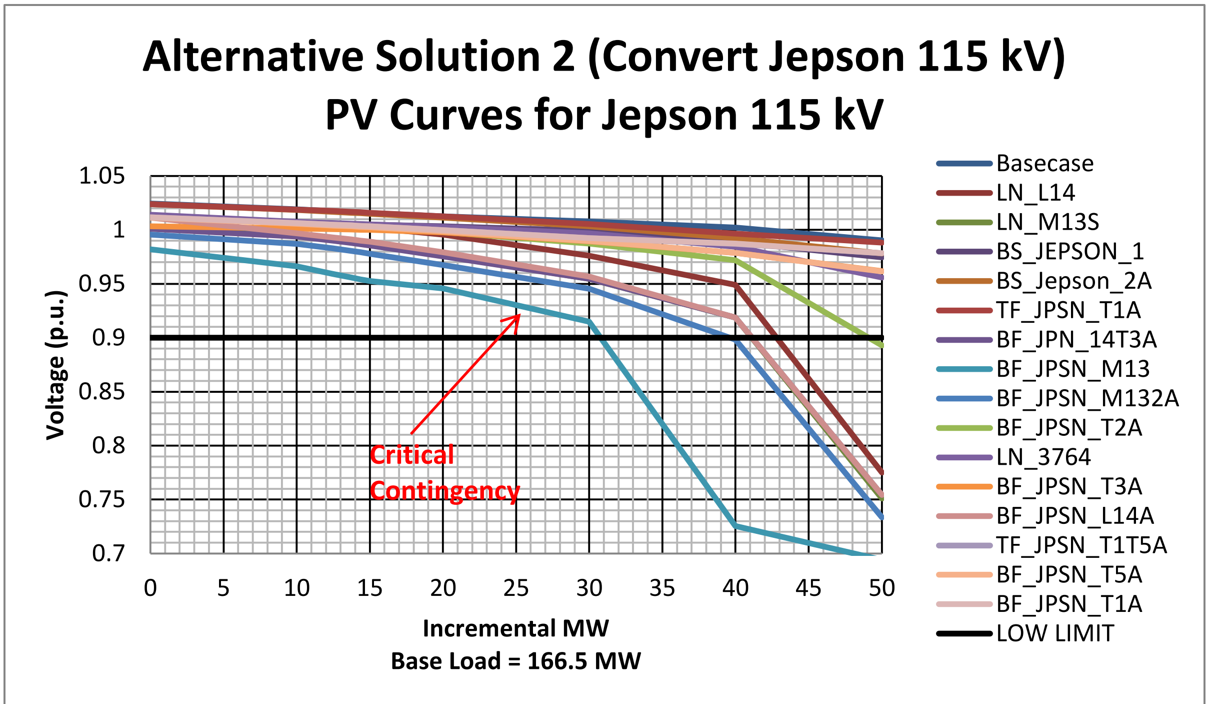
Alternative Solution 1 – Reinforce Dexter, rebuild the 61/62 lines and Jepson at 69 kV

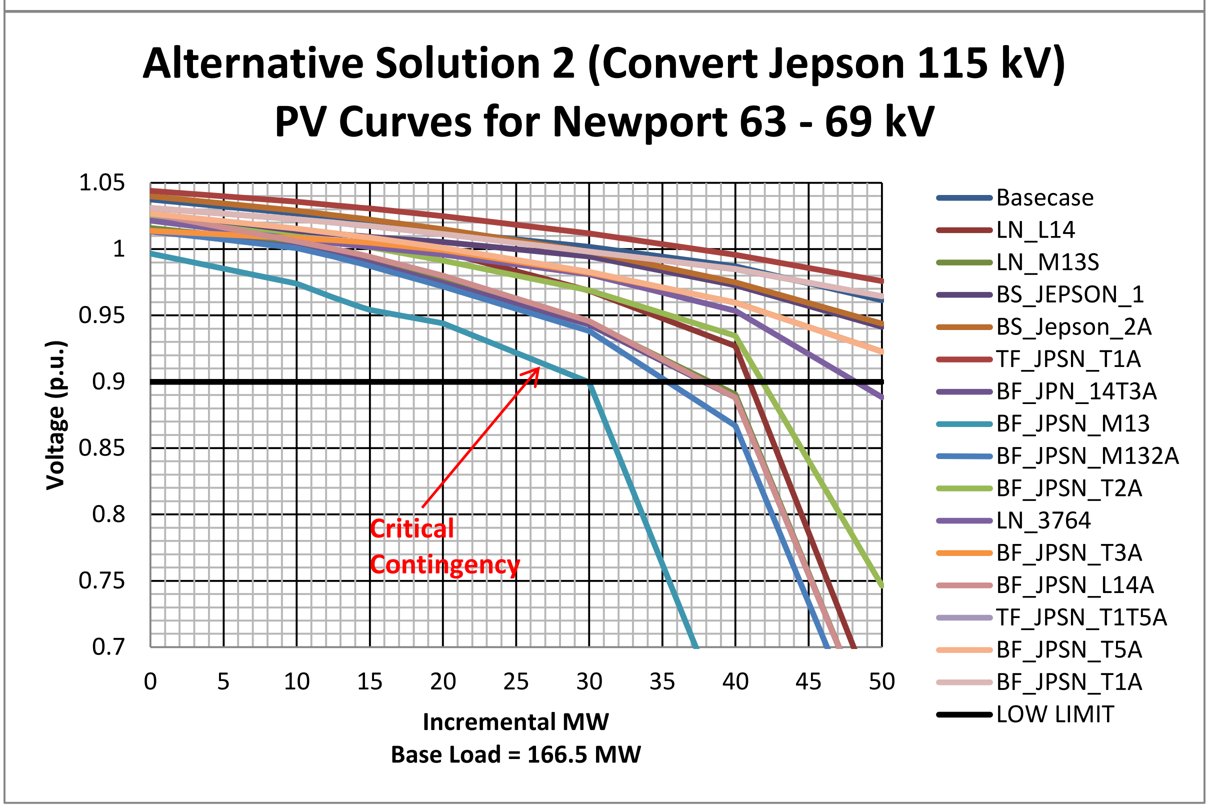




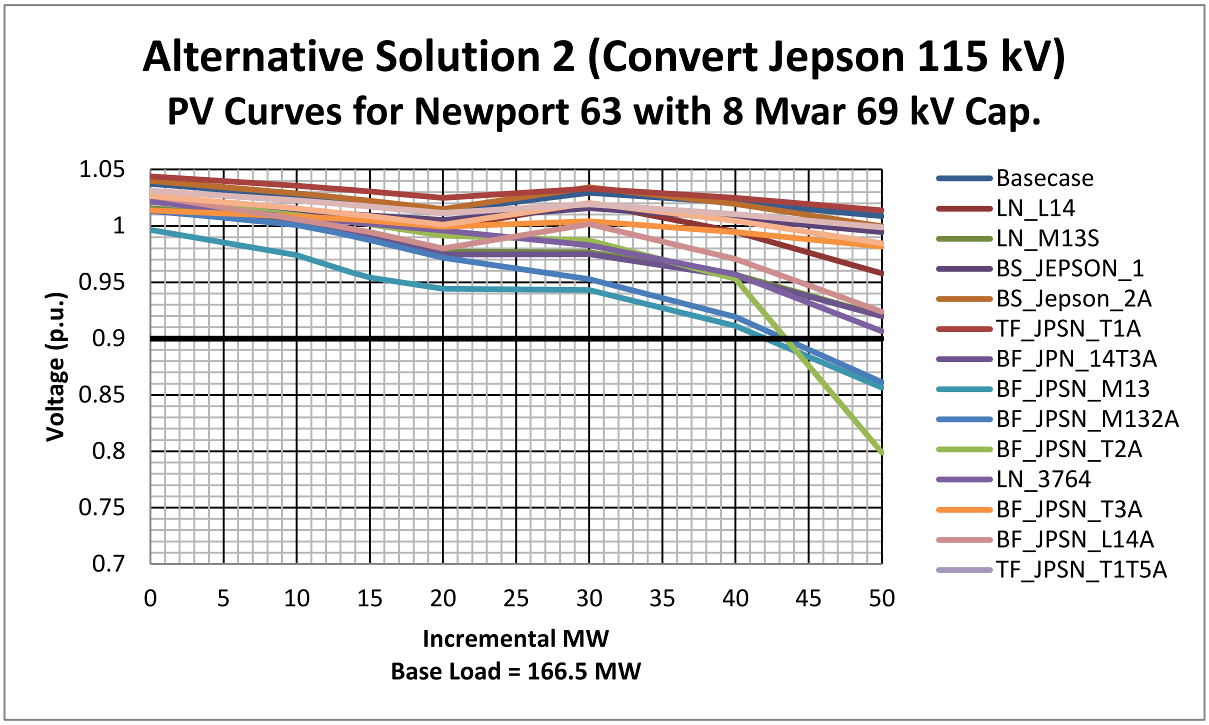
The PV analysis for Alternative Solution 1 indicate National Grid's low voltage criteria of 0.90 per unit voltage will not be met after an incremental load of 16 MW at Newport Substation. The limiting contingency is breaker failure L14-2 at Dexter Substation; the next limiting contingencies are breakers failures M13 and M13-2 also Dexter Substation. These three contingencies take out one of the two 115 kV line supplying Dexter along with the 115-69 kV transformers supplying the 61 or 62 lines.

Alternative Solution 2 – Convert 61/62 lines and Jepson Substation to 115 kV





The PV analysis for Alternative Solution 2 indicate National Grid's low voltage criteria of 0.90 per unit voltage would be met up to an incremental load of 29 MW at Newport Substation. Breaker Failure M13 at Jepson Substation takes out one of the 13.8 kV transformers at Jepson and the M13 line. Adding an 8 MVar 69 kV capacitor bank at Newport on the 63 circuit would increase the load growth capability up to 41 MW as shown below.



From the above results Alternative Solution 2 provides a superior performance when compared to the voltage performance from Alternative Solution 1.

In order for alternative solution 1 to provide a comparable performance, additional upgrades on the transmission facilities between Dexter and Jepson would be required. These upgrades could involve the following:

1. Upgrading the 61 and 62 Lines to 115 kV, this would involve replacing the 69 kV structures with 115 kV structures. These upgrades would also introduce complex cutovers at the newly rebuilt Jepson Substation requiring numerous equipment outages in order to operate part of the Substation at 115 kV and at 69 kV.
2. Constructing an additional 69 kV transmission line between Dexter and Jepson Substations. Due to space constraints on the existing right-of-way, this line could not be constructed overhead on the existing Dexter-Jepson right of way. Significantly more complex and costly alternatives would involve securing new right-of-way for the third overhead line or constructing the third line underground.

6.1.3 N-1-1 Thermal and Voltage Performance Summary

There are no applicable N-1-1 contingencies within criteria on Aquidneck Island, as an outage on a network element in one of the supply followed by an outage on a network element in the remaining supply would result in losing the section of the island south of the outage.

6.1.4 Results of Extreme Contingency Testing

N/A

6.1.5 Results of Delta P Testing

N/A

6.2 Stability Performance Results

6.2.1 Stability Performance Results

N/A

6.2.2 All-Lines-In Stability Performance Results

N/A

6.2.3 Line-Out-of-Service Stability Performance Results

N/A

6.3 Short Circuit Performance Results

The alternative solutions did not significantly increase the short circuit duty outside Aquidneck Island. The maximum observed short circuit increase outside Aquidneck Island is 1% at the Tiverton Power 115 kV bus. Within Aquidneck Island the only significant short circuit duty increase was observed at the Gate II 69 kV bus. Alternative Solution 1 (69 kV Reinforcement) resulted in a short circuit duty percent increase from 21% to 51% of existing equipment interrupting capability, Alternative Solution 2 (Jepson 115 kV Conversion) resulted in a short circuit duty percent increase from 21% to 47%.

Section 6.3.1 below shows the short circuit results pre and post project with Greater Boston Project, NEEWS IRP, GRI Projects (RSP 791, 914 and 917). In order to account for a potential impact of a future 69 kV line between Jepson and Newport Substation, a second 115-69 kV transformer at Jepson along with a new 69 kV line between Jepson and Newport Substation was modeled in the cases.

The Alternatives did not result in any breaker becoming over-dutied.

6.3.1 Short Circuit Performance Results

			Without GRI Projects					With GRI Projects				
Substation	Breaker	Alternative	Duty (%)	Duty (A)	Breaker Capability	Isc	X/R	Duty (%)	Duty (A)	Breaker Capability	Isc	X/R
Somerset 115 kV	1128	Pre	55.3	24987	45185	24328	8.7	78.5	35487	45185	32921	12.5
		Dexter 115	55.3	24991	45185	24331	8.7	78.5	35488	45185	32921	12.5
		Jepson 115	55.5	25090	45185	24428	8.7	78.8	35608	45185	33033	12.5
	1138	Pre	55.3	24987	45185	24328	8.7	78.5	35487	45185	32921	12.5
		Dexter 115	55.3	24991	45185	24331	8.7	78.5	35488	45185	32921	12.5
		Jepson 115	55.5	25090	45185	24428	8.7	78.8	35608	45185	33033	12.5
	TL713	Pre	62	23696	38222	23696	8.8	84.7	32386	38222	32386	12.6
		Dexter 115	62	23699	38222	23699	8.8	84.7	32387	38222	32387	12.6
		Jepson 115	62.3	23796	38222	23796	8.8	85.0	32499	38222	32499	12.6
	TL812	Pre	47.3	22321	47222	22321	8.4	69.2	32670	47222	32670	12.5
		Dexter 115	47.3	22324	47222	22324	8.4	69.2	32671	47222	32671	12.5
		Jepson 115	47.5	22421	47222	22421	8.4	69.4	32778	47222	32778	12.5
Bell Rock 115 kV	1802	Pre	25.6	16120	63000	16120	8.2	39.4	24817	63000	24817	10.7
		Dexter 115	25.6	16125	63000	16125	8.2	39.4	24825	63000	24825	10.7
		Jepson 115	25.6	16146	63000	16146	8.2	39.5	24860	63000	24860	10.7
	1805	Pre	25.6	16120	63000	16120	8.2	39.4	24817	63000	24817	10.7
		Dexter 115	25.6	16125	63000	16125	8.2	39.4	24825	63000	24825	10.7
		Jepson 115	25.6	16146	63000	16146	8.2	39.5	24860	63000	24860	10.7
Tiverton Power 115 kV		[redacted]										

			Without GRI Projects						With GRI Projects				
Substation	Breaker	Alternative	Duty (%)	Duty (A)	Breaker Capability	Isc	X/R		Duty (%)	Duty (A)	Breaker Capability	Isc	X/R
Dexter 115 kV	L14	Pre	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
		Dexter 115	20.9	8369	40000	8369	8.9		22.2	8897	40000	8897	8.5
		Jepson 115	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
	L14-2	Pre	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
		Dexter 115	21	8410	40000	8410	8.9		22.3	8938	40000	8938	8.5
		Jepson 115	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
	M13	Pre	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
		Dexter 115	21	8410	40000	8410	8.9		22.3	8938	40000	8938	8.5
		Jepson 115	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
	M13-2	Pre	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
		Dexter 115	20.9	8369	40000	8369	8.9		22.2	8897	40000	8897	8.5
		Jepson 115	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
Dexter 69 kV	361T	Pre	30.5	5795	19002	5731	9.8		31.0	5884	19002	5822	9.7
		Dexter 115	30	9438	31500	9438	9.6		30.8	9717	31500	9717	9.4
		Jepson 115	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
	362T	Pre	84.6	6740	7969	6707	9.5		86.3	6875	7969	6843	9.4
		Dexter 115	27.9	8789	31500	8789	11.1		28.8	9078	31500	9078	10.9
		Jepson 115	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
	363T	Pre	84.6	6740	7969	6707	9.5		86.3	6875	7969	6843	9.4
		Dexter 115	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
		Jepson 115	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
Existing Jepson	3763	Pre	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
		Dexter 115	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A
		Jepson 115	22.5	7090	31500	7090	10.7		23.2	7295	31500	7295	10.5
	3764	Pre	25	4893	19556	4893	7.8		25.5	4994	19556	4994	8.5

			Without GRI Projects					With GRI Projects				
Substation	**Breaker**	**Alternative**	**Duty (%)**	**Duty (A)**	**Breaker Capability**	**Isc**	**X/R**	**Duty (%)**	**Duty (A)**	**Breaker Capability**	**Isc**	**X/R**
		Dexter 115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Jepson 115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3765	Pre	28	4954	17722	4923	8.7	28.6	5069	17722	5040	8.5
		Dexter 115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Jepson 115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3766	Pre	39.1	7638	19556	7638	8.9	39.9	7805	19556	7805	8.7
		Dexter 115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Jepson 115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3767	Pre	98.1	7691	7841	7638	8.9	100.2	7856	7841	7805	8.7
		Dexter 115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Jepson 115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3769	Pre	59.8	4921	8233	4890	8.7	61.0	5023	8233	4994	8.5
		Dexter 115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Jepson 115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
New Jepson	69 kV: 61 115 kV: M13	Pre	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Dexter 115	27.4	8617	31500	8617	9.2	28.0	8833	31500	8833	9.0
		Jepson 115	23.2	9277	40000	9277	9.1	24.2	9676	40000	9676	8.8
	69 kV: 61-64 115 kV: M13-T2	Pre	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Dexter 115	26.5	8349	31500	8349	9.3	27.2	8553	31500	8553	9.2
		Jepson 115	21.7	8680	40000	8680	9.5	22.6	9032	40000	9032	9.2
	69 kV: 62 115 kV: L14	Pre	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Dexter 115	27.4	8617	31500	8617	9.2	28.0	8833	31500	8833	9.0
		Jepson 115	23.2	9277	40000	9277	9.1	24.2	9676	40000	9676	8.8
	69 kV: 62-T3 115 kV: L14-T3	Pre	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Dexter 115	25.8	8131	31500	8131	9.0	26.4	8325	31500	8325	8.9

			Without GRI Projects					With GRI Projects				
Substation	Breaker	Alternative	Duty (%)	Duty (A)	Breaker Capability	Isc	X/R	Duty (%)	Duty (A)	Breaker Capability	Isc	X/R
		Jepson 115	22.8	9126	40000	9126	9.2	23.8	9516	40000	9516	8.9
	69 kV: 63 115 kV: T1	Pre	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Dexter 115	27.4	8617	31500	8617	9.2	28.0	8833	31500	8833	9.0
		Jepson 115	23.2	9277	40000	9277	9.1	24.2	9676	40000	9676	8.8
Newport 69 kV	63	Pre	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Dexter 115	18.3	7306	40000	7306	8.4	19	7459	40000	7459	8.3
		Jepson 115	17.4	6941	40000	6941	10.3	18	7103	40000	7103	10.1
Gate II 69 kV		[redacted]										

6.4 Other Assessment Performance Results

N/A

6.5 Sensitivity Case Testing Results

N/A

Section 7
Comparison of Alternative Solutions

The solutions alternatives were compared on the thermal and voltage impacts within Aquidneck Island. Both alternative solutions mitigate the asset condition issues and thermal concerns within the study area. Solution Alternative 1 however, does not compare favorably with Alternative Solution 2, which costs $1.0 million more and does not provide a superior performance as it is not able to accommodate a larger amount of future load growth without additional investments between Dexter and Jepson Substations.

7.1 Factors Used to Compare Alternative Solutions

The key factors used for comparison and differentiations of alternative solutions were the following:

1. The cost for the transmission upgrades to resolve the observed thermal issues while mitigating the asset condition issues at Jepson Substation and resolve the observed thermal issues
2. Robustness; performance beyond the Study horizon allowing for future load growth
3. Project duration

7.2 Cost Estimates for Selected Alternative Solutions

The conceptual grade estimate was developed to compare the two alternative solutions, which would mitigate the thermal overloads and the asset condition issues at Jepson Substation.

7.3 Comparison of Alternative Solutions

		Aquidneck Island Transmission Solutions	
		Alternative Solution 1	**Alternative Solution 2**
Transmission Upgrades		1. Reconstruct the 61 and 62 Lines at 69 kV 2. Relocate and Rebuild Jepson Substation to address both asset condition and thermal concerns 3. Reinforce Dexter Substation by reconfiguring the 115 kV into a breaker and half layout initially operated with 4 breakers, replacing the existing 115-69 kV transformers with four 115-69 kV transformers.	1. Reconstruct the 61 and 62 Lines at 115 kV 2. Relocate and Rebuild Jepson Substation to address both asset condition and thermal concerns 3. Reconfigure Dexter by Removing the 115-69 kV transformers and 69 kV equipment. Reconfigure the 115 kV yard by removing the 115 kV circuit switchers and installing load break switches on the line sides of the 115/13.8 kV transformer. Install a 115 kV circuit switcher to protect the 115/13.8 kV transformer.
Transmission Line Cost (in 2014 $USD millions with -25/+50% accuracy level)		$11.5	$22.1 (PTF: All)
Transmission Substation Cost (in 2014 $USD with -25/+50% accuracy level)	Dexter ($millions)	$18.3 (PTF: $9)	$3.9 (PTF: $3.0)
	Jepson ($millions)	$10.3	$13.2 (PTF: $9.5)
Total		$40.1 (PTF: $9)	$39.2 (PTF: $34.6)
Project Construction Time		30 months	24 months

7.4 Comparison Matrix of Alternative Solutions

Table 7-1 below provides a comparison matrix showing the performance of the alternative solutions.

Table 7-1
Comparison Matrix of Alternative Solutions

Factors Considered for Comparison of Alternative Solutions		Alternative Solution 1	Alternative Solution 2
1. Overall Cost	a. Lower overall cost Estimated installed cost in 2014 dollars (millions)	✗ $40.10	✓ $39.20
2. Expansion Capabilities	a. a. Allows for future load growth and expansion to existing area Substations	✗	✓
	b. Robustness (superior performance)	✗	✓
3. Early In Service Date	a. Shorter construction time	✗	✓
	b. Less transmission work scope	✗	✓
	c. Less outages required	✗	✓

✗ - Does not satisfy this objective
✓ - Achieves this objective

Section 8
Conclusion

The two solutions alternatives resolve the asset condition issues at Jepson and resolve the thermal issues at Dexter and Jepson Substations and on the 61 and 62 Lines. However, alternative solution 1 costs $1.0 million more and from a performance perspective, it does not compare favorably to alternative solution 2. Alternative Solution 1 would only allow a 9.6% load growth due to two breaker failures at Dexter 115 kV. Alternative Solution 2 would allow 17.4% of load growth. Furthermore installing an 8 MVar 69 kV capacitor bank on Newport 63 would increase the load growth capability up to 24%.

In order to increase the load serving capability of alternative solution 1, more transmission upgrades between Dexter and Jepson Substations would be required. These upgrades could take the form of reconstructing the 61 and 62 lines from 69 kV to 115 kV or installing a third transmission line from Dexter to Jepson, which cannot be constructed overhead on the existing right of way due to the space constraints along the entire length of right of way.

8.1 Recommended Solution Description

The recommended solution based on the lower cost and superior performance along with less construction duration and with less outage complexity is alternative solution 2. This alternative solution converts the 61 and 62 Lines and Jepson Substation from 69 kV to 115 kV. The scope of this solution is the following:

- 61/62 Lines: Reconstruct the 61 and 62 Lines between Dexter and Jepson at 115 kV
- Jepson Substation: Relocate and Rebuild Jepson Substation at 115 kV
- Dexter Substation: Reconfigure Dexter by removing the 115-69 kV transformers and 69 kV equipment. Reconfigure the 115 kV Yard by removing the 115 kV circuit switchers and installing load break switches north and south of the 115/13.8 kV transformer. Install a 115 kV circuit switcher to protect the 115/13.8 kV transformer

8.2 Solution Component Year of Need

Based on the Critical Load Level Analysis the year of need for the overall project is between now and June 2016. The need to resolve the thermal issues on the 69 kV ring at Jepson, 61 and 62 Lines is in the past. The need to resolve the thermal issues on the 115-69 kV transformers at Dexter is June 2016.

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

The existing Jepson Substation is not a BPS facility, it is anticipated that the new Jepson configuration along with the required transmission upgrades will not result in any additional facilities becoming NPCC, A-10 defined BPS facilities, and this will be confirmed as part of the PPA analysis on the recommended alternative. The Study performed complies with the NERC TPL standards. The planned completion date of the preferred solution as described in Section 8.1 above is 06/2019. This Study has reviewed the continuing need and has identified a recommended solution.

Section 9
Appendix A: Load Forecast

Table 9-1
2013 Seasonal Peak Load Forecast Distributions

1.6 - 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)	2013	26470	26715	27045	27420	27840	28285	28735	29385	30135	30790
	2014	26900	27150	27485	27865	28290	28740	29200	29860	30620	31280
	2015	27410	27665	28005	28390	28825	29285	29750	30425	31185	31860
	2016	27910	28165	28515	28910	29350	29815	30295	30980	31740	32420
	2017	28325	28590	28940	29340	29790	30265	30750	31445	32210	32900
	2018	28675	28940	29295	29700	30155	30635	31125	31830	32615	33315
	2019	29025	29295	29655	30065	30525	31010	31505	32220	33010	33720
	2020	29345	29615	29980	30395	30860	31350	31855	32575	33380	34095
	2021	29670	29950	30315	30735	31205	31700	32210	32935	33755	34480
	2022	29970	30250	30625	31045	31520	32020	32535	33270	34105	34840
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)	2013/14	22025	22140	22235	22295	22445	22595	22765	22865	23080	23505
	2014/15	22205	22320	22420	22480	22630	22780	22955	23055	23255	23685
	2015/16	22385	22500	22595	22660	22810	22960	23135	23235	23440	23870
	2016/17	22540	22660	22755	22815	22970	23125	23295	23400	23620	24050
	2017/18	22680	22795	22895	22955	23110	23265	23440	23540	23780	24205
	2018/19	22800	22920	23020	23080	23235	23390	23565	23670	23920	24345
	2019/20	22915	23035	23130	23195	23350	23505	23685	23785	24045	24470
	2020/21	23030	23150	23250	23315	23470	23625	23805	23910	24160	24590
	2021/22	23145	23265	23365	23425	23585	23745	23920	24025	24280	24705
	2022/23	23255	23380	23480	23540	23700	23860	24040	24145	24395	24820
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/trans/celt/fsct_detail/.
(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.

Section 10
Appendix B: Upgrades Included in Base Case

- All I.3.9 approved transmission projects as of March 2014 are included in the base case, including updated GSRP, RIRP, and IRP components of NEEWS
- Solutions for surrounding areas that do not yet have PPA approval have been included – Greater Boston Working Group (GBWG) solutions presented at the March 2012 PAC meeting
- Non-NEEWS portions of GRI are included: New Brayton Point – Somerset 115 kV line, new Somerset Bell Rock 115 kV line and Bell Rock upgrades. These projects were included as a proxy to mitigate the larger network needs in the Somerset/Bell Rock area and do not mitigate the thermal needs on Aquidneck Island.

Section 11
Appendix C: Case Summaries and Load Flow Plots

Appendix C has been redacted for Critical Energy Infrastructure Information (CEII)

Section 12
Appendix D: Assessment Criteria (i.e., Steady State Thermal and Voltage Criteria)

Steady State Thermal Limits

New England electric utilities follow a planning philosophy whereby normal thermal ratings shall not be violated under all-lines-in conditions, and the applicable emergency rating shall not be violated under contingency conditions. Table 4-2 contains the thermal loading performance criteria that will be applied to transmission lines and transformers in this Study. The use of long-time emergency (LTE) thermal ratings for importing areas in planning studies recognizes the limited line switching, re-dispatch and system re-configuration options available to operators. The use of short-time emergency (STE) thermal ratings for exporting areas recognizes operator's ability to re-dispatch generation assets in an expeditious manner during system emergencies. These ratings provide adequate flexibility to system operations to address unique circumstances encountered on a day-to-day basis.

System Condition	Time Interval	Maximum Allowable Facility Loading
Pre-Contingency (all lines in)	Continuous	Normal Rating
Post-Contingency	Less than 15 minutes after contingency occurs	Short Time Emergency (STE) Rating
	More than 15 minutes after contingency occurs	Long Time Emergency (LTE) Rating

Table 13-1 Steady State Thermal Loading Criteria

Steady State Voltage Limits

Transmission voltage levels must be maintained within a prescribed bandwidth to ensure proper operation of electrical equipment at both the transmission and customer voltage ranges. Equipment damage and widespread power outages are more likely to occur when transmission-level voltages are not maintained within pre-defined limits. Table 4-1 contains the voltage performance criteria that will be used in this analysis.

Transmission Owner	Voltage Level	Bus Voltage Limits (Per-Unit)	
		Normal Conditions	Emergency (Contingency) Conditions
National Grid	345 & 230 kV and above	0.98 to 1.05	0.95 to 1.05
	115 kV[1] and below	0.95 to 1.05	0.90 to 1.05

Maximum Percent Voltage Variation at Delivery Points		
Condition	345 & 230 kV (%)	115 kV[1] and below (%)
Post contingency & Automatic Actions	5.0	10.0
Switching of Reactive Sources or Motor Starts (All elements in service)	2.0 *	2.5 *
Switching of Reactive Sources or Motor Starts (One element out of service)	4.0 *	5.0 *

[1] Buses that are part of the bulk power system, and other buses deemed critical by Network Operations shall meet requirements for 345 kV and 230 kV buses.

[*] These limits are maximums which do not include frequency of operation. Actual limits will be considered on a case-by-case basis and will include consideration of frequency of operation and impact on customer service in the area.

Table 12-1 Steady State Voltage Criteria

Notes to Table 4-1:

e) Voltages apply to facilities which are still in service post-contingency.
f) Site specific operating restrictions may override these ranges.
g) These limits do not apply to automatic voltage regulation settings which may be more stringent.
h) These limits only apply to National Grid facilities.

Section 13
Appendix E: Contingency List

Table 13-1
Steady State Contingency List

Contingency Label	NERC Type	Description
LN_SOM_BELRK	B2	FUTURE CTG (RSP - 0914) - Greater RI - New 115 kV Line (Somerset - Bell Rock)
LN_109	B2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion
LN_D21	B2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion
LN_L14GRI	B2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion
LN_M13_N GRI	B2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion
LN_M13_S GRI	B2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion
LN_N12	B2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion
GN_BRA1	B1	BRA1 - Brayton Point Unit 1
GN_BRA2	B1	BRA2 - Brayton Point Unit 2
GN_BRAD	B1	BRAD - Brayton Point Diesel
GN_BRA3	B1	BRA3 - Brayton Point Unit 3
GN_BRA4	B1	BRA4 - Brayton Point Unit 4
GN_CLE8	B1	CLE8 - Cleary G8
GN_CLERY9_CC	B1	Cleary G9 Combined Cycle
GN_DAR3	B1	DAR3 - Dartmouth Power C3
GN_DART_CC	B1	DART - Dartmouth Power Combined Cycle
GN_MANC09_CC	B1	Manchester 09 Combined Cycle
GN_MANC10_CC	B1	Manchester 10 Combined Cycle
GN_MANC11_CC	B1	Manchester 11 Combined Cycle
GN_PAWP_CC	B1	Pawtucket Power Combined Cycle
GN_SEM1	B1	SEM1 - SEMASS G1
GN_SEM2	B1	SEM2 - SEMASS G2
GN_DIGH	B1	DIGH - Dighton Power
GN_TVRTN_CC	B1	EMI Tiverton Combined Cycle
BS_SOMRSET_W	C1	Somerset 115kV West Bus
BF_BELLRK_H	C2	FUTURE CTG (RSP - 0914) - Greater RI - New 115 kV Line (Somerset - Bell Rock) Bell Rock 115 kV position H Breaker Failure
BF_BELLRK_I	C2	FUTURE CTG (RSP - 0914) - Greater RI - New 115 kV Line (Somerset - Bell Rock) Bell Rock 115 kV position I Breaker Failure
BF_SOMST_34	C2	FUTURE CTG (RSP - 0914) - Greater RI - New 115 kV Line (Somerset - Bell Rock) Somerset TL34 Breaker Failure
BF_SOMST_B	C2	FUTURE CTG (RSP - 0914) - Greater RI - New 115 kV Line (Somerset - Bell Rock) Somerset 115kV B Breaker Failure (Num Not Finalized)
BF_BELLRK_A	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Bell Rock 115 kV position A Breaker Failure
BF_BELLRK_B	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Bell Rock 115 kV position B Breaker Failure

Contingency Label	NERC Type	Description
BF_BELLRK_C	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Bell Rock 115 kV position C Breaker Failure
BF_BELLRK_D	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Bell Rock 115 kV position D Breaker Failure
BF_BELLRK_E	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Bell Rock 115 kV position E Breaker Failure
BF_BELLRK_F	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Bell Rock 115 kV position F Breaker Failure
BF_BELLRK_G	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Bell Rock 115 kV position G Breaker Failure
BF_HIGH_HL_1	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion High Hill 11142 Breaker Failure
BF_HIGH_HL_D	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion High Hill D2142 Breaker Failure
BF_SOMST_12	C2	Somerset TL12 Breaker Failure
BF_SOMST_128	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Somerset 1128 Breaker Failure
BF_SOMST_138	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Somerset 1138 Breaker Failure
BF_SOMST_23	C2	Somerset TL23 Breaker Failure
BF_SOMST_34	C2	Somerset TL34 Breaker Failure
BF_SOMST_45	C2	Somerset TL45 Breaker Failure
BF_SOMST_713	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Somerset TL713 Breaker Failure
BF_SOMST_812	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Somerset TL812 Breaker Failure
BF_TIVRTON_2	C2	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Tiverton 52-2 Breaker Failure
BF_TIVRTON_3	C2	Tiverton 52-3 Breaker Failure
BF_TIVRTON_4	C2	Tiverton 52-4 Breaker Failure
DC_L14_M13S	C5	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Lines L14 (115kV) and M13S (115kV) DCT
DC_M13N_N12	C5	FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion Lines M13N (115kV) and N12 (115kV) DCT
TF_DEXTR_361	B3	XFMR 361 AT DEXTER 115-69 kV
TF_DEXTR_362	B3	XFMR 361 AT DEXTER 115-69 kV
LN_3761	B2	National Grid's 61 69 kV Line
LN_3762	B2	National Grid's 62 69 kV Line
LN_3763	B2	National Grid's 63 69 kV Line
LN_3763-1	B2	National Grid's 63-1 Line section
BF_JPSN_3764	C2	BREAKER 3764 AT JEPSON 69 kV
BF_JPN_3764a	C2	BREAKER 3764 AT JEPSON 69 kV, close 23kV tie
BF_JPSN_3765	C2	BREAKER 3765 AT JEPSON 69 kV
BF_JPN_3765a	C2	BREAKER 3765 AT JEPSON 69 kV, close 23kV tie

Contingency Label	NERC Type	Description
BF_JPSN_3766	C2	BREAKER 3766 AT JEPSON 69 kV
BF_JPSN_3769	C2	BREAKER 3769 AT JEPSON
BF_JPN_3769a	C2	BREAKER 3769 AT JEPSON, CLOSE 23kV TIE
BF_JPSN_3767	C2	BREAKER 3767 AT JEPSON 69 kV POST NEWPORT PH.I
BF_JPN_3767a	C2	BREAKER 3767 AT JEPSON 69 kV POST NEWPORT PH.I, close 23kV tie
BS_DEXTER_1	C1	Alternative Solution 1: Dexter 115kV Bus 1
BS_DEXTER_2	C1	Alternative Solution 1: Dexter 115kV Bus 2
BF_JPSN_62T3	C2	Alternative Solution 1: NEW BREAKER 62-T3 AT JEPSON 69 kV
BF_JPN_62T3a	C2	Alternative Solution 1: NEW BREAKER 62-T3 AT JEPSON 69 kV
BF_JPSN_61	C2	Alternative Solution 1: NEW BREAKER 61 AT JEPSON 69 kV
BF_JPSN_61-2	C2	Alternative Solution 1: NEW BREAKER 61-2 AT JEPSON 69 kV
BF_JPSN_612a	C2	Alternative Solution 1: NEW BREAKER 61-2 AT JEPSON 69 kV, close Jepson 23kV
BF_JPSN_T3	C2	Alternative Solution 1: NEW BREAKER T3 AT JEPSON 69 kV
BF_JPSN_T3a	C2	Alternative Solution 1: NEW BREAKER T3 AT JEPSON 69 kV, close Jepson 23kV
BF_JPSN_62	C2	Alternative Solution 1: NEW BREAKER 62 AT JEPSON 69 kV
BF_JPSN_62a	C2	Alternative Solution 1: NEW BREAKER 62 AT JEPSON 69 kV, close Jepson 23kV
BF_JPSN_63T5	C2	Alternative Solution 1: NEW BREAKER 63-T5 AT JEPSON 115 kV
BF_JPSN_T5	C2	Alternative Solution 1: NEW BREAKER T5 AT JEPSON 115 kV
BF_JPSN_T5a	C2	Alternative Solution 1: NEW BREAKER T5 AT JEPSON 115 kV, close Jepson 23kV
BF_JPSN_63	C2	Alternative Solution 1: NEW BREAKER T1 AT JEPSON 115 kV
BF_DEXTR_M13	C2	Alternative Solution 1: DEXTER UPGRADES AS PART OF NEWPORT PH-II /*BREAKER FAILURE M13 AT DEXTER
BF_DEXTR_L14	C2	Alternative Solution 1: DEXTER UPGRADES AS PART OF NEWPORT PH-II /*BREAKER FAILURE L14 AT DEXTER
BF_DXTR_L142	C2	Alternative Solution 1: DEXTER UPGRADES AS PART OF NEWPORT PH-II /*BREAKER FAILURE L14-2 AT DEXTER
BF_DXTR_M132	C2	Alternative Solution 1: DEXTER UPGRADES AS PART OF NEWPORT PH-II /*BREAKER FAILURE M13-2 AT DEXTER
BF_DXTR_3661	C2	Alternative Solution 1: DEXTER UPGRADES AS PART OF NEWPORT PH-II /*BREAKER FAILURE 3761 AT DEXTER
BF_DXTR_3662	C2	Alternative Solution 1: DEXTER UPGRADES AS PART OF NEWPORT PH-II /*BREAKER FAILURE 3762 AT DEXTER
LN_L14_J+BR	B2	Alternative Solution 2: FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion
LN_M13N	B2	Alternative Solution 2: FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion
LN_M13S	B2	Alternative Solution 2: FUTURE CTG (RSP - 0917) - Greater RI - Bell Rock Substation Expansion
BS_JEPSON_1	C1	Alternative Solution 2: Jepson 115kV 1 Bus
BS_JEPSON_2	C1	Alternative Solution 2: Jepson 115kV 1 Bus
BS_JEPSON_2a	C1	Alternative Solution 2: Jepson 115kV 1 Bus, close Jepson 23kV
LN_3763_JEPS	B2	Alternative Solution 2: National Grid's 63 69 kV Line
LN_3763-1JPS	B2	Alternative Solution 2: National Grid's 63 69 kV Line (Jepson - Navy Tap)

Contingency Label	NERC Type	Description
TF_JPSN_T1	B3	Alternative Solution 2: JEPSON T1 115/69 kV
BF_JPSN_14T3	C2	Alternative Solution 2: NEW BREAKER L14-T1 AT JEPSON 115 kV
BF_JPN_14T3a	C2	Alternative Solution 2: NEW BREAKER L14-T1 AT JEPSON 115 kV, close Jepson 23kV tie
BF_JPSN_M13	C2	Alternative Solution 2: NEW BREAKER M13 AT JEPSON 115 kV
BF_JPSN_M132	C2	Alternative Solution 2: NEW BREAKER M13-2 AT JEPSON 115 kV
BF_JPN_M132a	C2	Alternative Solution 2: NEW BREAKER M13-2 AT JEPSON 115 kV, close 23kV tie
BF_JPSN_T3	C2	Alternative Solution 2: NEW BREAKER T3 AT JEPSON 115 kV
BF_JPSN_T3a	C2	Alternative Solution 2: NEW BREAKER T3 AT JEPSON 115 kV, close Jepson 23kV
BF_JPSN_L14	C2	Alternative Solution 2: NEW BREAKER L14 AT JEPSON 115 kV
BF_JPSN_L14a	C2	Alternative Solution 2: NEW BREAKER L14 AT JEPSON 115 kV, close Jepson 23kV
BF_JPSN_T1T5	C2	Alternative Solution 2: NEW BREAKER T1-T5 AT JEPSON 115 kV
BF_JPSN_T5	C2	Alternative Solution 2: NEW BREAKER T5 AT JEPSON 115 kV
BF_JPSN_T5a	C2	Alternative Solution 2: NEW BREAKER T5 AT JEPSON 115 kV, close Jepson 23kV
BF_JPSN_63	C2	Alternative Solution 2: NEW BREAKER 63 AT JEPSON 69 kV
BF_JPSN_T1	C2	Alternative Solution 2: NEW BREAKER T1 AT JEPSON 115 kV

Section 14
Appendix F: N-1 Contingency Results

Monitored Element	Pre-Project		Alternative Sol. 1		Alternative Sol. 2	
	Contingency	% LTE	Contingency	% LTE	Contingency	% LTE
Dexter T361 (118177 - 118180) LTE Rating: 130 MVA	LN_3762	112	-	<90	-	<90
Dexter T62 (118178 - 118183) LTE Rating: 65 MVA	LN_3761	112	-	<90	-	<90
Dexter T63 (118178 - 118183) LTE Rating: 65 MVA	LN_3761	112	-	<90	-	<90
Line 61 Dexter - Jepson (118180 - 118181) LTE Rating: 98 MVA Alt. 1: LTE Rating: 220 MVA Alt. 2: LTE Rating: 290 MVA	LN_L14	153	-	<90	-	<90
Line 62 Dexter - Jepson (118183 - 118181) LTE Rating: 98 MVA Alt. 1: LTE Rating: 220 MVA Alt. 2: LTE Rating: 290 MVA	LN_M13	154	-	<90	-	<90
Jepson Breaker 7	BF_JPSN_3765	154	N/A	N/A	N/A	N/A
Jepson Breaker 9	BF_JPSN_3765	192	N/A	N/A	N/A	N/A
Line 63 Jepson - Navy (118181 - 118179) LTE Rating: 78 MVA	BF_JPSN_3769	102*	BF_JPSN_T5	103*	BF_JPSN_M132	105*

*This overload will be mitigated by removing the conductor clearance limitations on two spans of Line 63. The mitigation involves re-arranging distribution facilities.