This document has been redacted for Critical Energy/
Electric Infrastructure Information (CEII). 2/25/2025

Transmission System Impact Study Results for Group 3 of Distributed Energy Resource (DER) Additions in Western Massachusetts

June 2022

Prepared by:
Dean Latulipe
Raman Somayajulu
Nitish Sharma

nationalgrid

This page intentionally left blank

This document and all attachments hereto (the "Document") is being provided to you by, or on behalf of, a National Grid USA affiliated company (the “Company”), but only upon and subject to the express understanding that:

(a) neither the Company, its parents or affiliates, nor any of their respective officers, directors, agents, or employees, make any warranty, assurance, guaranty, or representation with respect to the contents of the Document or the accuracy or completeness of the information contained or referenced in the Document,

(b) the Company, its parents and affiliates, and their respective officers, directors, agents, and employees, shall have no liability or responsibility for inaccuracies, errors, or omissions in, or any technical, business, policy, or other decisions made by any direct or indirect recipient in reliance on, the Document or the information contained or referenced therein; all such liability is expressly disclaimed,

(c) recipient(s) of the Document shall not acquire any rights in or to the Document, or to the information contained or referenced therein, by virtue of its disclosure,

(d) no license to any such recipients, under any trademark, patent, or other intellectual property right, is either granted or implied by the provision of the Document to the recipient(s), and

(e) the provision of the Document and/or the contents thereof shall not be deemed to be an inducement or a commitment by the Company, its parents or affiliates, or any of their respective officers, directors, agents, or employees, to enter into or proceed with any transaction.

If the Document is specified as being a deliverable to the recipient under any written agreement currently in effect between the Company and recipient (an “Agreement”), then, in the event of any conflict between the preceding paragraph and the express terms of the Agreement, the express conflicting term(s) of the Agreement shall govern to resolve such conflict.

NEW ENGLAND POWER COMPANY
40 Sylvan Rd
Waltham, MA 02451

This page intentionally left blank

Table of Contents

List of Tables

List of Figures

1 EXECUTIVE SUMMARY

This document provides the transmission system impact study results for Group 3 of National Grid's Western MA DER interconnection cluster study. Group 3 consists of the third stage of proposed Distributed Energy Resources (DER) additions applying for interconnection into the National Grid distribution system in Western MA. Groups 1 and 2 (previously approved) consisted of 314 MW of DER in Western Massachusetts, after accounting for all project attrition. None of Group 1 and 2 DER can charge from the transmission grid. Group 3 consists of an additional 252 MW of DER in Western MA, of which 121 MW can charge from the transmission system.

The following table shows the Group 3 DER broken down by Generation type.

Table 1 - Group 3 DER by Generation Type

Generation Type	Group 3 Total PV + BESS Discharging Limit[1] (kW)	Group 3 Total BESS Charging Limit[2] (kW)
PV Only	9,998	N/A
BESS Only	164,750	113,550
PV+DC BESS*	51,681	6,150
PV+AC BESS**	25,448	1,000
Grand Total	**251,877**	**120,700**

*With DC coupled PV+BESS, the PV and BESS share the same inverter
** With AC coupled PV+BESS, the PV and BESS are each equipped with dedicated inverters

Results of the steady state analysis indicate the the following Transmission upgrades need to be made to accommodate the integration of the Group 3 DER,

- **A1/B2 line rebuild/reconductor:** The A1/B2 69 kV transmission lines were found to overload following the addition of Group 3 DER. These overloads will be eliminated following the rebuild of both lines that is already planned due to asset condition issues. The lines will be rebuilt using 795 ACSS conductor. The refurbishment is scheduled to be completed in 2027.

- **Royalston Breaker Additions**: Voltage problems were identified at several substations along the A1/B2 lines following the addition of Group 3 DER. 69 kV breaker additions at Royalston substation, already planned as part of the A1/B2 rebuild project, will resolve these high voltage problems.

[1] Discharging limit imposed by distribution system constraints
[2] Charging limit imposed by distribution system constraints

- **Vernon 69 kV substation rebuild**: A-1 and B-2 69 kV terminal equipment at Vernon substation were found to overload following the addition of Group 3 DER. There is presently an asset condition project planned to rebuild Vernon station (to be renamed "Huntington" substation) which will eliminate the overloads. The rebuild is scheduled to be completed in 2026.

- **E5/F6 line rebuild/reconductor:** The E-5/F-6 69 kV transmission lines were found to overload following the addition of Group 3 DER if [redacted] Solar (QP1031) is built These overloads will be eliminated following the rebuild of both E5/F6 lines, already scheduled to address asset condition issues on the lines. The lines will be rebuilt using 795 ACSS conductor. The rebuild project is scheduled to be completed in 2030. Note that if QP1031 is withdrawn, Group 3 DER alone does not cause the E5/F6 lines to become overloaded.

Transient stability, short circuit, and PSCAD analyses were also conducted during this study, and no issues were identified.

2 INTRODUCTION

This document provides the system impact study results for the interconnection of 252 MW of Distributed Energy Resources (DER), greater than 1 MW, into the Western Massachusetts distribution system, owned by National Grid, over the years 2022 to 2025. Below are some additional characteristics of the Group 3 DER:

- None of the additional DER will be directly connected to the transmission system.
- All the DER will be mixed with distribution load.
- None of the additional DER will control voltage.
- All DER was set to a power factor of unity in the study.
- All the DER will respond to frequency deviations.

2.1 Study Objective

The objective of this study is to identify the transmission upgrades, if any, required to integrate the proposed DER without resulting in any significant adverse impact on the reliability, stability, and operating characteristic of the New England bulk power transmission system and National Grid transmission system.

2.2 Project Description

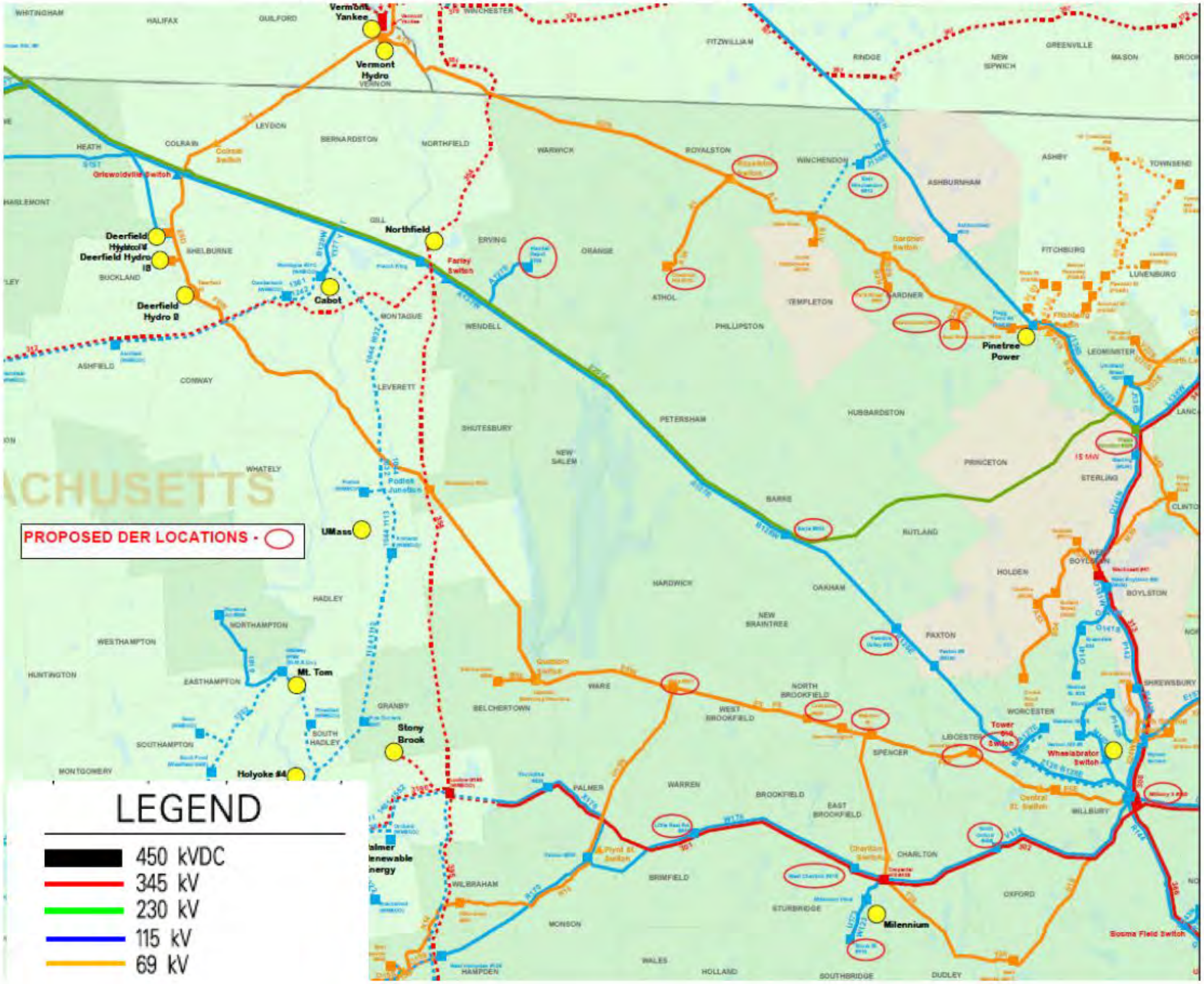
252 MW of DER (>1 MW) have applied to interconnect to the National Grid distribution system in Western MA by 2025.

2.3 Study Area

The transmission system geographic map and one-line diagram of the study area are shown in the following figures, with the DER project locations identified.

This page intentionally left blank

Figure 1 - Proposed DER Locations - Geographic Map



This page intentionally left blank

Figure 2 - Proposed DER locations for Group 3 - One Line Diagram

[redacted]

3 STUDY APPROACH

DER additions 1 MW and below, did not need to be added to the base cases for this study. The base cases utilized for this study already modeled DER 1 MW and below, via negative loads (with "PD" identifiers) that model the forecasted PV, 1 MW and below, out to year 2025. This DER, 1 MW and below, is distributed proportionally across the load busses in Western Massachusetts. Therefore, only DER additions that exceed 1 MW, were added to the cases utilized for this study. All 252 MW associated with Group 3 is greater than 1 MW.

3.1 Group 3 Totals by Substation

The Group 3 total amounts to 252 MW of new DER, and constitutes the third increment of National Grid DER studied in Western MA. The DER totals for Group 3 are shown in the following table for each substation.

Table 2 - Group 3 Total DER by Substation

Substation	Generation Type	Group 3 Total PV + BESS Discharging Limit[3] (kW)	Group 3 Total BESS Charging Limit[4] (kW)
BARRE SUBSTATION	Battery only	8,000	8,000
	DC coupled	4,400	3,150
Crystal Lake SUBSTATION	Battery only	8,000	5,200
E. WESTMINSTER SUBSTATION	DC coupled	4,990	3,000
E. WINCHENDON SUBSTATION	Battery only	14,900	8,800
	PV Only	4,999	N/A
LASHAWAY SUBSTATION	Battery only	15,000	12,000
LITTLE REST RD SUBSTATION	AC Coupled	3,000	0
	DC coupled	2,800	0
MEADOW STREET 552 SUBSTATION	DC coupled	8,800	0
	PV Only	4,999	N/A
MILLBURY SUBSTATION	AC Coupled	2,750	0
	Battery only	10,000	3,500
N. OXFORD SUBSTATION	Battery only	13,600	11,200
	DC coupled	4,400	0
PRATTS JUNC. SUBSTATION	Battery only	11,000	7,000
ROYALSTON SUBSTATION	AC Coupled	7,500	0
SNOW ST. SUBSTATION	AC Coupled	4,998	1,000
	Battery only	18,250	14,750
STAFFORD ST SUBSTATION-New	Battery only	10,000	10,000
	DC coupled	12,500	0
TREASURE VALLEY SUBSTATION	Battery only	10,000	5,000
W. CHARLTON SUBSTATION	Battery only	20,000	8,500
WARE SUBSTATION	DC coupled	11,000	0
WENDELL DEPOT SUBSTATION	AC Coupled	7,200	0
	Battery only	18,000	15,200
	DC coupled	2,791	0
LAUREL CIRCLE SUBSTATION	Battery only	8,000	4,400
Grand Total		**251,877**	**120,700**

[3] Discharging Limits imposed by distribution system constraints

[4] Charging Limits imposed by distribution system constraints

The total DER studied for the Group 3 Western MA Cluster study amounts to 252 MW. This DER is incremental to the DER in Groups 1 and 2 of the Western Massachusetts Cluster, which amounted to 314 MW, after accounting for all project attrition within the clusters. No DER in Groups 1 and 2 can charge from the transmission system. The totals for Groups 1 and 2 are shown in the following table for each substation.

Table 3 – Group 1 + 2 DER Totals by Substation, Post Attrition

Substation for Groups 1 + 2	Total MW
ADAMS SUBSTATION	11
ASHBURNHAM SUBSTATION	5
BARRE SUBSTATION	12.4
BEAR SWAMP UPPER YARD SUBSTATION	2.5
BELCHERTOWN SUBSTATION	8
CHESTNUT HILL 702 SUBSTATION	3.3
Crystal Lake SUBSTATION	24.7
E. WEBSTER SUBSTATION	5
E. WESTMINSTER SUBSTATION	8
E. WINCHENDON SUBSTATION	3.9
EAST LONGMEADOW SUBSTATION	9
FIVE CORNERS SUBSTATION	3
LASHAWAY SUBSTATION	13.7
LEICESTER SUBSTATION	2.6
LITCHFIELD ST SUBSTATION	10
LITTLE REST RD SUBSTATION	6
MEADOW STREET 552 SUBSTATION	13.4
MILLBURY SUBSTATION	14.4
N. OXFORD SUBSTATION	8.7
PALMER 503 SUBSTATION	18
PONDVILLE SUBSTATION	4.9
SHUTESBURY	20
SNOW ST. SUBSTATION	24.7
THORNDIKE SUBSTATION	12.5
TREASURE VALLEY SUBSTATION	2.2
W. CHARLTON SUBSTATION	17
WARE SUBSTATION	13.3
WENDELL DEPOT SUBSTATION	15
West Hampden 139 SUBSTATION	13.2
WESTMINSTER SUBSTATION	4.9
WILBRAHAM SUBSTATION	4
Total	**314**

3.2 Distribution Substation Upgrades

Several distribution substation upgrades will need to be built in order to accommodate the interconnection of the Group 3 DER into the Western MA Distribution system:

Wendel Depot Substation

A second 115/13.8 kV transformer [redacted] will be installed, as well as the replacement of the existing 115/13.8 kV transformer [redacted]

Figure 3 – Wendel Depot Substation Upgrades

[redacted]

E Winchendon Substation

Replace existing 115/13.8 kV transformer with a [redacted]

Figure 4 – E Winchendon Substation Upgrades

[redacted]

Barre Substation

Replace both existing 115/13.8 kV transformers with [redacted]

Figure 5 – Barre Substation Upgrades

[redacted]

Ware Substation

Replace existing 69/23 kV transformer with 69/13.8 kV [redacted].

Figure 6 – Ware Substation Upgrades

[redacted]

Meadow St Substation

Install a second 69/13.2 kV transformer ([redacted] and install 69 kV breaker.

Figure 7 – Meadow St Substation Upgrades

[redacted]

Lashaway Substation

Replace the existing 69/13.2 kV transformer with a [redacted] unit, and replace the existing 69/23kV transformer with a 69/13.2 kV transformer ([redacted]

Figure 8 – Lashaway Substation Upgrades

[redacted]

Leicester 69/13.8kV substation - Retire

3.3 Study Assumptions

- DER was dispatched as follows in both the steady state base cases, as well as the stability base cases:
  - All the Group 1, 2, and 3 DER in this study, greater than 1 MW, were added to the cases, and dispatched at 100% nameplate, at all load levels. This DER is modeled with negative load[5] at each distribution bus for the substations listed in Table 3. No distribution feeder impedance is assumed.
  - For the purposes of describing the treatment of existing and forecasted PV in the study, PV is placed into three categories:
    - All existing Category 1 PV (existing or PPA approved PV facilities greater than or equal to 5 MW) in the 2025 base case representation provided by ISO-NE, was dispatched at 100 % output for all load levels.
    - All existing Category 2 PV (existing PV facilities greater than 1 MW and less than 5 MW) provided by ISO-NE with the 2025 base cases, is dispatched at 100 % output at the peak load level only. No Category 2 PV was modeled in the light load and intermediate load cases.
    - All existing Category 3 PV (Existing facilities less than or equal to 1 MW and all future forecasted solar PV for which locational information is not available) provided by ISO-NE with the 2025 base cases, is dispatched at 100 % output at the peak load level only. Note that the "future" solar PV greater than 1 MW and less than 5 MW is carved out of the Category 3 PV to avoid double counting of the new DER for which this study is being conducted. No Category 3 PV was modeled in the light load and intermediate load cases.

.

- None of the DER additions were modeled in voltage control mode, since all of the new DER will be mixed with distribution load (i.e., no DER will be installed on dedicated feeders)
- All of the Group 3 DER will be operated in frequency response mode (per the new Source Requirements Document (SRD) developed for Group 3). None of the Group 1 and Group 2 DER will be operated in frequency response mode (per the previous SRD in place during the Group 1 and Group 2 studies). Therefore, the DER additions for each group were modeled accordingly in the stability study.
- No transmission ring busses are required for any DER additions that are mixed with distribution load, or will be mixed with distribution load in the future.
- Starting from the original base cases developed for this study, and prior to testing any contingencies, the Group 1, 2 and 3 DER was dispatched (at 100% output) against existing (and PPA approved) non-DER generation in Connecticut. This maintained the same transfer levels (pre vs post DER additions) of interfaces relevant to this study (i.e., E-W and NY-NE).

---

[5] DER was modeled as generators in the load flow base cases utilized for the stability testing

- Treatment of transmission overloads above 100 kV in study:
    - [redacted]
    - [redacted]
    - [redacted]

- Treatment of transmission overloads below 100 kV in study:
    - [redacted]
    - [redacted]

[6] This is consistent with the Mininum Interconnection Standard (MIS) outlined by FERC Order 2003.

Table 4 - Generators Available for Redispatch to Prevent [redacted] 69 kV Overloads

PSSE Bus number	Generator Name
109296	Sears Wind_E
109297	Sears Wind_W
109403	Drfld East G
109404	Drfld West G
109503	Harriman G3
109504	Harriman G2
109505	Harriman G1
109517	Sears Hydro
109529	Vernon Hyd A
109530	Vernon Hyd B
109531	Vernon Hy T1
109532	Vernon Hy T2
113098	Deerfield 2g
113099	Deerfield 3g
113100	Deerfield G4
113101	Deerfield G5
113102	Fife Brook
113104	Sherman Hyd
113123	Hoosac Clr1
113125	Hoosac Clr2
113096	Bearswamp G1
913096	Bearswamp P1
113097	Bearswamp G2
913097	Bearswamp P2

- No DER generation can be redispatched between contingencies to eliminate 69 kV [redacted] overloaded elements.
- It is assumed that [redacted] involving 69 kV double circuit towers, or 69 kV breaker failures will not cause a significant adverse impact outside the local area [redacted], and therefore were not tested.

- Hydro Generation that is defined as "Daily Cycle Pondage" or "Weekly Cycle" in the CELT report can be ramped up to nameplate capability, according to the ISO-NE Planning Technical Guide, between [redacted] and [redacted] contingencies to prevent post [redacted] contingency thermal overloads or voltage violations. However, this generation can't be assumed to ramp up between contingencies post Group 3, if ramping up solves [redacted] voltage or thermal problems that did not exist prior to Group 3 going in-service (Per ISO-NE PP5-6 document, section 3.4: "No Increase in Conditional Dependence").

Table 5 - Hydro Generation Available to Ramp Up between Contingencies

RESOURCE NAME	GEN TYPE ID	PRIM FUEL TYPE	FUEL GEN TYPE DESC	STATE	RSP AREA	NAMEPLATE (MW)	WINTER SCC (MW) Jan 1, 2019	ACTUAL WINTER PEAK SCC (MW) Jan 21, 2019	EXPECTED SUMMER PEAK SCC (MW) JUL 1, 2019
BELLOWS FALLS	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	VT	VT	45.900	47.216	47.216	47.216
COBBLE MOUNTAIN	HW	WAT	HYDRO (WEEKLY CYCLE)	MA	WMA	23.100	27.431	27.431	31.989
DEERFIELD 5	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	MA	WMA	17.550	13.990	13.990	13.965
HARRIMAN	HW	WAT	HYDRO (WEEKLY CYCLE)	VT	WMA	33.600	38.471	38.471	40.798
JACKMAN	HW	WAT	HYDRO (WEEKLY CYCLE)	NH	NH	3.200	3.459	3.459	3.600
DEERFIELD 2 LWR DRFIELD	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	MA	WMA	9.600	18.667	18.667	18.580
SEARSBURG	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	VT	WMA	4.500	4.567	4 567	4.451
SHERMAN	HW	WAT	HYDRO (WEEKLY CYCLE)	MA	WMA	8.100	6.220	6 220	6.154
VERNON	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	VT	WMA	34.560	32.000	32.000	32.000
WILDER	HW	WAT	HYDRO (WEEKLY CYCLE)	VT	VT	35.640	40.674	40.674	40.920
CABOT TURNERS FALLS	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	MA	WMA	61.920	61.800	61.800	61.800
CABOT TURNERS FALLS	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	MA	WMA	6.400	6.400	6.400	6.400

- Pumped Storage Generation in the study area (Northfield and Bear Swamp) can be ramped up to 1/2 nameplate capability (two units at Northfield and 1 unit at Bear Swamp) between [redacted] and [redacted] contingencies to prevent post [redacted] contingency thermal overloads or voltage violations. Note that this can only be assumed if the units are off or in generating mode in the base case [redacted]. If units are in pumping mode in the base case, it cannot be assumed that units can be ramped up into generating mode between contingencies.

- "Smart Capacitor" Control Additions in Western Massachusetts, required for the addition of the Group 1 DER interconnections, were assumed in-service for the Group 3 analysis. These "smart capacitor" controls automatically switch off distribution feeder capacitors during light load and minimum load conditions. These "smart capacitor" automation schemes are itemized in the following table.

Table 6 - "Smart Capacitor" Control Additions in Western Massachusetts

Substation Bus	[redacted]
E Winchendon1 13.8	
Crystal Lk1 13.8	
Crystal Lk2 13.8	
E Wstmstr T1 13.8	
E Wstmstr T2 13.8	
E Longmeadow 1 13.2	
N Hampden T1 13.2	
Palmer 13.2	
Wilbraham 13.2	
Lashaway 13.2	
W Charlton 13.2	
Litl Rest Rd 13.2	
Thorndike 13.2	
Treasure Vly 13.8	
Chesnut Hl T1 13.8	
Chesnut Hl T2 13.8	
Total	

Presently, in the existing system, the feeder capacitors listed in the preceding table are fixed capacitors; meaning that they are not switched automatically, and are in service all the time unless switched out manually in the field. After the automatic switching schemes are installed, these feeder capacitors will be switched out automatically if the feeder loading becomes less than 45% of peak feeder load. From a loadflow perspective, switching out these capacitors during light load and minimum load conditions is modeled by placing an equivalent amount of [redacted] lagging load at each the substation busses listed in the table. These smart capacitor controls will be installed before Group 1 of the DER cluster goes into service. The new smart capacitors will have radios for status monitoring and control. The system operators will have the ability to put the capacitors in manual operation to either open or close as needed.

- H-134 115 kV project (RSP #951) (E Winchendon to Otter River) not in-service (PPA withdrawn)
- The Ware 69 kV breaker addition project, completing the O-15N 69 kV bay, as required for interconnection of Group 2 DER of the Western MA cluster, assumed in-service.
- New Stafford St 115/13.8 kV substation in Leicester MA, which will sectionalize the A-127, B-128 and Z-126 115 kV lines near the existing Tower 510 structure, assumed in-service.
- Reconductor of A-1/B-2 69 kV lines with 795 ACSS scheduled for 2027 in-service date. Since the Group 3 DER is scheduled to be in-service between 2022 and 2025, the reconductor of A-1/B-2 was not included in the base cases for this study.
- All the transmission and generation projects with approved PPA's were included in the base cases for this study. Additionally, the following relevant generators in the ISO-NE Interconnection Queue were modeled in each base case. Note that some of these projects that were withdrawn during the course of this study were placed out of service in the base cases.

- QP 660 (“Vernon Solar“ 20 MW PV unit connecting directly to D-4 69 kV line between Deerfield 4 and Vernon), withdrawn.

- QP-651 Alps Berkshire Phase Shifting Transformer Not In-Service (Withdrawn).

- QP697 (5.97 MW) and QP698 (8.04 MW), both connected at the E Winchendon 13.8 kV, in-service

- QP 797 [redacted] Solar – Meadow St) in-service

- QP 754 [redacted] Solar – connected to I-135N 115 kV line) Not In-Service (Withdrawn)

- QP 1105 ([redacted] Battery Storage Project – off A-127 115kV line) not-in-service (withdrawn from ISO-NE study queue)

- QP 1112 ([redacted] Storage Project – off B-128 115 kV line between Barre and French King substation) not-in-service (but tested as a sensitivity in study)

- QP 1031 ([redacted] Solar Project – off F-6W 69 kV line between Ware and Belchertown substations) not-in-service (but tested as a sensitivity in the study)

- Millbury 115 kV IEC61850 project – In-service. Project will replace the following [redacted] circuit breakers and associated Bushing Current Transformers (BCTs) with [redacted] circuit breakers:

    - B128, A127, Z126, M165, 27-302, 65-74, V174.
    - Replacing breakers 65-74 and V-174 will increase V-174 thermal rating [redacted]

4 STUDY CRITERIA

This analysis is conducted in accordance with the following criteria.

- NERC Transmission Planning Standards TPL-001-4, "*Transmission System Planning Performance Requirements*",
- [redacted]
- ISO New England Planning Procedure #3 (PP3) – "*Reliability Standards for the New England Area Bulk Power System*".
- ISO New England Planning Procedure #5 (PP5) – "Proposed Plan Application Procedure".
- National Grid Transmission Group Procedure (TGP) #28 – "*Transmission Planning Guide for the National Grid USA Service Company*".

5 STEADY STATE ANALYSIS

The following tables identify the steady state voltage criteria that were applied in the study:

Table 7 - Steady State Voltage Limits

Facility Owner	Voltage Level	Bus Voltage Limits (Per-Unit)	
		Pre-Contingency	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 to 1.05[7]
Eversource	115 kV and above	0.95 to 1.05	0.90 to 1.05 (before system adjustments) 0.95 to 1.05 (after system adjustments)
GMP	115 kV and below	0.95 to 1.05	0.90 to 1.10
VELCO	230 kV and above	0.98 to 1.05	0.95 to 1.05
	115 kV and below	0.95 to 1.05	0.95 to 1.05

Table 8 - Maximum Percent Voltage Variation at Delivery Points

CONDITION	345 & 230 kV (%)	115 kV[1] & 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 *

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

Notes on two preceding Tables:

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.

[7] National Grid 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

The following table identifies the thermal criteria that is applied in the study.

Table 9 - Thermal Criteria Applied in Study

SYSTEM CONDITION	TIME FRAME	MAXIMUM ALLOWABLE FACILITY LOADING
Pre-contingency (All lines in)	Continuous	Normal Rating
Post-contingency	Less than 15 minutes after contingency occurs	STE Rating
	More than 15 minutes after contingency occurs	LTE Rating

5.1 Steady State Solution Parameters

The steady state analysis is performed with pre-contingency solution parameters that allowed adjustment of load tap-changing transformers (LTCs), static VAR devices (SVDs including automatically switched capacitors. Post-contingency solution parameters were locked, and the area interchange control is disabled. The following table shows the pre- and post-contingency solution parameters that were used in this study.

Table 10 - Steady State Study Solution Parameters

Case	Area Interchange	Transformer LTCs	Phase Angle Regulators	Switched Shunts
Base	Disabled	Stepping	Locked	Regulating
Post Contingency	Disabled	Locked	Locked	Locked

5.2 Steady State Base Case Development

In order to investigate the impact of the proposed projects to the New England transmission system, a total of seven base cases were developed representing various load levels and interface transfer levels.

Study Year Tested

Since Group 3 of the DER will be installed by 2025, the year 2025 ISO-NE base cases, released in September 2020, were used for the steady state assessment.

Load Levels Tested

Four load levels were tested for steady state analysis. These cases are based on the loads contained in the CELT 2020 forecast.

1. Summer Peak Load
2. Shoulder Peak Load
3. Light Load
4. Minimum Load (8000 MW)

Interface Transfer Levels Tested

For each of the three load levels – Summer Peak Load, Shoulder Peak Load and Light Load, two base cases were developed for steady state testing:

1. High East to West Stress (3500 MW), with High NE-NY transfers (1200 MW), High Sandy Pond HVDC Import

2. High West to East Stress (3000 MW), with High NY-NE transfers (1600 MW), Low Sandy Pond HVDC Import

For Minimum Load level, one base case is developed for steady state testing.

The following table summarizes the interface levels and generation dispatches for the steady state base cases prior to the dispatch of Group 1,2 and 3 DER in the cases. More detailed case summaries are included in Appendix A.

To test the impact of the DER, both Group 1, 2 and 3 DER were added to each case and dispatched against Millstone 2 in Connecticut.

Table 11 - Steady State Base Case Summaries (before dispatching Group 1, 2, and 3 DER)

Base Case Load Flows (MW)							
Name	25pk-ew-100%-PV*	25pk-we-100%-PV*	25sh-ew+pump	25sh-we	25ll-ew+pump	25ll-we	Min-load
Year/Load Level	2025 Summer peak		2025 Shoulder peak		2025 Light Load		2025 Min Load
Bias	East-West	West-East	East-West	West-East	East-West	West-East	
Total Load	25697		18066		12518		8901
Scaling Load	31252		16673		11412		7858
Non-Scaling Load	556		556		556		556
DR passive	0		0		0		0
DR active	0		0		0		0
EE	-4756		0		0		0
Cat 2 and 3 PV	-2089		0		0		0
NON CELT MFG LOAD	301		301		301		301
New England Transmission Interface Transfers (MW)							
Sandy Pd HVDC Import	2000	1000	2000	1000	2000	1000	0
E-W	3512	-2996	3506	-3036	3543	-3002	65
NY-NE	-1231	1600	-1220	1599	-1204	1602	-34
North-South	4395	2212	3100	2841	3078	1584	2467
CT Export	-1190	-571	-64	-163	-763	336	165
Area Generation (MW)							
Northfield (MA) – 1180 MW (Max)	0	1180	-1100	1180.0	-1100	0	0
Bear Swamp 666 MW (Max)	0	666	-666	666	-666	0	0
Altresco (MA) – 164 MW (Max)	0	164	73	164	164	164	0
Cabot Hydro (MA) – 65 MW (Max)	11 (minimum)	65	11 (minimum)	65	11 (minimum)	65	11 (minimum)
Harriman Hydro (VT) – 41 MW (Max)	5 (minimum)	41	5 (minimum)	41	5 (minimum)	41	5 (minimum)
Vernon Hydro (VT) – 32 MW (Max)	5 (minimum)	32	5 (minimum)	32	5 (minimum)	32	5 (minimum)
Deerfield Hydro 2+3 +4 (20 MW Max)	5 (minimum)	20	5 (minimum)	20	5 (minimum)	20	5 (minimum)
Harrington St Solar (10 MW Max)	10	10	0	10	10	10	10
Warren Solar (Little Rest Rd) (14 MW Max)	14	14	0	14	14	14	14
Treasure Valley Solar (16 Max)	16	16	0	16	16	16	16
Millennium	0	360	361	0	361	360	0
Stony Brook	0	483	0	483	483	483	0
Bellows Falls	49	49	0	49	0	0	0
QP697&QP698 (14MW PV at E. Winchendon)	14	14	0	14	14	14	14

*Per the direction provided by ISO-NE, all existing PV in western MA (zone 41), modeled in peak load base case was scaled up from 26% output to 100% output. This PV was modeled as negative load (with "PD" and "PV" load identifiers) in the peak load cases. Note that the negative load with "PD" identifiers includes all existing PV less than 1 MW, as well as all future forecasted PV greater than 1 MW but less than 5 MW which does not have location based data associated with it. To avoid double counting of the "PD" load that includes the future forecasted PV between 1 and 5 MW, this portion of the "PD" was stripped out of the peak load base cases. The percent of "PD" load that includes the future forecasted PV for the Western MA zone 41 is 41.9%, per ISO-NE.

Sensitivity bases cases were also developed at peak load, with all DER in the study area at 26% output (of nameplate). The following tables summarize the interface levels and generation dispatches for the steady state base cases. Again, to test the impact of the DER, Group 1, 2 and 3 DER were added to each case and dispatched against Millstone 2 in Connecticut.

Table 12 - Steady State Base Case Summaries: Sensitivity to DER = 26% Output (Prior to dispatching Group 1, 2, and 3 DER)

Base Case Load Flows (MW)		
Name	25pk-ew-26%	25pk-we-26%
Year/Load Level	2025 Summer peak	
Bias	East-West	West-East
Total Load	26338	26282
Total Losses	966	683
Total Generation	27670	24419
Scaling Load	31227	
Non-Scaling Load	556	
DR passive	0	
DR active	0	
EE	-4756	
Station Service	678	621
NON CELT LOAD	301	
New England Transmission Interface Transfers (MW)		
Sandy Pd HVDC Import	2000	1000
E-W	3521	-2987
NY-NE	-1188	1641
North-South	4506	2321
CT Export	-742	-97
Area Generation (MW)		
Northfield (MA) – 1180 MW (Max)	0	1180
Bear Swamp 666 MW (Max)	0	666
Altresco (MA) – 164 MW (Max)	0	164
Cabot Hydro (MA) – 65 MW (Max)	11* (minimum)	65
Harriman Hydro (VT) – 41 MW (Max)	5* (minimum)	41
Vernon Hydro (VT) – 32 MW (Max)	5* (minimum)	32
Deerfield Hydro 2+3 +4 (20 MW Max)	5* (minimum)	20
Harrington St Solar (10 MW Max)	10	10
Warren Solar (Little Rest Rd) (14 MW Max)	14	14
Treasure Valley Solar (16 Max)	16	16
Millenium	0	360
Stony Brook	0	483
Bellows Fall	49	49
QP697&QP698 (14MW PV at E. Winchendon)	14	14

5.3 Study Matrix for Steady State Analysis

To test the impact of the DER, Group 1,2 and 3 DER were added to each case, according to the following table, and dispatched against Millstone 2 in Connecticut. Dispatching the DER against Millstone 2 will maintain the same East-West, and NY-NE transfer levels, compared to the pre-DER base cases.

Table 13 – Proposed Study Matrix for Steady State Analysis

		Group 3 DER		Group 1 and 2 DER	Pre-Group 1 and 2 DER	FERC BESS projects under Study	
Load Level	**Bias**	**BESS output**	**PV output**	**PV output**	**PV output**		**Comments**
Peak Summer load	E-W	100% discharging	100%	100%	100%	Sensitivity analysis was conducted for [redacted] (QP1031) and [redacted] (QP1112)	
	W-E						
	E-W	100% Charging	26%	26%	26%		
	W-E						
Shoulder Peak Load	E-W +pump	100% Charging	0% (peak load night/morning - before 8am)	0% (peak load night - before 8am)	0% (peak load night - before 8am)		This case represents a peak load night. BESS could be charging (7am) before Bear Swamp Pumps shut off. PV assumed to 0 MW in case.
	W-E	100% discharging	100% (no pump case (day)	100% for PV 5 MW and above. 100% for PV under 5 MW	0%		
Light Load	E-W +pump	100% discharging	100%	100% for PV 5 MW and above. 100% for PV under 5 MW	0%		
	W-E						
					0%		
Min Load	none	100% discharging	100%	100% for PV 5 MW and above. 100% for PV under 5 MW	0%		

5.4 Steady State Contingency Analysis

N-1 and N-1-1 contingency conditions were tested in steady state analysis on the load flow base cases with and without the new DER added to the cases.

5.4.1 N-1 Contingency List

The N-1 Contingency list is shown in the table below.

Table 14 - N-1 Steady State Contingency List

CONTINGENCY NAME	kV	DESCRIPTION
HVDC Facilities		
Sandy Pond HVDC Phase II	-	Sandy Pond HVDC Converter – 2000 MW Maximum
345 kV Transmission Lines		
301/302	345	Millbury – Carpenter Hill – Ludlow
308	345	Wachusett – Millbury
312	345	Berkshire – Northfield (Post Alps-Berkshire ETU)
393	345	Alps – Berkshire (Post Alps-Berkshire ETU)
313	345	Wachusett – Millbury
314	345	Sandy Pond – Wachusett
326	345	Scobie – Sandy Pond
320	345	Lake Rd – Card St
343	345	Sandy Pond – Wachusett
354	345	Northfield – Ludlow
367	345	Amherst – Fitzwilliam
3195	345	Amherst – Eagle
380	345	Eagle – Scobie Pd
368	345	Manchester – Card St
379	345	Vernon – Fitzwilliam
381	345	Vernon – Northfield
398	345	Long Mt – Pleasant Valley (NY)
3340	345	Vernon – Vermont Yankee
3381	345	Vernon – Vermont Yankee
3271	345	Lake Rd – Card St
330	345	Lake Rd – Card St
3348	345	Lake Rd – Killingly
341	345	Lake Rd – W Farnum
368	345	Card St - Manchester
345 kV Transformers		
Wachusett T5	345/115	Wachusett Transformer #5
Wachusett T6	345/115	Wachusett Transformer #6
Wachusett T7	345/115	Wachusett Transformer #7
Fitzwilliam T1	345/115	Fitzwilliam Transformer #1
Ludlow T2	345/115	Ludlow Transformer #2
Ludlow T3	345/115	Ludlow Transformer #3
Northfield T1	345/115	Northfield Transformer #1 (post Pittsfield-Greenfield upgrades)
Berkshire T1	345/115	Berkshire Transformer #1
Carpenter Hill T1	345/115	Carpenter Hill Transformer #1
Agawam T1	345/115	Agawam T1
Agawam T2	345/115	Agawam T2
345 kV Line End Open Contingencies		
301 Millbury	345	Millbury – Carpenter Hill
302 Ludlow	345	Ludlow – Carpenter Hill
312 Northfield	345	Northfield – Berkshire
345 kV Breaker Open Contingencies		
393 Alps	345	Berkshire - Alps
345 kV Breaker Failures		
Fitzwilliam 3791 BF	345	379 + Fitz T1
Fitzwilliam 671 BF	345	367 + Fitz T1

CONTINGENCY NAME	kV	DESCRIPTION
Wachusett 7T BF	345	308 + Wachusett T7
Wachusett 6T BF	345	313 + Wachusett T6
Wachusett43-6T BF	345	343 + Wachusett T6
Wachusett 14-7T BF	345	314 + Wachusett T7
Ludlow 1T BF	345	334 + Ludlow T2
Ludlow 2T BF	345	334 + Ludlow T3
Ludlow 3T BF	345	Ludlow T3
Ludlow 4T BF	345	354 + Ludlow T2
Ludlow 5T BF3t19	345	3196 + 354
Ludlow 6T BF	345	3196
Ludlow 7T BF	345	301/302 + Ludlow T2+ Carpenter Hill Auto
Ludlow 8T BF	345	3419 + 301/302 + Ludlow T2+ Carpenter Hill Auto
Ludlow 9T BF	345	3419
Millbury 308+302 BF	345	301/302 + 308
Northfield 2T BF	345	312 + Northfield G1 + G2 (post Pittsfield-Greenfield upgrades)
Northfield 5T BF	345	354 + Northfield G3 + G4 (post Pittsfield-Greenfield upgrades)
Vernon 3TB4-B1 BF	345	381 + Vernon Reactor
Vernon 3TB3-B1 BF	345	379 + 3381
Vernon 3TB1-B1 BF	345	3320 + 3340
Vernon 3TB2-B1 BF	345	340 + Vernon T1
Vermont Yankee 1T	345	Vermont Yankee GSU
Vermont Yankee 381	345	3381 + Vermont Yankee Auto
Vermont Yankee 81-1T	345	3381 + Vermont Yankee GSU
Vermont Yankee 79-40	345	3340 + Vermont Yankee Auto
	345 kV Double Ckt Towers	
-	-	-
	230 kV Transmission Lines	
E-205E	230	Bear Swamp – Pratts Jct.
E-205W	230	Bear Swamp – Eastover Rd (NY)
38	230	Rotterdam (NY) – Eastover Rd (NY)
	230 kV Double Ckt Towers	
-	-	-
	230/115 kV Transformers	
Bear Swamp T4	230/115	Bear Swamp Transformer #4
Bear Swamp T5	230/115	Bear Swamp Transformer #5
PrattsJct T8 + T8A	230/115	PrattsJct Transformer #8 + 8A
Eastover Rd T1	230/115	Eastover Rd Transformer #1
Eastover Rd T2	230/115	Eastover Rd Transformer #2
	230 kV Breaker Failures	
Bear Swamp 2205E BF	230	Bear Swamp G2 + T4 (230-115 kV) + E-205E
Bear Swamp 2205W BF	230	Bear Swamp G2 + T4 (230-115 kV) + E-205W
Bear Swamp 1205E BF	230	Bear Swamp G1 + T5 (230-115 kV) + E-205E + 115 kV Cap
Bear Swamp 1205W BF	230	Bear Swamp G1 + T5 (230-115 kV) + E-205W + 115 kV Cap
Eastover Rd RE205 BF	230	E-205W + Eastover Rd T1
Eastover Rd RE215 BF	230	E-205W + Eastover Rd T2
Eastover Rd R38 BF	230	38 + Eastover Rd T1
Eastover Rd R48 BF	230	38 + Eastover Rd T2
	115 kV Transmission Lines	
1242	115	Montague – Berkshire
1361	115	Montague – Cumberland (post Pittsfield-Greenfield upgrades)
1231	115	Berkshire – Cumberland
1551	115	Doreen – Berkshire
1662	115	Doreen – Berkshire
PV20	115	Plattsburg – South Hero
K6	115	Bennington – Hoosick (NY)
K7	115	Whitehall – Bliss Ville
A-127E	115	Millbury- Webster St – Erving (post Erving substation)
A-127W	115	Erving – Harriman (post Erving substation)
B-128	115	Harriman – Millbury
E-131	115	Bear Swamp – Harriman – Adams
F-132	115	Adams – Doreen
I-135	115	Fitzwilliam – Flagg Pd
I-135S	115	Flagg Pd – PrattsJct
J-136S	115	Flagg Pd – Litchfield Tap – PrattsJct
J-136N	115	Bellows Falls – Flagg Pd

CONTINGENCY NAME	kV	DESCRIPTION
O-141	115	Greendale – Nashua St
O-141N	115	PrattsJct – Wachussett
O-141S	115	Nashua St – Millbury
O-141W	115	Wachusett– Greendale
P-142	115	W Boylston – Rolfe Ave
P-142N	115	PrattsJct – Wachusett
P-142S	115	Rolfe Ave – Millbury
P142W	115	Wachusett – W Boylston
Q-117	115	Adams – Bennington
R-170	115	Palmer – W Hampden
1205	115	W Hampden - Ludlow
1976	115	W Hampden - Scitico
S-197	115	Bear Swamp – Deerfield
V-174W	115	Carpenter Hill – N Oxford
V-174	115	N Oxford – Millbury
W-175	115	Carpenter Hill – Palmer
X-176	115	Palmer – Ludlow
Y-177	115	Harriman – Montague (NU)
Z-126	115	Millbury – Tower 510 – Webster St
115 kV Double Ckt Towers		
1161+1211 DCT	115	1161 + 1211 + 1662
1231+1242 DCT	115	1231 + 1242
1551+1662 DCT	115	1551 + 1662 + 1211
1715+1816 DCT	115	1715 + 1816 + Altresco Gen
A127E+B128 DCT	115	A-127E + B-128 (Millbury – Erving) (post Erving substation)
A127W+B128 DCT	115	A-127W + B-128 (Erving – Harriman) (post Erving substation)
141W+142 DCT	115	O-141W + P-142
O141S+P142 DCT	115	O-141S + P-142
O141N+P142N DCT	115	O-141N + P-142N
O141S+142S DCT	115	O-141S + P-142S
O141W+P142W DCT	115	O-141W + P-142W
I135S+J136S DCT	115	I-135S + J-136S
I135N+J136N DCT		I-135N + J-136N
I135+J136N DCT		I-135 + J-136N
115/69 kV Transformers		
Millbury T1	115/69	Millbury Transformer #1 (56 MVA)
Millbury T2	115/69	Millbury Transformer #2 (56 MVA)
Millbury T3	115/69	Millbury Transformer #3 (45 MVA) + 63 Mvar Cap Bank
Pratts Jct T5 +T6 + T7	115/69	PrattsJct Transformer bank #1
PrattsJct T3+T4	115/69	PrattsJct Transformer bank #2
Deerfield 4 T3 + T4	115/69	Deerfield4 transformer #3 + T4
Adams Autotransformer	115/69	Adams Autotransformer
Bennington T69	115/69	Bennington VT 115-69 kV transformer
Harriman Autotransformer	115/69	Harriman Autotransformer
Palmer Transformer bank #1	115/69	Palmer T3 + T5
Palmer Transformer bank #1	115/69	Palmer T4 + T6
W Hampden T1	115-69	West Hampden T1
115 kV Breaker Failures		
Adams 731 BF	115	E-131 + Q-117 (Post Adams Upgrade)
Adams 217 BF	115	F-132 + Q-117 (Post Adams Upgrade)
Adams T3T BF	115	F-132 + Adams Auto (Post Adams Upgrade)
Adams T5T BF	115	E-131 + Adams Auto (Post Adams Upgrade)
Bear Swamp 131 BF	115	E-131 + Bear Swamp T4 + Bear Swamp GSU #1
Bear Swamp 197 BF	115	S-197 + Bear Swamp T4 + Bear Swamp GSU #1
Bear Swamp T31 BF	115	E-131 + Bear Swamp Fut Xfmr + Bear Swamp 115 kV Cap + Bear Swamp GSU #2 (Post Bear Swamp Upgrade)
Bear Swamp T97 BF	115	S-197 + Bear Swamp Fut Xfmr + Bear Swamp 115 kV Cap + Bear Swamp GSU #2 (Post Bear Swamp Upgrade)
Bennington K4 BF	115	Q-117 + Bennington 115 kV Cap #1
Bennington KT1 BF	115	Bennington Auto + Bennington 115 kV Cap #2
Berkshire 12T BF	115	1551 + Berkshire T2
Berkshire 13T BF	115	1551 + 1231
Berkshire 16T BF	115	1662 +1242
Doreen 6T BF	115	1161 + 1662
Doreen 7T BF	115	1211 + 1662
Doreen 8T BF	115	1211 + 1551
Doreen 9T BF	115	1551 + 1816

CONTINGENCY NAME	kV	DESCRIPTION
Doreen 12T BF	115	1715 + F-132
Erving A BF	115	A-127W + A-127E open ended + Northfield T1
Erving B BF	115	A-127E + A-127W open ended + Northfield T1
Erving C BF	115	A-127E + A-127W + Northfield T1
Harriman A127 BF	115	A-127W + B-128 open ended
Harriman B128 BF	115	A-127W open ended + B-128
Harriman E131 BF	115	E-131 + Y177 open ended + Harriman G1 + G2 +G3
Harriman Y177 BF	115	E-131 open ended + Y177 + Harriman G1 + G2 +G3
Harriman TIE BF	115	A-127W open ended + B-128 open ended + E-131 open ended + Y177 open ended + Harriman G1 + G2 +G3
Montague 1T BF	115	1632 + Cabot Gen
Montague 3T BF	115	1044 + Y-177 open ended
Montague 7T BF	115	1361 + A-127W open ended
Montague 8T BF	115	1361 + 1242
Montague 10T BF	115	1242 + Cabot Gen
PrattsJct O141 BF	115	Pratts T3 + T4 115-69 kV autos + O-141N + Pratts 63 MVAR capacitor
PrattsJct 801 BF	115	Pratts T3 + T4 115-69 kV autos + E-205E + Pratts 63 MVAR capacitor
PrattsJct I135 BF	115	Pratts T3 + T4 115-69 kV autos + I-135S + Pratts 63 MVAR capacitor
PrattsJct 1110 BF	115	Pratts T3 + T4 115-69 kV autos + Pratts 63 MVAR capacitor
PrattsJct P142 BF	115	Pratts T3 + T4 115-69 kV autos + P-142N + Pratts 63 MVAR capacitor
PrattsJct 802 BF	115	Pratts T5 + T6 + T7 115-69 kV autos + E-205E + J-136 (PJ – Litch Tap)
PrattsJct L138 BF	115	Pratts T5 + T6 + T7 115-69 kV autos + L-138 + J-136 (PJ – Litch Tap)
PrattsJct K137 BF	115	Pratts T5 + T6 + T7 115-69 kV autos + K-137 + J-136 (PJ – Litch Tap)
PrattsJct J136 BF	115	Pratts T5 + T6 + T7 115-69 kV autos + J-136S
PrattsJct 2110 BF	115	Pratts T5 + T6 + T7 115-69 kV autos + J-136 (PJ – Litch Tap)
PrattsJct 38-42 BF	115	L-138W + P-142N
PrattsJct 37-41 BF	115	K-137W + O-141N
115 kV Capacitor Banks		
Bear Swamp Cap #1	115	Bear Swamp 63 Mvar Cap Bank
Bear Swamp Cap #2	115	Bear Swamp 63 Mvar Cap Bank
115 kV Line-End Open Contingencies		
1242 Mont-open	115	Montague – Berkshire
1242 Berk-open	115	Montague – Berkshire
1231 Berk-open	115	Berkshire – Cumberland
1231 Cumb-open	115	Berkshire – Cumberland
A-127 Millb-open	115	A-127 (Millbury – Tower 510)
B-128 Millb-open	115	B-128 (Millbury – Tower 510)
I135 Flagg-open	115	I-135 (Flagg Pd – Chinook)
I-135 Fitz-open	115	I-135 (Fitzwilliam – Chinook)
J136S Flagg-open	115	J-136S (Flagg Pd – Litchfield St Tap)
O141N Wach-open	115	O-141N (Wachusett – Sterling)
O141N Pratts-open	115	O-141N (PrattsJct – Sterling)
P142N Wach-open	115	P-142N (Wachusett – Sterling)
P142N Pratts-open	115	P-142N (Pratts Jct – Sterling)
P142S Milb-open	115	P-142S (Millbury – Wyman Gordon)
P142S Bloom-open	115	P-142S (Rolfe Ave. – Bloomingdale Tap)
P142S Rolfe-open	115	P-142S (Rolfe Ave – Bloomingdale Tap)
E131 Bear-open	115	E-131 (Bear Swamp – Bear Swamp Jct)
E131 Adams-open	115	E-131 (Adams – Bear Swamp Jct)
F132 Doreen-open	115	F-132 (Doreen – Partridere)
W-175 Carp-open	115	W-175 (Carpenter Hill – W Charlton)
W-175 Palm-open	115	W-175 (Palmer – Little Rest Rd)
X-176 Palm-open	115	X-176 (Palmer – Thorndike)
X-176 Ludlow-open	115	X-176 (Ludlow – Thorndike)
115 kV Breaker Open Contingencies		
A127W Harriman	115	Harriman - Cabot Jct
J136S Pratts	115	Pratts Jct – Litchfield tap
I135N-Bellows	115	Bellows Falls – Fitzwilliam Tap
J136N-Bellows	115	Bellows Falls – E Winchendon
E131-harriman	115	Harriman – Bear Swamp Jct
B128-harriman	115	Harriman – Cabot Jct
Y177-harriman	115	Harriman – Sherman
Harriman T3 115 kV	115	Harriman T3 115 kV winding - Midpoint
115 kV Bus Faults		

CONTINGENCY NAME	kV	DESCRIPTION
Harriman Bus #1	115	A-127 open ended + B128 open ended + GSU # 1 + #2 (Post-Harriman Tie breaker)
Harriman Bus #2	115	E-131 open ended + Y-177 open ended + T3 open ended (Post-Harriman Tie breaker)
Pratts Bus #1	115	
Pratts Bus #2	115	
		69 kV Transmission Lines
A-1	69	Otter River – Chestnut Hill
A-1N	69	Chestnut Hill – Vernon
A-1S	69	PrattsJct – Otter River
B-2N	69	Park St – Vernon
B-2S	69	PrattsJct – Park St (Gardner)
D-4N	69	Vernon – QP660
D-4S	69	QP660- Deerfield 4
E-5	69	Meadow St. – Ware
E-5D	69	Shutesbury – Deerfield 4
E-5E	69	Millbury – Meadow St
E-5W	69	Ware – Shutesbury
F-6	69	Meadow St. – Ware
F-6E	69	Millbury – Meadow St
F-6W	69	Ware – Deerfield 4
J-10	69	Adams – Deerfield 5
M-39	69	Fitch Rd – Wachusett
N-40	69	Fitch Rd – PrattsJct
N-14	69	Palmer – E Longmeadow
O-15N	69	Palmer – Ware
O-15S	69	W Hamden - E Longmeadow
Y-25N-1	69	Searsburg – Searsburg Wind
Y-25N-2	69	Bennington – Deerfield Wind
Y-25S	69	Deerfield 5 – Harriman – Searsburg
		69 kV Breaker Failures
Pratts A1S BF	69	A-1S + U-21S + N-40 + open end 69 kV side of Pratts 115/69 kV transformer bank #1
Pratts B2S BF	69	B-2S + V-22S + open 69 kV side of Pratts 115/69 kV transformer bank #2
Pratts 160 BF	69	Pratts 115/69 kV transformer bank #2 + Open end A-1S + N-40 + U-21S
Pratts 260 BF	69	Pratts 115/69 kV transformer bank #2 + Open end B-2S + V-22S
Pratts Tie BF	69	PrattsJct 69 kV busses #1 and #2 (open all lines and transformers at PrattsJct 69 kV)
Pratts U21 BF	69	U-21S + N-40 + open end 69 kV side of Pratts 115/69 kV transformer bank #1 + open end A-1S
Pratts V22 BF	69	V-22S + open end B-2S + open 69 kV side of Pratts 115/69 kV transformer bank #2
Deerfield #4 540	69	E-5D + Deerfield 69 kV bus (open end all other facilities out of Deerfield 69 kV)
Deerfield #4 640	69	F-6W + Deerfield 69 kV bus (open end all other facilities out of Deerfield 69 kV)
Crystal Lake B2S BF	69	B-2S + Crystal Lake T1 (69/13kV)
Crystal Lake B2N BF	69	B-2N + Crystal Lake T2 (69/13kV)
Searsburg Y25 BF	69	Y-25N-1 + Y25S
Deerfield Wind Y25-1 BF	69	Searsburg Wind + Y-25N-1 + Y-25N-2 open ended
Deerfield Wind Y25-2 BF	69	Searsburg Wind + Y-25N-2 + Y-25N-1 open ended
Deerfield Wind Y25-Tie BF	69	Searsburg Wind + Y-25N-1 + Y-25N-2
Adams 360 BF	69	Adams 115/69kV Autotransformer + J-10
Chestnut Hill 230 BF	69	A-1N + A-1 open ended + T2
Chestnut Hill 130 BF	69	A-1 + A-1N open ended + T1
Otter River A1 BF	69	A-1 + A-1S open ended
Otter River A1S BF	69	A-1S + A-1 open ended
Harriman 3810 BF	69	Y-25S + Harriman G3 + Harriman 115/69kV Autotransformer
Vernon A1 BF	69	A-1N + GSU #1
Vernon B2 BF	69	B-2N + D-4 open ended + GSU #2
Vernon D4 BF	69	B-2N + D-4 open ended + GSU #2
Vernon Tie BF	69	All lines (A-1N, B-2N, D-4) open ended + GSU #1 & #2
Bennington Y25 BF	69	Y-25N-2 + Benn 115/69kV Autotransformer + Benn Cap #2
		69 kV Line-End Open Contingencies
E-5E Mill-open	69	Millbury – Pondville
E-5 Meadow-open	69	Meadow St – Harrington St
E-5W Ware-open	69	Ware - Shutesbury
F-6E Mill-open	69	Millbury - Pondville
F-6 Meadow-open	69	Meadow St. – Lashaway
F-6W Ware-open	69	Ware – Belchertown

CONTINGENCY NAME	kV	DESCRIPTION
69 kV Breaker Open Contingencies		
A-1 Otter River	69	Royalston – Otter River
A-1S Otter River	69	Otter River – E Westminster
A1 Chestnut Hill	69	Chestnut Hill – Royalston
A1S Pratts Jct	69	Pratts Jct – E Westminster
B2S Pratts Jct	69	Pratts Jct – E Westminster
B-2S Crystal Lake	69	Crystal Lake - Westminster
B-2N Crystal Lake	69	Crystal Lake – Otter River
E5D Deerfield 4	69	Deerfield 4 – Deerfield 3
F6 Meadow St	69	Meadow St - Lashaway
F6 Shutesbury	69	Shutesbury – Deerfield 2
F6W Deerfield 4	69	Deerfield 4 – Deerfield 3
Harriman T3 69 kV	69	Harriman T3 69 kV winding - Midpoint
Y25 Searsburg	69	Searsburg North bus - Searsburg South bus
Y25 Deerfield 5	69	Deerfield 5 – Hoosic Wind Tap
69 kV Bus Faults		
Pratts Bus #1	69	
Pratts Bus #2	69	
Vernon #1	69	A-1 open ended at Vernon + GSU #1
Vernon #2	69	B-2 and D-4 open ended at Vernon + GSU #2
Deerfield #4	69	All lines open ended at Deerfield 4 (E-5, F-6, D-4)
69 kV Double Ckt Towers		
A1S+B2S	69	
A1S+B2N	69	
A1+B2N	69	
A1N+B2N	69	
E5E+F6E DCT	69	
E5+F6 DCT	69	
E5W+F6W DCT	69	
E5D+F6W DCT	69	
Generators/GSU		
Harriman Hydro (VT)	115/6.9	GSU 1
Harriman Hydro (VT)	115/6.9	GSU 2
Harriman Hydro (VT)	115/6.9	GSU 3
Cabot Hydro (MA)	115/13.8	Cabot GSU
Northfield (MA)	345/13.8	GSU #1 Unit 1 + Unit 2
Northfield (MA)	345/13.8	GSU #2 Unit 3 + Unit 4
Altresco (MA)	115/13.8	Unit 1 + Unit 2
Altresco (MA)	115/13.8	Unit 3 + Unit 4
Vernon Hydro #1 (VT)	69/13.8	GSU #1
Vernon Hydro #2 (VT)	69/13.8	GSU #2
Seabrook	345	
Bear Swamp G1/P1	230 kV	Bear Swamp Generator/Pump #1
Bear Swamp G2/P2	230 kV	Bear Swamp Generator/Pump #2
Millenium GT + ST	115 kV	Millennium Gas Turbine + Steam Turbine Unit

5.4.2 N-1-1 Contingency List

The following table lists the contingencies that was tested as the first line out in N-1-1 contingency analysis. In each line-out case, all contingencies described in previous section is tested as the second contingency.

Table 15 - N-1-1 Contingency List

Initial facility out (N-1), one at a time	Second Contingency (N-1-1)
Each transmission circuit (69 kV and above) tested in N-1 analysis Each transmission transformer (115/69 kV and above) tested in N-1 analysis Each Generator (connected to 69 kV and above) tested in N-1 Analysis Loss of Seabrook G1 Loss of Sandy Pond HVDC Pole 1 Loss of Sandy Pond HVDC Pole 2 Shunt Device	All contingencies listed in Table 14 except: Non BPS* Double Circuit Towers Non BPS* Breaker Failures Non BPS* Bus sections Line-End-Open Contingencies

*** Non** BPS **equipment is defined as any line or device that is not terminated at a BPS station**

Steady State Results

5.4.3 N-0 Thermal and Voltage Results

N-0 Thermal Results

Simulation results indicate that addition of the Group 3 DER, incemental to the Groups 1+2 DER, results in several transmission facility overloads during all-lines-in conditions as shown in table below.

Table 16 - N-0 Thermal Overloads

Worst case Loading at or above 100% of LTE Rating				Base case
Overloaded Facility	**KV**	**Summer Normal Rating**	**Loading (% LTE)**	
B-2 [Pratts Jct – E Westminster] (2/0 Cu O/H line)	69	[redacted]	[redacted]	25pk-we-pv=100% + BESS discharge
				25sh-we_ PV=100% + BESS discharge
				25ll-we_ PV=100% + BESS discharge
				25sh-ew+pump PV=0% BESS Charging
B-2 [E Westminster - Westminster] (2/0 Cu O/H line)	69			25pk-we-pv=100% + BESS discharge
				25sh-we_ PV=100% + BESS discharge
B-2 [Westminster – Crystal Lake] (2/0 Cu O/H line)	69			25sh-we_ PV=100% + BESS discharge

N-0 Voltage Results

No N-0 voltage violations were found for any of the conditions tested.

N-1 Thermal and Voltage Results

N-1 Thermal Results

Simulation results indicate that addition of the Group 3 DER, incremental to the Groups 1+2 DER, results in several transmission facility overloads following N-1 contingencies as shown in table below.

Table 17 - N-1 Thermal Overloads

Worst case Loading at or above 100% of LTE Rating				Base case	CONTINGENCY (Loss of)
Overloaded Facility	KV	LTE Rating [redacted]	Loading (% LTE)		
B-2 [Pratts Jct – E Westminster] (2/0 Cu O/H line)	69		[redacted]	25pk-we-pv=100% + BESS discharge 25sh-we_ PV=100% + BESS discharge 25ll-we_ PV=100% + BESS discharge 25sh-ew+pump PV=0% BESS Charging	[redacted]
		[redacted]		25sh-we_ PV=100% + BESS discharge	
				25pk-we-pv=100% + BESS discharge	
				25pk-we-pv=100% + BESS discharge 25sh-we_ PV=100% + BESS discharge 25sh-ew+pump PV=0% BESS Charging	
B-2 [E Westminster - Westminster] (2/0 Cu O/H line)	69			25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	
B-2 [Westminster – Crystal Lake] (2/0 Cu O/H line)	69			25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	
A-1 [Otter River - Royalston] (2/0 Cu O/H line)	69			25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	

If QP1031 [redacted] goes forward, the addition of Group 3 DER results in the following additional N-1 overloads.

Table 18 – Additional N-1 Thermal Overloads

(w/ [redacted] (QP1031) and [redacted] (QP1112) In-service)

Worst case Loading at or above 100% of LTE Rating				Base case	CONTINGENCY (Loss of)
Overloaded Facility*	KV	LTE Rating	Loading (% LTE)		
E-5 [Meadow St- Leicester] (477 ACSR)	69	[redacted]	[redacted]	25pk-we-pv=100% + BESS discharge	[redacted]
F-6 [Meadow St- Leicester] (477 ACSR)	69			25pk-we-pv=100% + BESS discharge	
E-5 [Leicester - Pondville] (477 ACSR)	69			25pk-we-pv=100% + BESS discharge	
F-6 [Leicester - Pondville] (477 ACSR)	69			25pk-we-pv=100% + BESS discharge	
E-5 [Meadow St – Harrington St] (477 ACSR)	69			25pk-we-pv=100% + BESS discharge	

*All additional Overload facilities are due to the inclusion of QP1031 [redacted] only, not QP1112 [redacted].

N-1 Voltage Results

Simulation results indicate that the addition of the Group 3 DER (With or without QP1031 or QP 1112), results in several high and low voltage violations along the A1/B2 69 kV transmission circuits for several N-1 contingencies. These overloads are shown in the following table.

Table 19 - N-1 Voltage Violations

BUSSES W/ VOLTAGE VIOLATIONS		Voltage	BASE CASE	CONTINGENCY
Bus	KV	Pu		(Loss of)
E Westminster (A1)	69	1.07	25min pv=100% + BESS discharge	[redacted]
		0.88	25sh-ew+pump PV=0% BESS Charging	[redacted]
E Westminster (B2)	69	1.06	25min pv=100% + BESS discharge	[redacted]
Westminster (B2)	69	1.06	25sh-we pv=100% + BESS discharge	[redacted]
Vernon (A1/B2)	69	1.056	25min pv=100% + BESS discharge	[redacted]
Otter River (A1)	69	1.06	25min pv=100% + BESS discharge	[redacted]
		0.88	25sh-ew+pump PV=0% BESS Charging	[redacted]
Royalston (A1)	69	1.059	25min pv=100% + BESS discharge	[redacted]
		0.890	25sh-ew+pump PV=0% BESS Charging	[redacted]
Chestnut Hill (A1)	69	1.053	25min pv=100% + BESS discharge	[redacted]
		0.89	25sh-ew+pump PV=0% BESS Charging	[redacted]
Crystal Lake (B2)	69	1.07	25sh-we pv=100% + BESS discharge	[redacted]
		1.054	25sh-we pv=100% + BESS discharge	[redacted]

Appendix D provides the full N-0 and N-1 thermal and steady state voltage results.

5.4.4 N-1-1 Steady State Results

N-1-1 Thermal Results:

One additional thermal overload on the A-1 circuit (over and above that found for N-1 contingencies) was identified for N-1-1 contingencies. This occurs with or without [redacted] (QP1031) or [redacted] (QP1112) In-service.

Table 20 – N-1-1 Thermal Overloads (Incremental to N-1 Overloads)

Worst case Loading at or above 100% of LTE Rating				Base case	1st CONTINGENCY (Loss of)	2nd CONTINGENCY (Loss of)
Overloaded Facility	**KV**	**LTE Rating**	**Loading (% LTE)**			
A-1S [Pratts Jct – E Westminster] (2/0 Cu O/H line)	69	[redacted]	[redacted]	25sh-ew+pump PV=0% BESS Charging	[redacted]	[redacted]

Two additional thermal overloads (over and above that found for N-1 contingencies) were identified on the E-5/F-6 circuits with [redacted] (QP1031) in place.

Table 21 – Additional N-1-1 Thermal Overloads

(w/ [redacted] (QP1031) In-service)

Worst case Loading at or above 100% of LTE Rating				Base case	1st CONTINGENCY (Loss of)	2nd CONTINGENCY (Loss of)
Overloaded Facility*	**KV**	**LTE Rating**	**Loading (% LTE)**			
E-5E [Millbury- Pondville] (477 ACSR)	69	[redacted]	[redacted]	25ll-we-pv=100% + BESS discharge 25pk-we-pv=100% + BESS discharge	[redacted]	[redacted]
F-6E [Millbury- Pondville] (477 ACSR)	69	[redacted]	[redacted]	25ll-we-pv=100% + BESS discharge 25pk-we-pv=100% + BESS discharge	[redacted]	[redacted]

*All additional Overload facilities are due to the inclusion of QP1031 [redacted] only, not QP1112 [redacted].

N-1-1 Voltage Results:

No additional voltage problems (over and above those found for N-1 contingencies) were identified for N-1-1 contingencies. This is true with or without [redacted] (QP1031) or [redacted] (QP1112) In-service.

Transmission Upgrades Required for Group 3 DER

- **A1/B2 line rebuild/reconductor:** The thermal overloads identified on the A1/B2 69 kV transmission lines will be eliminated by an asset condition project already scheduled for the A1/B2 lines which involves the complete rebuild of the lines using 795 ACSS conductor (ISD 2027)

- **Royalston Breaker Additions**: 69 kV breaker additions at Royalston substation are needed to eliminate voltage violations along the A1/B2 lines caused by the Group 3 DER after the A1/B2 rebuild is complete. These breaker additions are already required as part of the asset condition project to rebuild of the A1/B2 lines. Note that with the Royalston breakers in place, along with the rebuilt A1/B2 lines, the Chestnut Hill 69 kV substation will be supplied via two radial taps from A1 and B2 (unlike the existing supply to Chestnut Hill substation, which involves a loop through of the A-1 line). This new arrangement is shown in the following one-line diagram. The Chestnut Hill substation is also scheduled to be rebuilt in 2026 due to asset condition issues.

- **Vernon 69 kV substation rebuild**: 69 kV equipment at Vernon substation must be upgraded to eliminate overloads on the A-1N and B-2N 69 kV circuits. These overloads occur when both DER Group 3 is connected, and the A1/B2 are reconductored (decreases impedance). There is an asset condition project already planned to rebuild Vernon station (which will be named "Huntington" substation) in 2026, which will eliminate the overloads.

- **E5/F6 line rebuild/reconductor:** The thermal overloads on the E5/F6 69 kV transmission lines caused by the combination of [redacted] (QP1031) and Group 3 DER will be eliminated by the rebuild of both E5/F6 lines and reconductor with 795 ACSS conductor. The rebuild of both E5/F6 lines is already planned due to asset condition issues, and will be completed by year 2030. Note that if QP1031 is withdrawn, Group 3 DER does not cause the E5/F6 lines to become overloaded.

Figure 9 – Asset Condition Projects Planned for A1/B2 69 kV Corridor

[redacted]

5.5 Group 3 DER that Can't Connect until Transmission Upgrades are Built

The following Group 3 DER can't interconnect until the A-1/B-2 69 kV transmission lines are rebuilt, the Royalston Breakers installed, and the Vernon substation is rebuilt:

PPA ID	ISO QP Number	NGrid Case Number	Developer/Project Name	Substation
NEP-22-G03-036	1174	290747	[redacted]	Crystal Lake
NEP-22-G03-037	1175	301762		East Westminster
NEP-22-G03-041	1183	318176		Royalston

If [redacted] (QP1031) goes in-service, the following Group 3 DER can't interconnect until the E5/F6 69 kV line rebuild is completed:

PPA ID	ISO QP Number	NGrid Case Number	Developer/Project Name	Substation
NEP-22-G03-028	1177	281385	[redacted]	Lashaway
NEP-22-G03-029	1177	283873		Lashaway
NEP-22-G03-032	1179	178171		Meadow Street
NEP-22-G03-031	1179	178483		Meadow Street
NEP-22-G03-030	1179	193213		Meadow Street
NEP-22-G03-022	1188	178170		Ware
NEP-22-G03-023	1188	191401		Ware
NEP-22-G03-024	1188	191403		Ware
NEP-22-G03-025	1188	191405		Ware

6 TRANSIENT STABILITY ANALYSIS

Stability testing was performed with all Group 1, 2 and 3 DER in-service, along with the transmission upgrades required for the interconnection of Group 3 DER, described in the previous sections. The stability testing was performed according to all applicable reliability standards. The purpose of the testing is to verify that the addition of the Group 3 DER and associated transmission upgrades do not cause significant adverse impact on the stability of the New England transmission system.

PSS/E Rev 34 was used to conduct the stability simulations.

6.1 Stability Performance Criteria

Normal Contingency (NC) Criteria

- Both system wide stability and individual unit stability must be maintained for all normal design contingencies. Individual generating units ≥ 5 MW or any set of units totaling more than 20 MW shall not lose synchronism or trip off due to voltage, frequency or other protection, except for the units that are tripped for fault clearing.
- A 53% reduction in the magnitude of system oscillations must be observed over four periods of the oscillation.

Bulk Power System (BPS) Testing

BPS testing is performed to determine the impact of the Project on facilities classified as part of the Bulk Power System (BPS), in accordance with revision 2 of the NPCC Document A-10, dated March 27, 2020, "Classification of Bulk Power System Elements". The criteria for BPS testing are as follows.

Acceptable BPS Reponses

- A 53% reduction in the magnitude of system oscillations observed over four periods.
- Loss of source up to 1200 MW

Unacceptable BPS Reponses

- Transiently unstable, with wide spread system collapse.
- Transiently stable, with undamped or sustained power system oscillations.
- Loss of source greater than 1200 MW.

NEPOOL Voltage SAG Guidelines

For Normal Contingenciess, the minimum post-fault positive sequence voltage sag must remain above 70% of nominal voltage and must not exceed 250 milliseconds below 80% of nominal voltage within 10 seconds following a fault. These limits are supported by the typical sag tolerances shown in IEEE Standard 1346-1998.

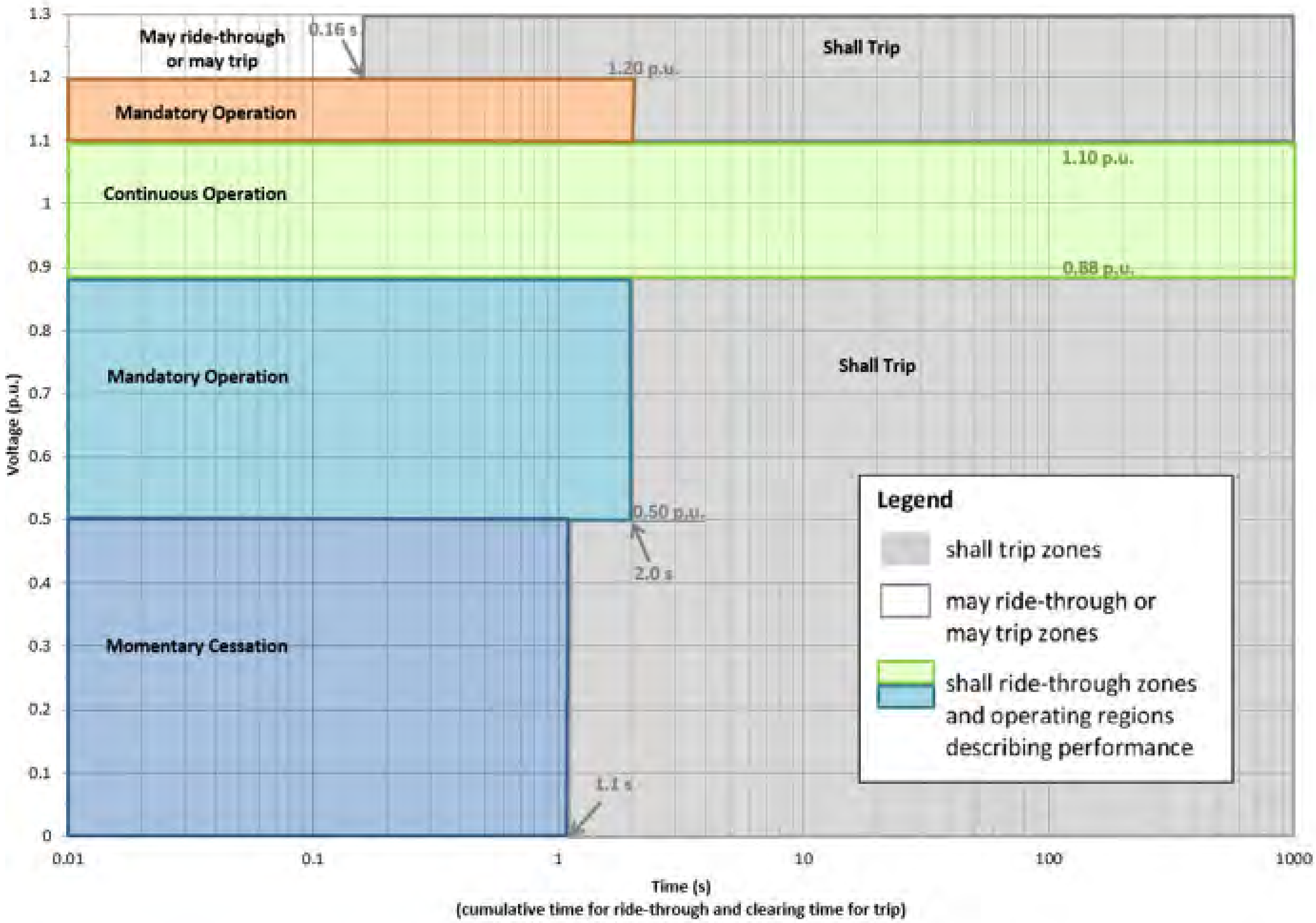
6.2 Voltage and Frequency Ride-Through Capability of DER

Groups 1, 2 and 3 DER do not have the same ride-through requirements. Groups 1 and 2 had an earlier version "Source Requirements Document" (SRD) applied to their interconnection requirements compared to the SRD applied to Group 3.

6.2.1 Voltage Ride-Through Capability for Groups 1 and 2 DER

The Voltage Ride-Through capability of Groups 1 and 2 DER were modeled according to the SRD that was applied to their interconnection, which is shown below.

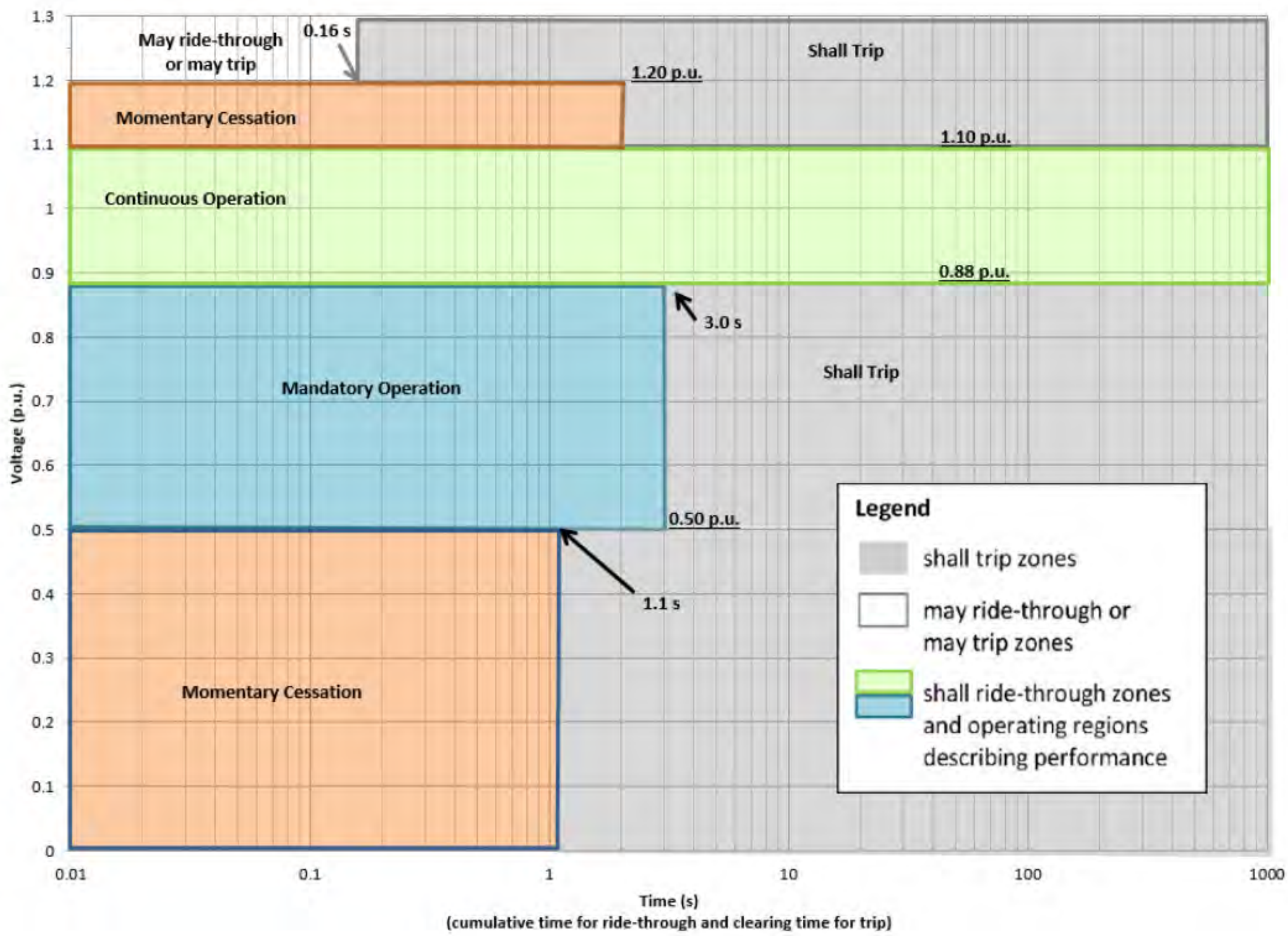
Figure 10 - Groups 1 and 2 Voltage Ride-Through Capability Curve



6.2.2 Voltage Ride-Through Capability for Group 3 DER

The Voltage Ride-Through capability of Group 3 DER is shown below. Note that the SRD was revised for Group 3 of the Western MA Cluster DER. Note that the only change pertaining to voltage ride-through in the revised SRD is that it extends the "Mandatory Operation" region from 2.0 seconds to 3.0 seconds. All Group 3 DER were modeled according to this voltage ride through curve.

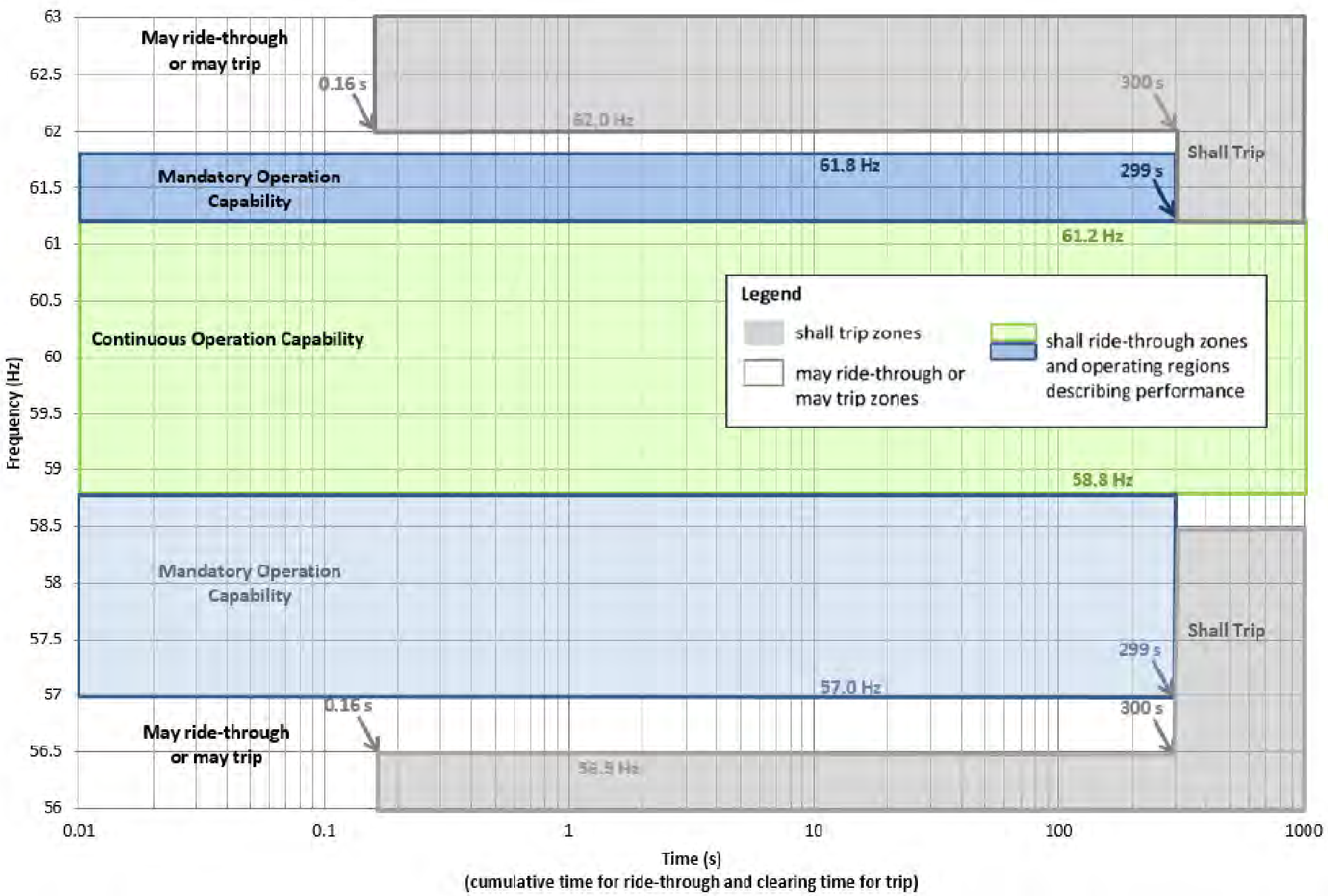
Figure 11 - Group 3 Voltage Ride-Through Capability Curve



6.2.3 Frequency Ride-Through Capability for Group 1, 2 and 3 DER

The Frequency Ride-Through requirement in the revised SRD for Group 3 is the same as in the SRD applied to Group 1 and 2. This frequency ride-through requirement curve is shown below. It was applied to all DER in Group 1, 2, and 3.

Figure 12 – Groups 1, 2, and 3 Frequency Ride-Through Curve



6.3 Frequency Response Requirement for Group 3 DER

The revised SRD for Group 3 requires that this DER respond to frequency deviations via a droop characteristic. No such requirement applies to Groups 1 and 2. Group 3 DER therefore was modeled with frequency response enabled in the stability simulations. Below are the Frequency-Droop control settings specified in the revised SRD for Group 3 DER.

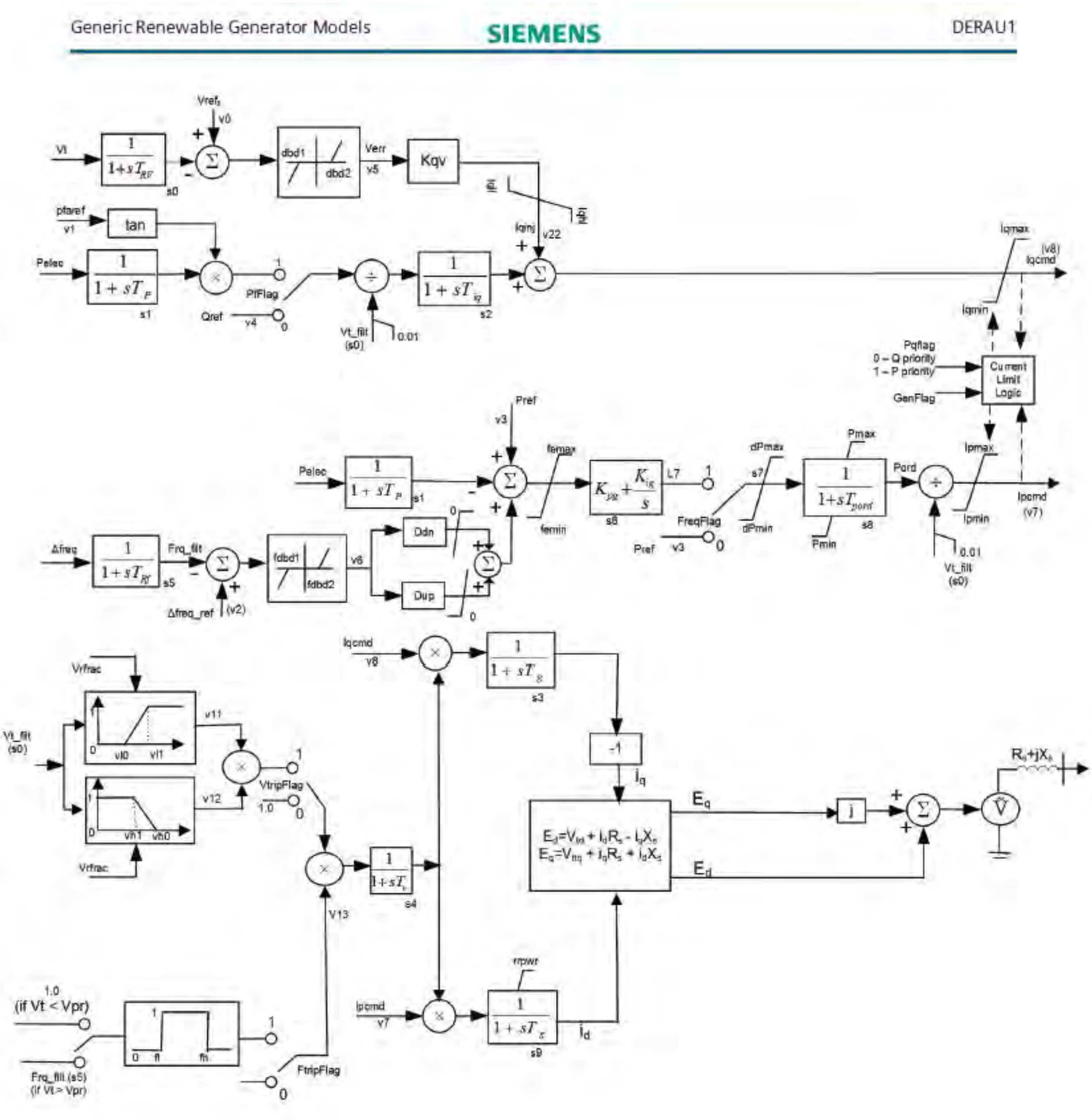
Frequency-Droop Control Settings required for Group 3 DER

Parameter	Inverter
dbOF, dbUF (Hz)	0.036
kOF, kUF (Droop)	0.05
T-response (small-signal) (s)	5

6.4 Stability Models for Group 1, 2, and 3 DER Between 1MW and 5MW

For Group 1, 2 and 3 DER greater than 1 MW, and less than 5 MW, this generation was modeled with the DER_A model. The block diagram of the DER_A model is shown in the following figure.

Figure 13 - DER_A Model Block Diagram



The input data that was used for the DER_A model is shown below. The parameters related to inverter dynamics characteristics are selected based on the latest guideline document from NERC.[8] The parameters related to voltage and frequency trip settings are selected such that the inverter complies with the voltage and frequency ride-through requirement of National Grid SRD.

Table 22 - DER_A Model Parameters Assumed for Study

Parameters	Value		Notes
	Group 1 and 2 DER	Group 3 DER	
trv	0.02	0.02	Voltage Transducer Time constant (default)
trfs	0.02	0.02	Frequency measurement transducer time constant (not in NERC guidance document, but assumed 0.02, same as Voltage Transducer Time constant)
dbd1	-99	-99	No voltage control will be modeled (default)
dbd2	99	99	No voltage control will be modeled (default)
kqv	0	0	No voltage control will be modeled (default)
vref0	0	0	No voltage control will be modeled (default)
tp	0.02	0.02	Power Transducer Time constant (default)
tiq	0.02	0.02	Q control Transducer Time constant (default)
ddn	0	20	reciprocal of droop for over-frequency conditions
dup	0	0 or 20	reciprocal of droop for under-frequency conditions (0 for solar and wind units. 20 for storage device)
fdbd1	-99	-0.0006	deadband (default)
fdbd2	99	0.0006	deadband (default)
femax	0	99	Freq error up limit (default)
femin	0	-99	Freq error low limit (default)
pmax	1	1	1 for wind, solar and battery units
pmin	0 or -1	0 or -1	0 for wind, solar units. -1 for battery units
dpmax	99	99	Power reference max ramp rate (default)
dpmin	-99	-99	Power reference min ramp rate (default)
tpord	0.02	5	Power Filter Open loop time constant (default)
kpg	0	0.1	Not mappable to interconnection standards (0, for no frequency control)
kig	0	10	Not mappable to interconnection standards (0, for no frequency control)
imax	1.2	1.2	Maximum converter current (typical inverter max output)
vl0	0.50	0.50	Voltage at head of feeder at which DER at head of feeder starts tripping.
vl1	0.55	0.55	Voltage at head of feeder at which DER at tail of feeder trips. Assume 5% voltage drop across Feeder. Amount of DER dropped will follow a linearly increasing amount until vl0, when all will be dropped
vh0	1.15	1.15	Voltage at head of feeder at which DER at tail of feeder trips. Assume 5% voltage drop across feeder
vh1	1.1	1.1	Voltage at head of feeder at which DER at head of feeder starts tripping. Amount of DER dropped will follow a linearly increasing amount until vh0, when all will be dropped

[8] https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Reliability_Guideline_DER_A_Parameterization.pdf

Parameters	Value		Notes
	Group 1 and 2 DER	**Group 3 DER**	
tvl0	1.1	1.1	low voltage cut-out timer corresponding to voltage vl0
tvl1	1.1	1.1	low voltage cut-out timer corresponding to voltage vl1
tvh0	2.0	2.0	High voltage cut-out timer corresponding to voltage vh0
tvh1	2.0	2.0	High voltage cut-out timer corresponding to voltage vh1
vrfrac	1	1	Per unit of DER that comes back after tripping (1 = 100% of DER comes back online if terminal voltage recovers above vlo (0.5 pu) within 1.1 seconds; 0 = 100% of DER is tripped permanently if terminal voltage does not recover above vlo (0.5 pu) within 1.1 seconds). The same logic holds true for voltages that exceed vh1.
fltrp	57.0	57.0	Frequency trip settings per National Grid SRD
fhtrp	62.0	62.0	
tfl	0.16	0.16	
tfh	0.16	0.16	
tg	0.02	0.02	† current control time constant (inner control loops) (default)
rrpwr	2.0	2.0	Ramp rate for real power increase following a fault (pu/S) as per 1547-2018 to achieve 80% recovery in 0.4 sec
tv	0.02	0.02	time constant on the output of the multiplier (time delay for partial tripping) (default value)
vpr	0.7	0.7	Low voltage inhibit on frequency tripping (due to spurious spikes that occur in positive sequence stability models) - **NOTE: all frequency tripping during simulations should be double checked for tripping due to spurious frequency spikes**
iqh1	0	0	No voltage control
iql1	0	0	No voltage control
pfflag	1	1	Constant power factor (based on initial value from steady state model)
frqflag	0	1	Freq control (1 to enable, 0 to disable)
pqflag	1	1	Active current (P) priority (during large disturbances)
Genflag	1 or 0	1 or 0	1 for Generator (0 is for storage device)
vtripflag	1	1	Enables voltage trip logic
ftripflag	1	1	Enables frequency trip logic

Note that all Group 3 DER will respond to frequency deviations, while all Group 1 and 2 DER will not, due to differences in the SRD between the groups.

All DER greater than 1 MW, but less than 5 MW, is modeled aggregately as a single equivalent generator, at the distribution bus of each substation to which it is connected. The MW size of the single equivalent generator, at a specific substation, is equal to the total amount of DER (greater than 1 MW but less than 5 MW) to be connected to that substation. No distribution feeder impedance is modeled between the equivalent generator and the distribution bus to which it is connected.

6.5 Stability Models of Group 1 and 2 DER Equal to 5MW and Greater

The Group 1 and 2 DER, equal to, or greater than 5 MW, were modeled with the same PSS/E library models as used for the Group 2 study.

These generators were modeled as individual generators combined with their equivalent collection system and GSU at the low side of the substation to which they will be connected through.

These generators were modeled with a standard PSS/E library model set consisting of the following modules:

REGCA – Renewable Energy Generator/Converter Model
REECA – Renewable Energy Electrical Model
REPCA – Plant Controller model

The following projects below exceeded 5 MW for Group 2.

Table 23 - Group 2 DER Greater than 5MW

Substation	Size (MW)
Shutesbury	10.0

The following projects below exceeded 5 MW for Group 1.

Table 24 - Group 1 DER Greater than 5MW

Substation	Size (MW)
Belchertown	8
Lashaway	6
Snow Street	12
Wendell Depot	5

6.6 Stability Models for Group 3 DER Equal to 5MW and Greater

The Group 3 DER, equal to, or greater than 5 MW, were modeled with the following library models for inverter based resources available in PSS/E Rev34.

1.) Renewable Energy Generator/Converter Model: REGC_B
2.) Renewable Energy Electrical Model: REEC_D
3.) Plant Controller model: REPCA

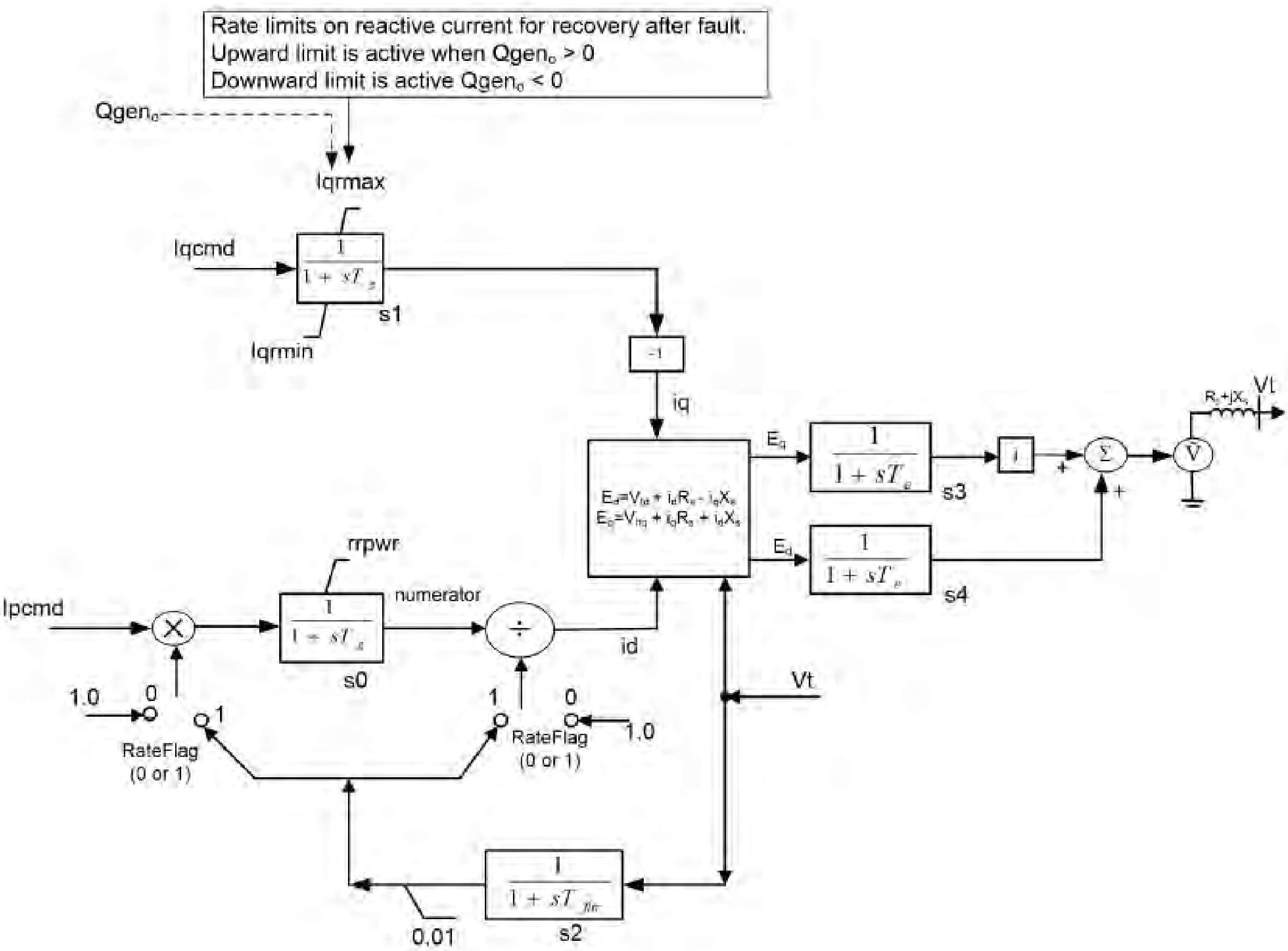
The following projects below exceeded 5 MW for Group 3.

Table 25 - Group 3 DER Greater than 5MW

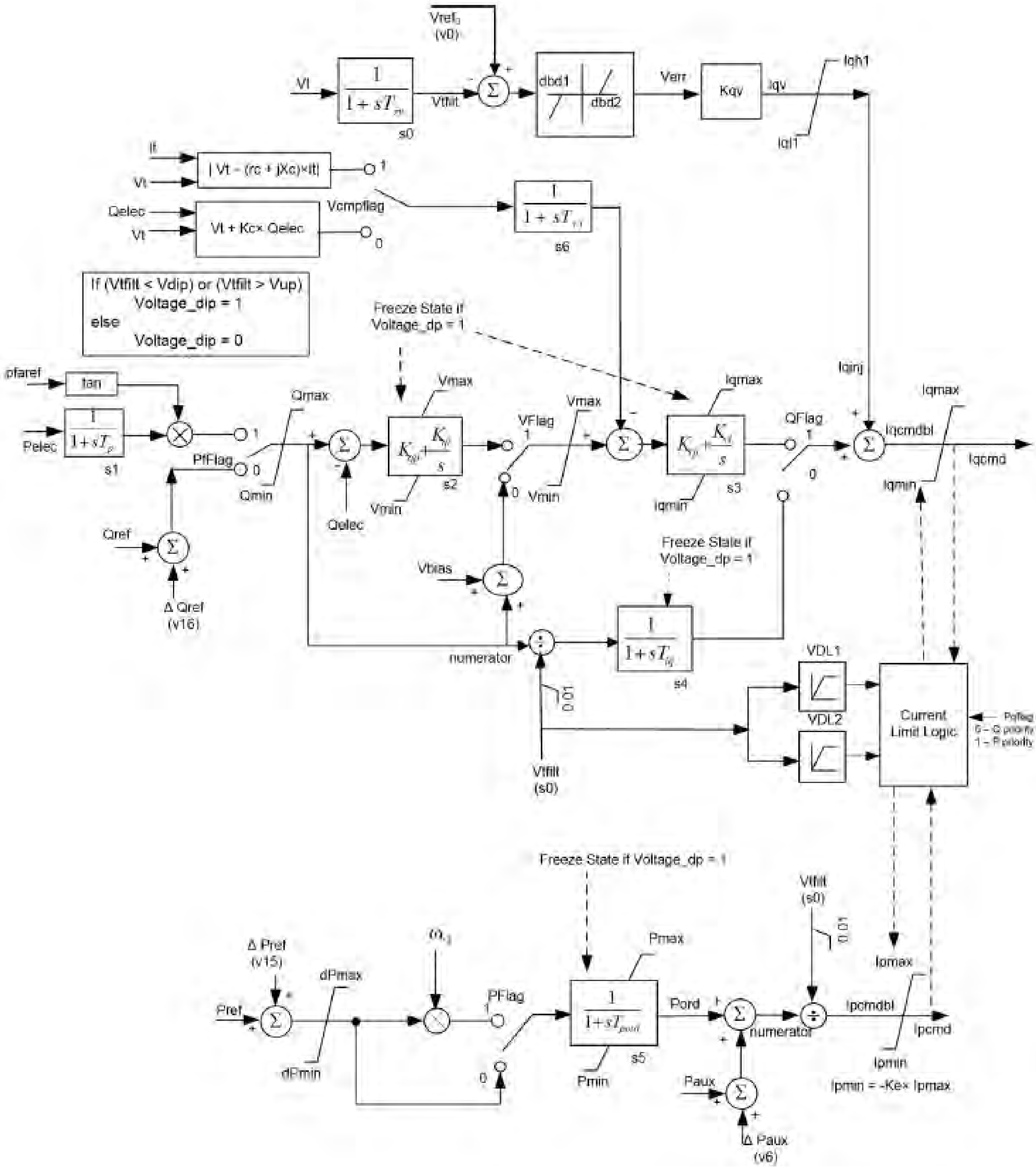
PPA ID	Substation	Type	Size (MW)	
			Discharging Limit	Charging Limit
NEP-22-G03-034	Barre	BESS only	8	8
NEP-22-G03-036	Crystal Lake	BESS only	8	5.2
NEP-22-G03-038	East Winchendon	BESS only	9.4	4.6
NEP-22-G03-039	East Winchendon	BESS only	5.5	4.2
NEP-22-G03-029	Lashaway	BESS only	10	7
NEP-22-G03-008	Laurel Circle	BESS only	8	4.4
NEP-22-G03-009	Millbury	BESS only	10	3.5
NEP-22-G03-011	North Oxford	BESS only	8	6.4
NEP-22-G03-013	North Oxford	BESS only	5.6	4.8
NEP-22-G03-006	Pratts Junction	BESS only	6	4.5
NEP-22-G03-041	Royalston	AC Coupled	5	0
NEP-22-G03-015	Snow St	BESS only	5	2.5
NEP-22-G03-016	Snow St	BESS only	5	2.5
NEP-22-G03-017	Snow St	BESS only	5.5	6.5
NEP-22-G03-001	Stafford St	DC Coupled	5	5
NEP-22-G03-033	Treasure Valley	BESS only	10	5
NEP-22-G03-020	West Charlton	BESS only	5	4.5
NEP-22-G03-021	West Charlton	BESS only	10	4
NEP-22-G03-044	Wendell Depot	BESS only	8	7.2
NEP-22-G03-043	Wendell Depot	BESS only	10	8

The block diagrams for these models are shown in the following figures.

REGC_B Block Diagram [Source: PSS/E]

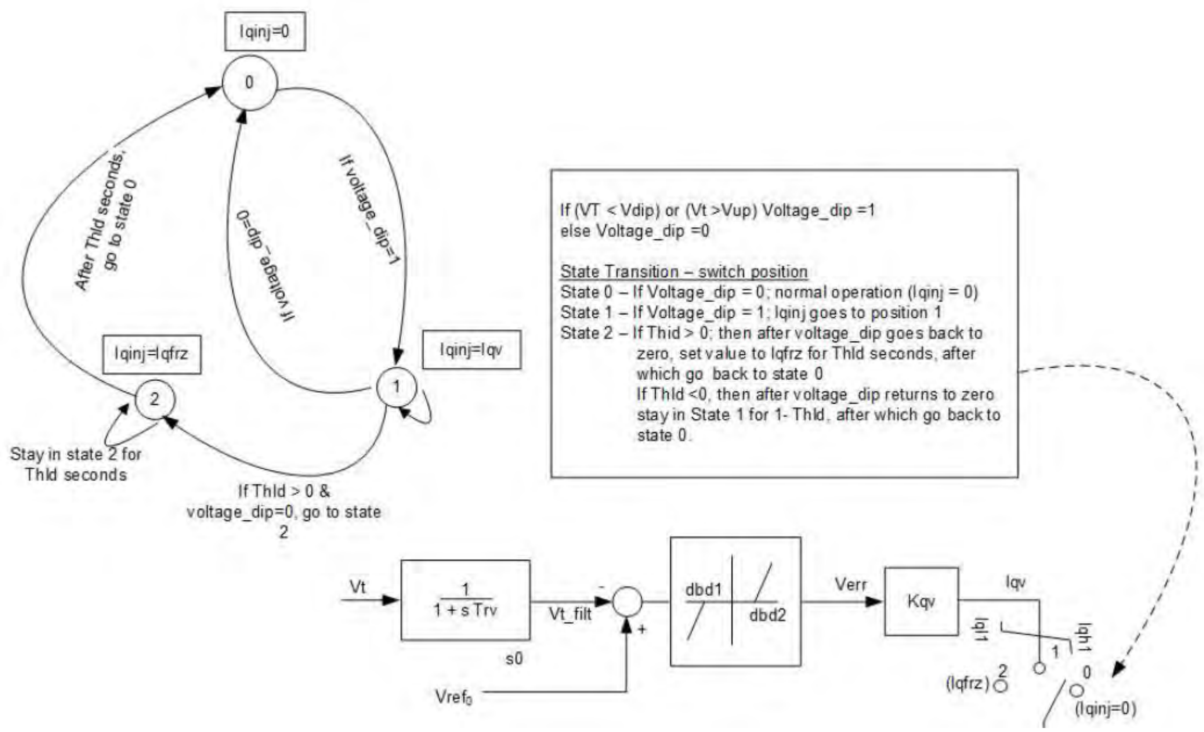


REEC_D Block Diagram [Source: PSS/E]

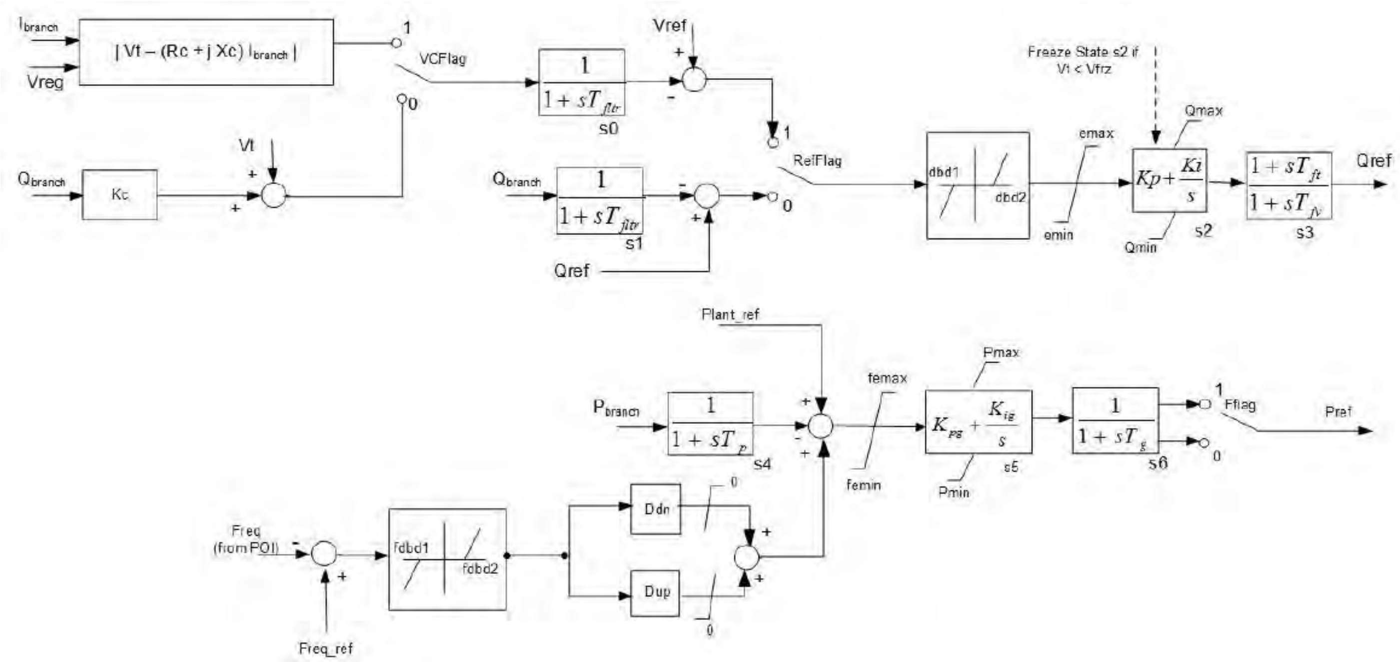


REEC_D Block Diagram – Continued:

REEC_D Block Diagram continued:
State Transition Diagram for dynamic voltage support during high or low voltage conditions



REPC_A Block Diagram [Source: PSS/E]



6.7 Stability Analysis Case Development

In order to investigate the impact of the proposed Group 3 DER on the New England transmission system, two base cases representing the 2026 summer peak load levels and two base cases representing the 2026 light load levels, were developed for this study.

Four base cases derived from the 2026 light load levels were also developed to determine if any existing substations, that are not part of the NPCC Bulk Power System (BPS) become part of the BPS as a result of the addition of Group 3 DER.

Year 2026 ISO-NE dynamics cases (PSS/E Rev 34), released in April 2021, were used for this transient stability assessment.

6.8 Stability Case Summaries

The following table summarizes the interface levels and generation dispatches for the stability base cases that includes Group 1,2 and 3 DER.

Table 26 - Stability Case Summaries for Design Contingency Testing

Interface Name	Interface Flows (MW)			
	Peak Load Case		Light Load Cases	
	23pk-ew	23pk-we	23ll-ew	23ll-we
NB-NE	808	1017	1013	1013
ORR_SOUTH	1375	1189	1326	1326
SURW_SOUTH	1359	1183	1611	1667
ME-NH	1996	1203	1978	2035
EAST-WEST	3104	-3072	3917	-2527
NE-NY	1290	-1467	1223	-1303
NNE-SCOB+394	3658	2961	3021	1697
NORTH-SOUTH	3724	2826	4060	1682
SEMA/RI – NE	2746	-2559	1121	-1255
HIGHGATE_IMP	224	224	224	224
SNDYPD_IMP	2000	2000	2000	0
CT IMPORT	3412	309	563	-144
Cross sound cable Export to NY	101	101	101	101
Bear Swamp	666	666	-666	0
Northfield	1180	1180	-1000	0
Altresco	197	197	197	197
Millennium	412	412	OOS	285

Table 27 - Stability Light Load Case Summaries for BPS Simulations

Interface Name	Interface Flows (MW)			
	WMAVT	BOS	ME_C	SEMA
NB-NE	1013	1013	1013	1013
SURW_SOUTH	1663	896	1252	897
ME-NH	1437	1255	1609	1256
EAST-WEST	-1578	3790	3867	4179
NE-NY	1054	1210	1279	1429
NNE-SCOB+394	3176	2678	3089	2447
NORTH-SOUTH	2980	2559	3237	2066
SEMA/RI - NE	-1816	2367	1743	3174
HIGHGATE_IMP	224	224	224	224
SNDYPD_IMP	0	2000	2000	2000
CT IMPORT	401	1100	1100	1148
Cross sound cable Export to NY	101	101	101	101
Bear Swamp	666	-666	-666	-666
Northfield	1180	-1100	-1100	-1100
Alresco	197	197	197	197
Millenium	412	0	0	0

6.9 Stability Study Matrix

To test the impact of the DER, Group 1,2 and 3 DER were added to each case, according to the following table, and dispatched against generation in Connecticut. Dispatching the DER against Connecticut will maintain the same East-West, and NY-NE transfer levels, compared to the pre-DER base cases.

Table 28 – Study Matrix for Stability Analysis

Load Level	Bias	Group 3 DER		Group 1 and 2 DER	Pre Group 1 and 2 DER	FERC BESS projects under Study	Comments
		BESS output	PV output	PV output	PV output		
Summer Peak load	E-W	100% Charging	26%	26%	only ≥5MW projects in WMA already modeled in the basecases were turned on	[redacted] (QP1031) and [redacted] (QP1112) were modeled in the study	All 1-5MW projects were modeled using DER_A model using parameters based on the latest guideline document from NERC. All ≥ 5 MW projects were modeled using standard renewable energy models parametrized by individual project developers
	W-E	100% discharging	100%	100%			
Light Load	E-W	100% charging	26%	26%			
	W-E	100% discharging	100%	100%			
BPS	WMAVT	100% discharging	100%	100%			
	BOS						
	ME-C						
	SEMA						

6.10 BPS Contingencies

The following simulations were conducted to determine if any existing substations become classified as Bulk Power System (BPS) substations as a result of the addition of Group 3 DER. Further, whether any of the new stations, required to accommodate the interconnection of the Group 3 DER, need to meet BPS design requirements.

Table 29 - Bulk Power System (BPS) Contingencies

Contingency Name	Type	kV	Location	Clearing Times (cycles)	Protection Groups	Light Load Results			
						BOS	ME_C	SEMA	WMAVT
BS-230-BPS	BPS	230	Bear Swamp	[redacted]					
BS-115-BPS	BPS	115	Bear Swamp	[redacted]					
PJ-115-BPS	BPS	115	Pratts Jct	[redacted]					

Contingency Name	Type	kV	Location	Clearing Times (cycles)	Protection Groups	Light Load Results			
						BOS	ME_C	SEMA	WMAVT
PJ-230-BPS	BPS	230	Pratts Jct	[redacted]					
Palmer-115-BPS	BPS	115	Palmer						
Carp-115-BPS	BPS	115	Carpenter Hill						
Flagg-115-BPS	BPS	115	Flagg Pd						
Stafford-115-BPS	BPS	115	Stafford St (new)						

6.11 N-1 Stability Contingencies

Several Breaker Failure (BF) contingencies were tested. These Breaker Failures were first tested with a 3-phase initiating fault, which is categorized as an Extreme Contingency. If this test failed the performance requirements outlined in ISO-NE PP-3, a corresponding design contingency is tested (Breaker failure with single line to ground imitating fault); otherwise, no corresponding design contingency is tested.

Table 30 - N-1 Breaker Failure Contingencies

Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
BS-1205E-BF	EC	230	[redacted]						
BS-T97-BF	EC	115							

Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
ML-0802-BF	EC	345	[redacted]						
WM-105-BF	EC	345	[redacted]						
SP-3521-BF	EC	345	[redacted]						
CH-321-BF	EC	345	[redacted]						
CH-174W-BF	EC	115	[redacted]						
CH-175-BF	EC	115	[redacted]						

Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
PJ-69kV-TIE-BF	EC	69`	[redacted]						
NFLD-2T-BF	EC	345	[redacted]						
PALM-X176-BF	EC	115	[redacted]						
AD-3T5T-BF	EC	115	[redacted]						
STAFF-2728E-BF	EC	115	[redacted]						
STAFF-B128E-BF	EC	115	[redacted]						
STAFF-2728W-BF	EC	115	[redacted]						

Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
			[redacted]						

Several design contingencies were tested on the transmission system facilities located along the Western and Central Massachusetts transmission corridor.

Table 31 - N-1 Stability Design Contingencies

Contingency Name	Type	kV	Location/ Description	Clearing times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
V174-CH	NC	115	[redacted]						
V174-ML	NC	115	[redacted]						
E205E-PJ	NC	230	[redacted]						
E205W-BS	NC	230	[redacted]						
354-NFld	NC	345	[redacted]						
354-Ludlow	NC	345	[redacted]						
S197-BS	NC	115	[redacted]						

Contingency Name	Type	kV	Location/ Description	Clearing times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
E131-BS	NC	115	[redacted]						
Z126-WEB	NC	115	[redacted]						
E5-WARE	NC	69	[redacted]						
E5-F6E-DCT-Millbury	NC	69	[redacted]						
A1S-B2S-DCT-Gardner	NC	69	[redacted]						
A1N-B2N-DCT-Royalston	NC	69	[redacted]						
D4-Vernon	NC	69	[redacted]						
J136N-BELFS	NC	115	[redacted]						

Contingency Name	Type	kV	Location/ Description	Clearing times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
O15N- PALM	NC	69	[redacted]						
A127-ERV	NC	115	[redacted]						
A127-ST	NC	115	[redacted]						
I135-FP	NC	115	[redacted]						
I135-CHINK	NC	115	[redacted]						
X176E-PALM	NC	115	[redacted]						
X176-LUD	NC	115	[redacted]						
W175W-PALM	NC	115	[redacted]						

Contingency Name	Type	kV	Location/ Description	Clearing times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
SP-HVDC Bipole	NC	450	[redacted]						
STAFF-2728E-BF-SLG	NC	115	[redacted]						
STAFF-B128E-BF-SLG	NC	115	[redacted]						
STAFF-2728W-BF-SLG	NC	115	[redacted]						
PJ-69kV-TIE-BF-SLG	NC	69`	[redacted]						
BS-1205E-BF-SLG	NC	230	[redacted]						
BS-1205W-BF-SLG	NC	230	[redacted]						

Contingency Name	Type	kV	Location/ Description	Clearing times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
BS-T97-BF-SLG	NC	115	[redacted]						
BS-T31-BF-SLG	NC	115	[redacted]						
AD-3T5T-BF-SLG	NC	115	[redacted]						

6.12 N-1-1 Stability Contingencies

Several design contingencies were tested with an initial element out of service as shown in the table below. Any generation backdown that is required between contingencies were found not to exceed existing limits.

Table 32 - N-1-1 Stability Design Contingencies

Initial N-1	Post N-1	N-1-1 Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
Line Out	System Adjustments							EW	WE	EW	WE
301/302 345 kV [Ludlow-Millbury]	None	E205E-PJ	NC	230	[redacted]						
		Z126-WEB	NC	115							
		S197-BS	NC	115							
		V174-ML	NC	115							
		NFLD-2T-BF-SLG	NC	345							

Initial N-1	Post N-1	N-1-1 Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
Line Out	System Adjustments							EW	WE	EW	WE
					[redacted]						
		NFLD-9T-BF-SLG	NC	345							
		Ludlow-5T-BF-SLG	NC	345							
		CH-174W-BF-SLG	NC	115							
		381-NFLD	NC	345							
		FITZ-3791-BF-SLG	NC	345							
		SP-HVDC Bipole	NC	450							

Initial N-1	Post N-1	N-1-1 Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
Line Out	System Adjustments							EW	WE	EW	WE
		BS-T97-BF-SLG	NC	115	[redacted]						
Northfield 345-115 kV auto	none	A127-ST	NC	115	[redacted]						
Fitzwilliam 345-115 kV auto	none	I135-FP	NC	115	[redacted]						
S-197 115 kV line [Bear Swamp-Deerfield]	None	B2S-PJ	NC	69	[redacted]						
A-1S from Pratts to Otter River	None	B2S-CL	NC	69	[redacted]						
E-5E from Millbury – Meadow St	None	O15N-Ware	NC	69	[redacted]						

This page intentionally left blank

7 SHORT CIRCUIT ANALYSIS

ASPEN Version 14 was used to conduct the short circuit simulations for this study.

7.1 Short Circuit Models

ISO-NE's N+5 (five year out) short circuit case, dated January 1st,2020 was used for this study. Group 1 and 2 DER were already included in this case. The Group 3 DER was modeled at each substation, in an aggregate fashion, with a single equivalent generator at the low side of each substation to which the DER will be connected. The MW size of the single equivalent generator, equaled the total amount of DER (greater than 1 MW) to be connected to that substation.

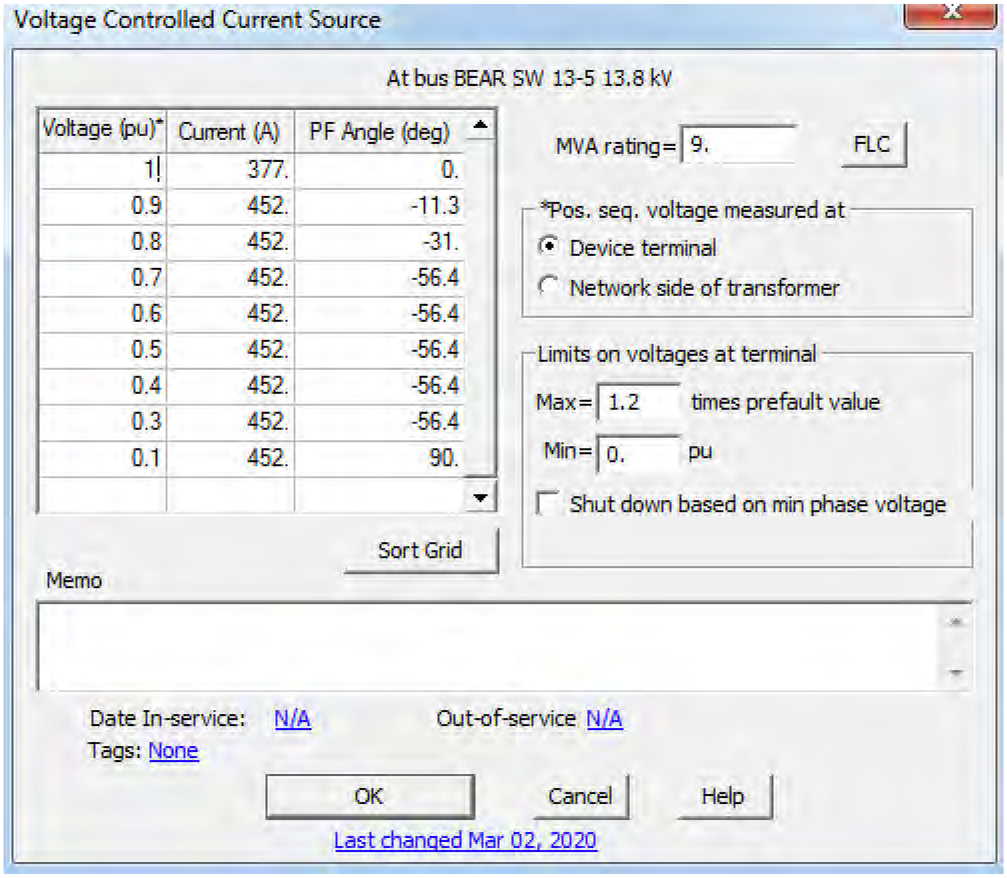
7.2 Methodology and Criteria

The modeling assumptions and short circuit performance criteria, including settings used in Aspen's breaker rating module, are per National Grid's TGP34 'Circuit Breaker Fault Current Assessment Guide' and its associated TGP34 Technical Guidelines.

The aggerate MWs for Group 3 DER was combined with the aggregate MWs for Group 1 and 2 DER, to come up with a single aggerate generator at each substation, as applicable.

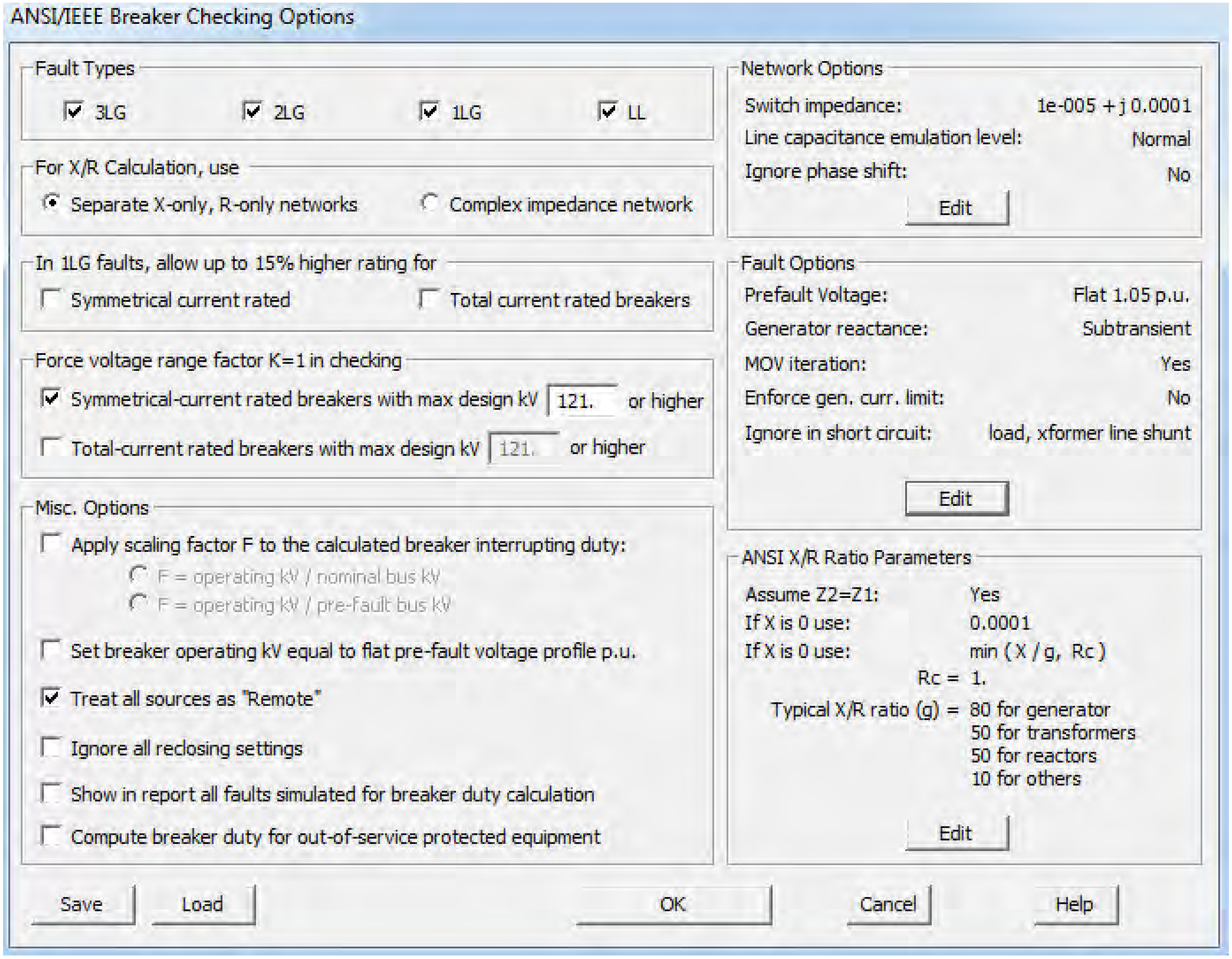
Voltage Controlled Current Source (VCCS) models were used for all PV inverters in Groups 3, as were for Groups 1 and 2. The VCCS models were assumed to deliver up to 1.2 p.u. of its nameplate current during fault conditions. Distinct Power Factor (PF) angles were modeled for several different voltage levels for each inverter. The PF Angle (degrees) for each DER terminal voltage was calculated based on recommendations provided in the ASPEN "Technical Bulletin on Modeling Type-4 Wind Plants and Solar Plants". The following figure is an example of an ASPEN model that was used for a 9 MW aggregate unit.

Figure 14 - Sample VCCS model



The figure below shows the ASPEN solution options assumed for the short circuit analysis. Note that current limits were not enforced for inverter-based generation modeled with current limited synchronous generators. This is a slightly conservative assumption, but not overly conservative since there is very little, if any inverter-based generators modeled with current limited synchronous generators in the study area.

Figure 15 - ASPEN Solution Options Assumed for short circuit analysis



7.3 Results

The following table shows the short circuit duty at each National Grid transmission substation (69 kV and above) in Western Massachusetts, following the additional of all 252 MW of DER associated with Group 3. The table includes the maximum short circuit current in Percentage (Duty_P) and Momentary Breaker Duty in Percentage (M_Duty_P) generated by the ASPEN breaker rating module for all 69 kV and above circuit breakers in Western Massachusetts.

The results show that the short circuit currents are less than 95% of the interrupting capability for all transmission breakers in the study area. Therefore, the PV inverters in Group 3 do not cause any breaker in the system to become overdutied.

Table 33 - ASPEN short circuit Results – Post Group 1 + 2 +3 DER

BUS	Breaker	DUTY A (Maximum short ckt Amps)	BKR_CAPA (Amps)	DUTY P (%)	M DUTY A (Amps)	M BKR CAPA (Amps)	M DUTY P (%)	3LG_AMPS	1LG_AMPS	2LG_AMPS	LL_AMPS
AYER 115kV	AYER 137	16030.5	40000	40.1	23886	64000	37.3	20311	15181.8	19305.5	17526.4
BEAR SWAMP 115.kV	BEAR SWP 131	24167.9	50000	48.3	36869.3	80000	46.1	23019.6	21923.4	22604.4	18959.1
BEAR SWAMP 115.kV	BEAR SWP 197	24167.9	50000	48.3	36869.3	80000	46.1	23019.6	21923.4	22604.4	18959.1
BEAR SWAMP 230.kV	BEARSW 1205E	14306.9	63000	22.7	20816.3	100800	20.7	14204.7	14236.7	14491.6	11345.2
BEAR SWAMP 230.kV	BEARSW 2205E	14306.9	63000	22.7	20816.3	100800	20.7	14204.7	14236.7	14491.6	11345.2
[redacted]											
CHESTNUT HIL 69.kV	Proxy - 69kv	2823.6	40000	7.1	2954.2	64000	4.6	2823.6	1680.5	2617.2	2474.3
Crystal Lake 69.kV	Proxy - 69kv	4104.1	31500	13	4509	50400	8.9	4104.1	2437.6	3802.6	3571.2
DEERFIELD 4 69.kV	Proxy - 69kv	10090.3	40000	25.2	13825.8	64000	21.6	10090.3	8435.9	9693.4	8466.7
E LONGMDW 14 69.kV	Proxy - 69kv	3229.6	40000	8.1	3868.5	64000	6	3229.6	1590.7	2922.4	2821
E LONGMDW 15 69.kV	Proxy - 69kv	4170.9	40000	10.4	6073.4	64000	9.5	4170.9	3698.4	4046.1	3592.7
FLAGG POND 115.kV	1135	17165.8	20000	85.8	23407.7	32000	73.1	17165.8	12456	15487	14501.6
FLAGG POND 115.kV	1136	17165.8	20000	85.8	23407.7	32000	73.1	17165.8	12456	15487	14501.6
FLAGG POND 115.kV	1235	12722.7	20924.4	60.8	17137.7	33479.1	51.2	17165.8	12456	15487	14501.6
FLAGG POND 115.kV	1236	12722.7	36444.4	34.9	17137.7	58311.1	29.4	17165.8	12456	15487	14501.6
FLAGG POND 115.kV	2135	12722.7	18884.4	67.4	17137.7	30215.1	56.7	17165.8	12456	15487	14501.6
FLAGG POND 115.kV	2136	17165.8	20000	85.8	23407.7	32000	73.1	17165.8	12456	15487	14501.6

BUS	Breaker	DUTY A (Maximum short ckt Amps)	BKR_CAPA (Amps)	DUTY P (%)	M DUTY A (Amps)	M BKR CAPA (Amps)	M DUTY P (%)	3LG_AMPS	1LG_AMPS	2LG_AMPS	LL_AMPS
HARRIMAN 69.kV	Proxy - 69kv	7396.6	40000	18.5	11298	64000	17.7	7278.6	7354.7	7396.6	6184.9
HARRIMAN 115.kV	115BT	15632.9	40000	39.1	22648.3	64000	35.4	15632.9	11759.7	14439.4	13195.1
HARRIMAN 115.kV	HARRIM 3810	14752.8	40000	36.9	21206.6	64000	33.1	15632.9	11759.7	14439.4	13195.1
HARRIMAN 115.kV	HARRIM A127	13721.1	40000	34.3	20070.4	64000	31.4	15632.9	11759.7	14439.4	13195.1
HARRIMAN 115.kV	HARRIM B128	14514.7	40000	36.3	21166.7	64000	33.1	15632.9	11759.7	14439.4	13195.1
HARRIMAN 115.kV	HARRIM Y177	13919.7	40000	34.8	20216.5	64000	31.6	15632.9	11759.7	14439.4	13195.1
Harrington 69.kV	Proxy - 69kv	9010.6	40000	22.5	11228.6	64000	17.5	9010.6	5774.6	8186	7596.7
MEADOW ST 69.kV	Proxy - 69kv	10415.2	31500	33.1	13036.9	50400	25.9	10415.2	5931.4	9178.1	8711.6

[redacted]

BUS	Breaker	DUTY A (Maximum short ckt Amps)	BKR_CAPA (Amps)	DUTY P (%)	M DUTY A (Amps)	M BKR CAPA (Amps)	M DUTY P (%)	3LG_AMPS	1LG_AMPS	2LG_AMPS	LL_AMPS
[redacted]											
MILLBURY5 B1 69 kV	Proxy - 69kv	20323	31500	64.5	30826.8	50400	61.2	20323	19321.5	19873.1	17228.9
[redacted]	[redacted]	[redacted]									
OTTER RIV 1 69 kV	Proxy - 69kv	3143.9	22000	14.3	3275.3	35200	9.3	3143.9	2051.3	2886	2759.1
PALMER 69 kV	Proxy - 69kv	14900.8	31500	47.3	22943	50400	45.5	14900.8	13192.6	14155.5	12659.6
PALMER 115 115 kV	PALMER 176T	15499.7	40000	38.7	22992.3	64000	35.9	15499.7	11411.5	14107	13187.4
PALMER 115 115 kV	PALMER 7075	12114.1	40000	30.3	18031.3	64000	28.2	15499.7	11411.5	14107	13187.4
PALMER 115 115 kV	PALMER R170	15499.7	40000	38.7	22992.3	64000	35.9	15499.7	11411.5	14107	13187.4
PALMER 115 115 kV	PALMER W175	15499.7	40000	38.7	22992.3	64000	35.9	15499.7	11411.5	14107	13187.4
PALMER 115 115 kV	PALMER X176	15337.5	40000	38.3	22778	64000	35.6	15499.7	11411.5	14107	13187.4
PRATTS 115 115 kV	PRATTSJ 1110	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ 2110	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ 3741	29129.3	40000	72.8	41420.6	64000	64.7	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ 3842	28691.1	40000	71.7	40622	64000	63.5	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ 4A	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ 801	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1

BUS	Breaker	DUTY A (Maximum short ckt Amps)	BKR_CAPA (Amps)	DUTY P (%)	M DUTY A (Amps)	M BKR CAPA (Amps)	M DUTY P (%)	3LG_AMPS	1LG_AMPS	2LG_AMPS	LL_AMPS
PRATTS 115 115 kV	PRATTSJ 802	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ I135	31300.6	40000	78.3	44923.4	64000	70.2	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ J136	31317	40000	78.3	44947	64000	70.2	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ K137	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ L138	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ O141	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ P142	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 230 230 kV	Pratts E205E	7383.7	50000	14.8	11329.1	80000	14.2	9289.3	8252.5	8974	7953.1
PRATTS JCT 1 69.kV	Proxy - 69kv	26782.7	31500	85	39834.9	50400	79	26782.7	25112.5	26254.5	22989.3
SEARSBURG 69.kV	Proxy - 69kv	5746.1	40000	14.4	8268.6	64000	12.9	5746.1	4584.6	5382.2	4928.6
SHUTESBRY E5 69.kV	Proxy - 69kv	4237.8	31500	13.5	5114.8	50400	10.1	4237.8	2281.2	3687.6	3548.6
Stafford st 115.kV	Proxy	18799.6	40000	47	25829.4	64000	40.4	18799.6	11232.1	17131.6	16204.3
VERNON 115.kV	K186	26529.4	40000	66.3	41305.5	64000	64.5	25824.7	25137.7	25990.5	21146.5
VERNON 115.kV	K40	26529.4	40000	66.3	41305.5	64000	64.5	25824.7	25137.7	25990.5	21146.5
VERNON 115.kV	KT1	26529.4	40000	66.3	41305.5	64000	64.5	25824.7	25137.7	25990.5	21146.5
VERNON 115.kV	KTB1-B1	23286.6	40000	58.2	35581.9	64000	55.6	25824.7	25137.7	25990.5	21146.5
VERNON 115.kV	KTB2-B1	26529.4	40000	66.3	41305.5	64000	64.5	25824.7	25137.7	25990.5	21146.5
VERNON 1 69.kV	Proxy - 69kv	5764.3	40000	14.4	7680	64000	12	5233.2	5535.9	5764.3	4425.4
WARE 69.kV	Proxy - 69kv	10293	31500	32.7	13232.8	50400	26.3	10293	5170	8897.3	8638.9
West Hampden 115.kV	1205	14358.4	40000	35.9	21013.7	64000	32.8	14358.4	10683.9	13280.9	12185.6
West Hampden 115.kV	1976	14358.4	40000	35.9	21013.7	64000	32.8	14358.4	10683.9	13280.9	12185.6
West Hampden 115.kV	3T-05	14331.8	40000	35.8	20974.8	64000	32.8	14358.4	10683.9	13280.9	12185.6
West Hampden 115.kV	70-76	11870.2	40000	29.7	17336.8	64000	27.1	14358.4	10683.9	13280.9	12185.6
West Hampden 115.kV	Proxy 1	14358.4	40000	35.9	21013.7	64000	32.8	14358.4	10683.9	13280.9	12185.6
West Hampden 115.kV	R170	14358.4	40000	35.9	21013.7	64000	32.8	14358.4	10683.9	13280.9	12185.6

BUS	Breaker bus name and nominal kV
BREAKERS	Breaker name
RATINGTYPE	Breaker rating type: S for symmetrical current rated; T for total current rated
DUTY_P	Interrupting duty in percent
DUTY_A	Interrupting current in amps
BKR_CAPA	Calculated interrupting capacity in amps
M_DUTY_P	Momentary duty for total-current rated breakers and close-and-latch duty for symmetrical-current rated breakers in percent
M_DUTY_A	Momentary duty for total-current rated breakers and close-and-latch duty for symmetrical-current rated breakers in amps
M_BKR_CAPA	Calculated momentary capacity of total current rated breakers and close-and-latch capacity for symmetrical current rated breakers in amps
MAX_SC_CASE	Fault with maximum short circuit interrupting current
ISC	Breaker short circuit current in amps
ANSI_X/R	ANSI X/R ratio
FLAG	Rating flag, interrupting duty
FLAG_M	Rating flag, momentary (close-and-latch) duty
3LG_AMPS	Maximum 3LG fault current at breaker bus
3LG_X/R	ANSI X/R ratio in 3LG fault at breaker bus
2LG_AMPS	Maximum 2LG fault current at breaker bus
2LG_X/R	ANSI X/R ratio in 2LG fault at breaker bus
1LG_AMPS	Maximum 1LG fault current at breaker bus
1LG_X/R	ANSI X/R ratio in 1LG fault at breaker bus
LL_AMPS	Maximum LL fault current at breaker bus
LL_X/R	ANSI X/R ratio in LL fault at breaker bus

This page intentionally left blank

This appendix has been redacted for Critical Energy/ Electric Infrastructure Information (CEII).

Appendix A - Steady State Base Case Summaries

Note:
Base Case Summaries in Appendix A are for the transmission system prior to the dispatch of Group 1,2 and 3 DER

This appendix has been redacted for Critical Energy/
Electric Infrastructure Information (CEII).

Appendix B – Stability Case Summaries

Appendix C - Stability Models (IDEV + DYR files) for Group 3 DER Greater Than or Equal To 5MW

This page intentionally left blank

IDV File – 100% PV + BESS Discharging

```
//NEP-22-G03-034:
BAT_SPLT,113082,930822,'BARRE-GSU', 13.8
BAT_BRANCH_CHNG,113082,930822,'1',,,,,,0.030789,0.024765,,,,,,,,,,,,,;
BAT_SPLT,930822,930821,'BARRE-INV', 0.6
BAT_BUS_CHNG_3,930821,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930822,930821,'2',1,930822,600,0,0,0,33,0,930822,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930821,930822,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930821,930822,'1'
BAT_MBIDBRN,930821,930822,'2','1'
BAT_PLANT_DATA,930821,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930821,'D3',1,600,0,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930821,'D3',,,,,1, 8.0,,0.0,0.0, 8.0,-8.0, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-036:
BAT_SPLT,113396,933962,'Cryst-GSU', 13.8
BAT_BRANCH_CHNG,113396,933962,'1',,,,,,0.011195,0.006297,,,,,,,,,,,,,;
BAT_SPLT,933962,933961,'Cryst-INV', 0.6
BAT_BUS_CHNG_3,933961,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933962,933961,'2',1,933962,600,0,0,0,33,0,933962,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933961,933962,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933961,933962,'1'
BAT_MBIDBRN,933961,933962,'2','1'
BAT_PLANT_DATA,933961,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933961,'D3',1,600,0,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933961,'D3',,,,,1, 8.0,,0.0,0.0, 8.0,-5.2, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-038:
BAT_SPLT,113395,933952,'EWINC-GSU', 13.8
BAT_BRANCH_CHNG,113395,933952,'1',,,,,,0.002457,0.001382,,,,,,,,,,,,,;
BAT_SPLT,933952,933951,'EWINC-INV', 0.6
BAT_BUS_CHNG_3,933951,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933952,933951,'2',1,933952,600,0,0,0,33,0,933952,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933951,933952,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 9.4,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933951,933952,'1'
BAT_MBIDBRN,933951,933952,'2','1'
BAT_PLANT_DATA,933951,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933951,'D3',1,600,0,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933951,'D3',,,,,1, 9.4,,0.0,0.0, 9.4,-4.6, 9.4,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-039:
BAT_SPLT,113395,993952,'EWINC2-GSU', 13.8
BAT_BRANCH_CHNG,113395,993952,'1',,,,,,0.001785,0.001004,,,,,,,,,,,,,;
BAT_SPLT,993952,993951,'EWINC2-INV', 0.6
BAT_BUS_CHNG_3,993951,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993952,993951,'2',1,993952,600,0,0,0,33,0,993952,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993951,993952,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.5,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993951,993952,'1'
BAT_MBIDBRN,993951,993952,'2','1'
BAT_PLANT_DATA,993951,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993951,'D3',1,600,0,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993951,'D3',,,,,1, 5.5,,0.0,0.0, 5.5,-4.2, 5.5,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-029:
BAT_SPLT,113070,930702,'LASHA-GSU', 13.2
BAT_BRANCH_CHNG,113070,930702,'1',,,,,,0.005257,0.002957,,,,,,,,,,,,,;
BAT_SPLT,930702,930701,'LASHA-INV', 0.6
BAT_BUS_CHNG_3,930701,2,,,,,,,,,,,;
```

```
BAT_TWO_WINDING_DATA_4,930702,930701,'2',1,930702,600,0,0,0,33,0,930702,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930701,930702,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930701,930702,'1'
BAT_MBIDBRN,930701,930702,'2','1'
BAT_PLANT_DATA,930701,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930701,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930701,'D3',,,,,1, 10.0,,0.0,0.0, 10.0,-7.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-008:
BAT_SPLT,113377,933772,'LAURL-GSU', 13.8
BAT_BRANCH_CHNG,113377,933772,'1',,,,,,0.010658,0.008573,,,,,,,,,,,,,;
BAT_SPLT,933772,933771,'LAURL-INV', 0.6
BAT_BUS_CHNG_3,933771,2,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933772,933771,'2',1,933772,600,0,0,0,33,0,933772,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933771,933772,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933771,933772,'1'
BAT_MBIDBRN,933771,933772,'2','1'
BAT_PLANT_DATA,933771,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933771,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933771,'D3',,,,,1, 8.0,,0.0,0.0, 8.0,-4.4, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-009:
BAT_SPLT,113392,933922,'MILLB-GSU', 13.8
BAT_BRANCH_CHNG,113392,933922,'1',,,,,,0.004054,0.00228,,,,,,,,,,,,,;
BAT_SPLT,933922,933921,'MILLB-INV', 0.6
BAT_BUS_CHNG_3,933921,2,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933922,933921,'2',1,933922,600,0,0,0,33,0,933922,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933921,933922,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933921,933922,'1'
BAT_MBIDBRN,933921,933922,'2','1'
BAT_PLANT_DATA,933921,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933921,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933921,'D3',,,,,1, 10.0,,0.0,0.0, 10.0,-3.5, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-011:
BAT_SPLT,113388,933882,'NOXFO1-GSU', 13.2
BAT_BRANCH_CHNG,113388,933882,'1',,,,,,0.003861,0.003106,,,,,,,,,,,,,;
BAT_SPLT,933882,933881,'NOXFO1-INV', 0.6
BAT_BUS_CHNG_3,933881,2,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933882,933881,'2',1,933882,600,0,0,0,33,0,933882,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933881,933882,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933881,933882,'1'
BAT_MBIDBRN,933881,933882,'2','1'
BAT_PLANT_DATA,933881,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933881,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933881,'D3',,,,,1, 8.0,,0.0,0.0, 8.0,-6.4, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-013:
BAT_SPLT,113388,993882,'NOXFO2-GSU', 13.2
BAT_BRANCH_CHNG,113388,993882,'1',,,,,,0.008745,0.007034,,,,,,,,,,,,,;
BAT_SPLT,993882,993881,'NOXFO2-INV', 0.6
BAT_BUS_CHNG_3,993881,2,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993882,993881,'2',1,993882,600,0,0,0,33,0,993882,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993881,993882,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.6,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993881,993882,'1'
BAT_MBIDBRN,993881,993882,'2','1'
BAT_PLANT_DATA,993881,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993881,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993881,'D3',,,,,1, 5.6,,0.0,0.0, 5.6,-4.8, 5.6,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-006:
BAT_SPLT,113383,933832,'PRATT-GSU', 13.8
BAT_BRANCH_CHNG,113383,933832,'1',,,,,,0.020017,0.011259,,,,,,,,,,,,,;
```

BAT_SPLT,933832,933831,'PRATT-INV', 0.6
BAT_BUS_CHNG_3,933831,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933832,933831,'2',1,933832,600,0,0,0,33,0,933832,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933831,933832,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 6.0,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933831,933832,'1'
BAT_MBIDBRN,933831,933832,'2','1'
BAT_PLANT_DATA,933831,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933831,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933831,'D3',,,,,1, 6.0,,0.0,0.0, 6.0,-4.5, 6.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-041:
BAT_SPLT,113084,930842,'ROYAL-GSU', 13.8
BAT_BRANCH_CHNG,113084,930842,'1',,,,,,0.00271,0.00152,,,,,,,,,,,,,;
BAT_SPLT,930842,930841,'ROYAL-INV', 0.6
BAT_BUS_CHNG_3,930841,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930842,930841,'2',1,930842,600,0,0,0,33,0,930842,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930841,930842,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930841,930842,'1'
BAT_MBIDBRN,930841,930842,'2','1'
BAT_PLANT_DATA,930841,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930841,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930841,'D3',,,,,1, 5.0,,0.0,0.0, 5.0,0.0, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-015:
BAT_SPLT,113389,933892,'SNOW1-GSU', 13.2
BAT_BRANCH_CHNG,113389,933892,'1',,,,,,0.0119375,0.003094,,,,,,,,,,,,,;
BAT_SPLT,933892,933891,'SNOW1-INV', 0.6
BAT_BUS_CHNG_3,933891,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933892,933891,'2',1,933892,600,0,0,0,33,0,933892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933891,933892,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933891,933892,'1'
BAT_MBIDBRN,933891,933892,'2','1'
BAT_PLANT_DATA,933891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933891,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933891,'D3',,,,,1, 5.0,,0.0,0.0, 5.0,-2.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-016:
BAT_SPLT,113389,993892,'SNOW2-GSU', 13.2
BAT_BRANCH_CHNG,113389,993892,'1',,,,,,0.01416,0.00797,,,,,,,,,,,,,;
BAT_SPLT,993892,993891,'SNOW2-INV', 0.6
BAT_BUS_CHNG_3,993891,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993892,993891,'2',1,993892,600,0,0,0,33,0,993892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993891,993892,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.5,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993891,993892,'1'
BAT_MBIDBRN,993891,993892,'2','1'
BAT_PLANT_DATA,993891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993891,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993891,'D3',,,,,1, 5.5,,0.0,0.0, 5.5,-6.5, 5.5,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-017:
BAT_SPLT,113389,983892,'SNOW3-GSU', 13.2
BAT_BRANCH_CHNG,113389,983892,'1',,,,,,0.0119375,0.003094,,,,,,,,,,,,,;
BAT_SPLT,983892,983891,'SNOW3-INV', 0.6
BAT_BUS_CHNG_3,983891,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,983892,983891,'2',1,983892,600,0,0,0,33,0,983892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,983891,983892,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,983891,983892,'1'
BAT_MBIDBRN,983891,983892,'2','1'
BAT_PLANT_DATA,983891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,983891,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,983891,'D3',,,,,1, 5.0,,0.0,0.0, 5.0,-2.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-001:

```
BAT_SPLT,113363,933632,'STAFF-GSU', 13.8
BAT_BRANCH_CHNG,113363,933632,'1',,,,,,0.00301169,0.00893508,,,,,,,,,,,,,;
BAT_SPLT,933632,933631,'STAFF-INV', 0.6
BAT_BUS_CHNG_3,933631,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933632,933631,'2',1,933632,600,0,0,0,33,0,933632,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933631,933632,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933631,933632,'1'
BAT_MBIDBRN,933631,933632,'2','1'
BAT_PLANT_DATA,933631,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933631,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933631,'D3',,,,,1, 5.0,,0.0,0.0, 5.0,-5.0, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-033:
BAT_SPLT,113368,933682,'TREAS-GSU', 13.8
BAT_BRANCH_CHNG,113368,933682,'1',,,,,,0.002457,0.001382,,,,,,,,,,,,,;
BAT_SPLT,933682,933681,'TREAS-INV', 0.6
BAT_BUS_CHNG_3,933681,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933682,933681,'2',1,933682,600,0,0,0,33,0,933682,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933681,933682,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933681,933682,'1'
BAT_MBIDBRN,933681,933682,'2','1'
BAT_PLANT_DATA,933681,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933681,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933681,'D3',,,,,1, 10.0,,0.0,0.0, 10.0,-5.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-020:
BAT_SPLT,113390,933902,'WCHAR-GSU', 13.2
BAT_BRANCH_CHNG,113390,933902,'1',,,,,,0.005624,0.003164,,,,,,,,,,,,,;
BAT_SPLT,933902,933901,'WCHAR-INV', 0.6
BAT_BUS_CHNG_3,933901,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933902,933901,'2',1,933902,600,0,0,0,33,0,933902,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933901,933902,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933901,933902,'1'
BAT_MBIDBRN,933901,933902,'2','1'
BAT_PLANT_DATA,933901,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933901,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933901,'D3',,,,,1, 5.0,,0.0,0.0, 5.0,-4.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-021:
BAT_SPLT,113390,993902,'WCHAR2-GSU', 13.2
BAT_BRANCH_CHNG,113390,993902,'1',,,,,,0.00691,0.003887,,,,,,,,,,,,,;
BAT_SPLT,993902,993901,'WCHAR2-INV', 0.6
BAT_BUS_CHNG_3,993901,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993902,993901,'2',1,993902,600,0,0,0,33,0,993902,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993901,993902,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993901,993902,'1'
BAT_MBIDBRN,993901,993902,'2','1'
BAT_PLANT_DATA,993901,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993901,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993901,'D3',,,,,1, 10.0,,0.0,0.0, 10.0,-4.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-044:
BAT_SPLT,113085,930852,'WENDE1-GSU', 13.8
BAT_BRANCH_CHNG,113085,930852,'1',,,,,,0.002625,0.001477,,,,,,,,,,,,,;
BAT_SPLT,930852,930851,'WENDE1-INV', 0.6
BAT_BUS_CHNG_3,930851,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930852,930851,'2',1,930852,600,0,0,0,33,0,930852,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930851,930852,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930851,930852,'1'
BAT_MBIDBRN,930851,930852,'2','1'
BAT_PLANT_DATA,930851,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930851,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930851,'D3',,,,,1, 8.0,,0.0,0.0, 8.0,-7.2, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0
```

```
//NEP-22-G03-043:
BAT_SPLT,113085,990852,'WENDE2-GSU', 13.8
BAT_BRANCH_CHNG,113085,990852,'1',,,,,,,0.00271,0.001524,,,,,,,,,,,,,;
BAT_SPLT,990852,990851,'WENDE2-INV', 0.6
BAT_BUS_CHNG_3,990851,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,990852,990851,'2',1,990852,600,0,0,0,33,0,990852,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,990851,990852,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,990851,990852,'1'
BAT_MBIDBRN,990851,990852,'2','1'
BAT_PLANT_DATA,990851,0, 1.0, 100.0
BAT_MACHINE_DATA_2,990851,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,990851,'D3',,,,,1, 10.0,,0.0,0.0, 10.0,-8.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0
```

IDV File – 26% PV + BESS Charging

```
//NEP-22-G03-034:
BAT_SPLT,113082,930822,'BARRE-GSU', 13.8
BAT_BRANCH_CHNG,113082,930822,'1',,,,,,0.030789,0.024765,,,,,,,,,,,,,;
BAT_SPLT,930822,930821,'BARRE-INV', 0.6
BAT_BUS_CHNG_3,930821,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930822,930821,'2',1,930822,600,0,0,0,33,0,930822,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930821,930822,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930821,930822,'1'
BAT_MBIDBRN,930821,930822,'2','1'
BAT_PLANT_DATA,930821,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930821,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930821,'D3',,,,,,1, -8.0,,0.0,0.0, 8.0,-8.0, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-036:
BAT_SPLT,113396,933962,'Cryst-GSU', 13.8
BAT_BRANCH_CHNG,113396,933962,'1',,,,,,0.011195,0.006297,,,,,,,,,,,,,;
BAT_SPLT,933962,933961,'Cryst-INV', 0.6
BAT_BUS_CHNG_3,933961,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933962,933961,'2',1,933962,600,0,0,0,33,0,933962,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933961,933962,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933961,933962,'1'
BAT_MBIDBRN,933961,933962,'2','1'
BAT_PLANT_DATA,933961,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933961,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933961,'D3',,,,,,1, -5.2,,0.0,0.0, 8.0,-5.2, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-038:
BAT_SPLT,113395,933952,'EWINC-GSU', 13.8
BAT_BRANCH_CHNG,113395,933952,'1',,,,,,0.002457,0.001382,,,,,,,,,,,,,;
BAT_SPLT,933952,933951,'EWINC-INV', 0.6
BAT_BUS_CHNG_3,933951,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933952,933951,'2',1,933952,600,0,0,0,33,0,933952,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933951,933952,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 9.4,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933951,933952,'1'
BAT_MBIDBRN,933951,933952,'2','1'
BAT_PLANT_DATA,933951,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933951,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933951,'D3',,,,,,1, -4.6,,0.0,0.0, 9.4,-4.6, 9.4,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-039:
BAT_SPLT,113395,993952,'EWINC2-GSU', 13.8
BAT_BRANCH_CHNG,113395,993952,'1',,,,,,0.001785,0.001004,,,,,,,,,,,,,;
BAT_SPLT,993952,993951,'EWINC2-INV', 0.6
BAT_BUS_CHNG_3,993951,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993952,993951,'2',1,993952,600,0,0,0,33,0,993952,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993951,993952,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.5,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993951,993952,'1'
BAT_MBIDBRN,993951,993952,'2','1'
BAT_PLANT_DATA,993951,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993951,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993951,'D3',,,,,,1, -4.2,,0.0,0.0, 5.5,-4.2, 5.5,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-029:
BAT_SPLT,113070,930702,'LASHA-GSU', 13.2
BAT_BRANCH_CHNG,113070,930702,'1',,,,,,0.005257,0.002957,,,,,,,,,,,,,;
BAT_SPLT,930702,930701,'LASHA-INV', 0.6
BAT_BUS_CHNG_3,930701,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930702,930701,'2',1,930702,600,0,0,0,33,0,930702,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930701,930702,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930701,930702,'1'
BAT_MBIDBRN,930701,930702,'2','1'
```

```
BAT_PLANT_DATA,930701,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930701,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930701,'D3',,,,,,1, -7.0,,0.0,0.0, 10.0,-7.0, 10.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-008:
BAT_SPLT,113377,933772,'LAURL-GSU', 13.8
BAT_BRANCH_CHNG,113377,933772,'1',,,,,,0.010658,0.008573,,,,,,,,,,,,,;
BAT_SPLT,933772,933771,'LAURL-INV', 0.6
BAT_BUS_CHNG_3,933771,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933772,933771,'2',1,933772,600,0,0,0,33,0,933772,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933771,933772,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933771,933772,'1'
BAT_MBIDBRN,933771,933772,'2','1'
BAT_PLANT_DATA,933771,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933771,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933771,'D3',,,,,,1, -4.4,,0.0,0.0, 8.0,-4.4, 8.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-009:
BAT_SPLT,113392,933922,'MILLB-GSU', 13.8
BAT_BRANCH_CHNG,113392,933922,'1',,,,,,0.004054,0.00228,,,,,,,,,,,,,;
BAT_SPLT,933922,933921,'MILLB-INV', 0.6
BAT_BUS_CHNG_3,933921,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933922,933921,'2',1,933922,600,0,0,0,33,0,933922,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933921,933922,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933921,933922,'1'
BAT_MBIDBRN,933921,933922,'2','1'
BAT_PLANT_DATA,933921,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933921,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933921,'D3',,,,,,1, -3.5,,0.0,0.0, 10.0,-3.5, 10.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-011:
BAT_SPLT,113388,933882,'NOXFO1-GSU', 13.2
BAT_BRANCH_CHNG,113388,933882,'1',,,,,,0.003861,0.003106,,,,,,,,,,,,,;
BAT_SPLT,933882,933881,'NOXFO1-INV', 0.6
BAT_BUS_CHNG_3,933881,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933882,933881,'2',1,933882,600,0,0,0,33,0,933882,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933881,933882,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933881,933882,'1'
BAT_MBIDBRN,933881,933882,'2','1'
BAT_PLANT_DATA,933881,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933881,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933881,'D3',,,,,,1, -6.4,,0.0,0.0, 8.0,-6.4, 8.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-013:
BAT_SPLT,113388,993882,'NOXFO2-GSU', 13.2
BAT_BRANCH_CHNG,113388,993882,'1',,,,,,0.008745,0.007034,,,,,,,,,,,,,;
BAT_SPLT,993882,993881,'NOXFO2-INV', 0.6
BAT_BUS_CHNG_3,993881,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993882,993881,'2',1,993882,600,0,0,0,33,0,993882,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993881,993882,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.6,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993881,993882,'1'
BAT_MBIDBRN,993881,993882,'2','1'
BAT_PLANT_DATA,993881,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993881,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993881,'D3',,,,,,1, -4.8,,0.0,0.0, 5.6,-4.8, 5.6,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-006:
BAT_SPLT,113383,933832,'PRATT-GSU', 13.8
BAT_BRANCH_CHNG,113383,933832,'1',,,,,,0.020017,0.011259,,,,,,,,,,,,,;
BAT_SPLT,933832,933831,'PRATT-INV', 0.6
BAT_BUS_CHNG_3,933831,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933832,933831,'2',1,933832,600,0,0,0,33,0,933832,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933831,933832,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 6.0,,,,,,,,,,,,,,,,,,,," "," "
```

```
BAT_PURGBRN,933831,933832,'1'
BAT_MBIDBRN,933831,933832,'2','1'
BAT_PLANT_DATA,933831,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933831,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933831,'D3',,,,,1, -4.5,,0.0,0.0, 6.0,-4.5, 6.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-041:
BAT_SPLT,113084,930842,'ROYAL-GSU', 13.8
BAT_BRANCH_CHNG,113084,930842,'1',,,,,,0.00271,0.00152,,,,,,,,,,,,,;
BAT_SPLT,930842,930841,'ROYAL-INV', 0.6
BAT_BUS_CHNG_3,930841,2,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930842,930841,'2',1,930842,600,0,0,0,33,0,930842,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930841,930842,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930841,930842,'1'
BAT_MBIDBRN,930841,930842,'2','1'
BAT_PLANT_DATA,930841,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930841,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930841,'D3',,,,,1, 0.0,,0.0,0.0, 5.0,0.0, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-015:
BAT_SPLT,113389,933892,'SNOW1-GSU', 13.2
BAT_BRANCH_CHNG,113389,933892,'1',,,,,,0.0119375,0.003094,,,,,,,,,,,,,;
BAT_SPLT,933892,933891,'SNOW1-INV', 0.6
BAT_BUS_CHNG_3,933891,2,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933892,933891,'2',1,933892,600,0,0,0,33,0,933892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933891,933892,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933891,933892,'1'
BAT_MBIDBRN,933891,933892,'2','1'
BAT_PLANT_DATA,933891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933891,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933891,'D3',,,,,1, -2.5,,0.0,0.0, 5.0,-2.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-016:
BAT_SPLT,113389,993892,'SNOW2-GSU', 13.2
BAT_BRANCH_CHNG,113389,993892,'1',,,,,,0.01416,0.00797,,,,,,,,,,,,,;
BAT_SPLT,993892,993891,'SNOW2-INV', 0.6
BAT_BUS_CHNG_3,993891,2,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993892,993891,'2',1,993892,600,0,0,0,33,0,993892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993891,993892,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.5,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993891,993892,'1'
BAT_MBIDBRN,993891,993892,'2','1'
BAT_PLANT_DATA,993891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993891,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993891,'D3',,,,,1, -6.5,,0.0,0.0, 5.5,-6.5, 5.5,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-017:
BAT_SPLT,113389,983892,'SNOW3-GSU', 13.2
BAT_BRANCH_CHNG,113389,983892,'1',,,,,,0.0119375,0.003094,,,,,,,,,,,,,;
BAT_SPLT,983892,983891,'SNOW3-INV', 0.6
BAT_BUS_CHNG_3,983891,2,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,983892,983891,'2',1,983892,600,0,0,0,33,0,983892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,983891,983892,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,983891,983892,'1'
BAT_MBIDBRN,983891,983892,'2','1'
BAT_PLANT_DATA,983891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,983891,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,983891,'D3',,,,,1, -2.5,,0.0,0.0, 5.0,-2.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-001:
BAT_SPLT,113363,933632,'STAFF-GSU', 13.8
BAT_BRANCH_CHNG,113363,933632,'1',,,,,,0.00301169,0.00893508,,,,,,,,,,,,,;
BAT_SPLT,933632,933631,'STAFF-INV', 0.6
BAT_BUS_CHNG_3,933631,2,,,,,,,,,,;
```

```
BAT_TWO_WINDING_DATA_4,933632,933631,'2',1,933632,600,0,0,0,33,0,933632,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933631,933632,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933631,933632,'1'
BAT_MBIDBRN,933631,933632,'2','1'
BAT_PLANT_DATA,933631,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933631,'D3',1,600,0,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933631,'D3',,,,,,1, -5.0,,0.0,0.0, 5.0,-5.0, 5.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-033:
BAT_SPLT,113368,933682,'TREAS-GSU', 13.8
BAT_BRANCH_CHNG,113368,933682,'1',,,,,,0.002457,0.001382,,,,,,,,,,,,,;
BAT_SPLT,933682,933681,'TREAS-INV', 0.6
BAT_BUS_CHNG_3,933681,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933682,933681,'2',1,933682,600,0,0,0,33,0,933682,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933681,933682,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933681,933682,'1'
BAT_MBIDBRN,933681,933682,'2','1'
BAT_PLANT_DATA,933681,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933681,'D3',1,600,0,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933681,'D3',,,,,,1, -5.0,,0.0,0.0, 10.0,-5.0, 10.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-020:
BAT_SPLT,113390,933902,'WCHAR-GSU', 13.2
BAT_BRANCH_CHNG,113390,933902,'1',,,,,,0.005624,0.003164,,,,,,,,,,,,,;
BAT_SPLT,933902,933901,'WCHAR-INV', 0.6
BAT_BUS_CHNG_3,933901,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933902,933901,'2',1,933902,600,0,0,0,33,0,933902,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933901,933902,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933901,933902,'1'
BAT_MBIDBRN,933901,933902,'2','1'
BAT_PLANT_DATA,933901,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933901,'D3',1,600,0,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933901,'D3',,,,,,1, -4.5,,0.0,0.0, 5.0,-4.5, 5.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-021:
BAT_SPLT,113390,993902,'WCHAR2-GSU', 13.2
BAT_BRANCH_CHNG,113390,993902,'1',,,,,,0.00691,0.003887,,,,,,,,,,,,,;
BAT_SPLT,993902,993901,'WCHAR2-INV', 0.6
BAT_BUS_CHNG_3,993901,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993902,993901,'2',1,993902,600,0,0,0,33,0,993902,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993901,993902,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993901,993902,'1'
BAT_MBIDBRN,993901,993902,'2','1'
BAT_PLANT_DATA,993901,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993901,'D3',1,600,0,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993901,'D3',,,,,,1, -4.0,,0.0,0.0, 10.0,-4.0, 10.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-044:
BAT_SPLT,113085,930852,'WENDE1-GSU', 13.8
BAT_BRANCH_CHNG,113085,930852,'1',,,,,,0.002625,0.001477,,,,,,,,,,,,,;
BAT_SPLT,930852,930851,'WENDE1-INV', 0.6
BAT_BUS_CHNG_3,930851,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930852,930851,'2',1,930852,600,0,0,0,33,0,930852,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930851,930852,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930851,930852,'1'
BAT_MBIDBRN,930851,930852,'2','1'
BAT_PLANT_DATA,930851,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930851,'D3',1,600,0,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930851,'D3',,,,,,1, -7.2,,0.0,0.0, 8.0,-7.2, 8.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-043:
BAT_SPLT,113085,990852,'WENDE2-GSU', 13.8
BAT_BRANCH_CHNG,113085,990852,'1',,,,,,0.00271,0.001524,,,,,,,,,,,,,;
```

```
BAT_SPLT,990852,990851,'WENDE2-INV', 0.6
BAT_BUS_CHNG_3,990851,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,990852,990851,'2',1,990852,600,0,0,0,33,0,990852,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,990851,990852,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,990851,990852,'1'
BAT_MBIDBRN,990851,990852,'2','1'
BAT_PLANT_DATA,990851,0, 1.0, 100.0
BAT_MACHINE_DATA_2,990851,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,990851,'D3',,,,,,1, -8.0,,0.0,0.0, 10.0,-8.0, 10.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0
```

```
///NEP-22-G03-034
930821 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/930821 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

930821 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993082101 'VTGTPAT' 930821 930821 D3 -1 1.2 0.16 0.0 /
993082102 'VTGTPAT' 930821 930821 D3 -1 1.1 2 0.0 /
993082103 'VTGTPAT' 930821 930821 D3 0.5 5 1.1 0.0 /
993082104 'VTGTPAT' 930821 930821 D3 0.88 5 3 0.0 /
993082105 'FRQTPAT' 930821 930821 D3 56.5 100 0.16 0.0 /
993082106 'FRQTPAT' 930821 930821 D3 58.5 100 300 0.0 /
993082107 'FRQTPAT' 930821 930821 D3 -100 61.2 300 0.0 /
993082108 'FRQTPAT' 930821 930821 D3 -100 62 0.16 0.0 /

///NEP-22-G03-036
933961 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933961 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933961 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993396101 'VTGTPAT' 933961 933961 D3 -1 1.2 0.16 0.0 /
993396102 'VTGTPAT' 933961 933961 D3 -1 1.1 2 0.0 /
993396103 'VTGTPAT' 933961 933961 D3 0.5 5 1.1 0.0 /
993396104 'VTGTPAT' 933961 933961 D3 0.88 5 3 0.0 /
993396105 'FRQTPAT' 933961 933961 D3 56.5 100 0.16 0.0 /
993396106 'FRQTPAT' 933961 933961 D3 58.5 100 300 0.0 /
993396107 'FRQTPAT' 933961 933961 D3 -100 61.2 300 0.0 /
993396108 'FRQTPAT' 933961 933961 D3 -100 62 0.16 0.0 /

///NEP-22-G03-038
933951 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933951 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933951 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
```

0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993395101 'VTGTPAT' 933951 933951 D3 -1 1.2 0.16 0.0 /
993395102 'VTGTPAT' 933951 933951 D3 -1 1.1 2 0.0 /
993395103 'VTGTPAT' 933951 933951 D3 0.5 5 1.1 0.0 /
993395104 'VTGTPAT' 933951 933951 D3 0.88 5 3 0.0 /
993395105 'FRQTPAT' 933951 933951 D3 56.5 100 0.16 0.0 /
993395106 'FRQTPAT' 933951 933951 D3 58.5 100 300 0.0 /
993395107 'FRQTPAT' 933951 933951 D3 -100 61.2 300 0.0 /
993395108 'FRQTPAT' 933951 933951 D3 -100 62 0.16 0.0 /

///NEP-22-G03-039
993951 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/993951 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

993951 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

999395101 'VTGTPAT' 993951 993951 D3 -1 1.2 0.16 0.0 /
999395102 'VTGTPAT' 993951 993951 D3 -1 1.1 2 0.0 /
999395103 'VTGTPAT' 993951 993951 D3 0.5 5 1.1 0.0 /
999395104 'VTGTPAT' 993951 993951 D3 0.88 5 3 0.0 /
999395105 'FRQTPAT' 993951 993951 D3 56.5 100 0.16 0.0 /
999395106 'FRQTPAT' 993951 993951 D3 58.5 100 300 0.0 /
999395107 'FRQTPAT' 993951 993951 D3 -100 61.2 300 0.0 /
999395108 'FRQTPAT' 993951 993951 D3 -100 62 0.16 0.0 /

///NEP-22-G03-029
930701 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/930701 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

930701 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993070101 'VTGTPAT' 930701 930701 D3 -1 1.2 0.16 0.0 /
993070102 'VTGTPAT' 930701 930701 D3 -1 1.1 2 0.0 /
993070103 'VTGTPAT' 930701 930701 D3 0.5 5 1.1 0.0 /
993070104 'VTGTPAT' 930701 930701 D3 0.88 5 3 0.0 /
993070105 'FRQTPAT' 930701 930701 D3 56.5 100 0.16 0.0 /
993070106 'FRQTPAT' 930701 930701 D3 58.5 100 300 0.0 /
993070107 'FRQTPAT' 930701 930701 D3 -100 61.2 300 0.0 /
993070108 'FRQTPAT' 930701 930701 D3 -100 62 0.16 0.0 /

///NEP-22-G03-008
933771 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933771 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

```
933771 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993377101 'VTGTPAT' 933771 933771 D3 -1 1.2 0.16 0.0 /
993377102 'VTGTPAT' 933771 933771 D3 -1 1.1 2 0.0 /
993377103 'VTGTPAT' 933771 933771 D3 0.5 5 1.1 0.0 /
993377104 'VTGTPAT' 933771 933771 D3 0.88 5 3 0.0 /
993377105 'FRQTPAT' 933771 933771 D3 56.5 100 0.16 0.0 /
993377106 'FRQTPAT' 933771 933771 D3 58.5 100 300 0.0 /
993377107 'FRQTPAT' 933771 933771 D3 -100 61.2 300 0.0 /
993377108 'FRQTPAT' 933771 933771 D3 -100 62 0.16 0.0 /

///NEP-22-G03-009
933921 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933921 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933921 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993392101 'VTGTPAT' 933921 933921 D3 -1 1.2 0.16 0.0 /
993392102 'VTGTPAT' 933921 933921 D3 -1 1.1 2 0.0 /
993392103 'VTGTPAT' 933921 933921 D3 0.5 5 1.1 0.0 /
993392104 'VTGTPAT' 933921 933921 D3 0.88 5 3 0.0 /
993392105 'FRQTPAT' 933921 933921 D3 56.5 100 0.16 0.0 /
993392106 'FRQTPAT' 933921 933921 D3 58.5 100 300 0.0 /
993392107 'FRQTPAT' 933921 933921 D3 -100 61.2 300 0.0 /
993392108 'FRQTPAT' 933921 933921 D3 -100 62 0.16 0.0 /

///NEP-22-G03-011
933881 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933881 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933881 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993388101 'VTGTPAT' 933881 933881 D3 -1 1.2 0.16 0.0 /
993388102 'VTGTPAT' 933881 933881 D3 -1 1.1 2 0.0 /
993388103 'VTGTPAT' 933881 933881 D3 0.5 5 1.1 0.0 /
993388104 'VTGTPAT' 933881 933881 D3 0.88 5 3 0.0 /
993388105 'FRQTPAT' 933881 933881 D3 56.5 100 0.16 0.0 /
993388106 'FRQTPAT' 933881 933881 D3 58.5 100 300 0.0 /
993388107 'FRQTPAT' 933881 933881 D3 -100 61.2 300 0.0 /
993388108 'FRQTPAT' 933881 933881 D3 -100 62 0.16 0.0 /
```

```
///NEP-22-G03-013
993881 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/993881 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

993881 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

999388101 'VTGTPAT' 993881 993881 D3 -1 1.2 0.16 0.0 /
999388102 'VTGTPAT' 993881 993881 D3 -1 1.1 2 0.0 /
999388103 'VTGTPAT' 993881 993881 D3 0.5 5 1.1 0.0 /
999388104 'VTGTPAT' 993881 993881 D3 0.88 5 3 0.0 /
999388105 'FRQTPAT' 993881 993881 D3 56.5 100 0.16 0.0 /
999388106 'FRQTPAT' 993881 993881 D3 58.5 100 300 0.0 /
999388107 'FRQTPAT' 993881 993881 D3 -100 61.2 300 0.0 /
999388108 'FRQTPAT' 993881 993881 D3 -100 62 0.16 0.0 /

///NEP-22-G03-006
933831 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933831 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933831 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993383101 'VTGTPAT' 933831 933831 D3 -1 1.2 0.16 0.0 /
993383102 'VTGTPAT' 933831 933831 D3 -1 1.1 2 0.0 /
993383103 'VTGTPAT' 933831 933831 D3 0.5 5 1.1 0.0 /
993383104 'VTGTPAT' 933831 933831 D3 0.88 5 3 0.0 /
993383105 'FRQTPAT' 933831 933831 D3 56.5 100 0.16 0.0 /
993383106 'FRQTPAT' 933831 933831 D3 58.5 100 300 0.0 /
993383107 'FRQTPAT' 933831 933831 D3 -100 61.2 300 0.0 /
993383108 'FRQTPAT' 933831 933831 D3 -100 62 0.16 0.0 /

///NEP-22-G03-041
930841 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8
 0      0
 0.0200      0.0200      99.000      -99.000      10.000
 0.0100      1.0000/


930841 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
 0      0      0      0      0      0
 0.8800      1.2000      0.0200      -0.1000      0.1000
 1.0000      1.0000      -1.0000      0.0000      0.0000
 0.0000      0.0000      0.0100      0.0000      0.0000
 1.1000      0.9000      0.3000      5.0000      0.5000
 0.0000      0.0000      0.0200      99.000      -99.000
 1.0000      -1.0000      1.2000      0.0200
 0.01 0.01  0.499 0.01  0.5 1.0  0.6 1.0  0.9 1.0  1.0 1.0  1.1 1.0  1.2 1.0  1.201 0.01  1.3 0.01
 0.01 0.01  0.499 0.01  0.5 1.0  0.6 1.0  0.9 1.0  1.0 1.0  1.1 1.0  1.2 1.0  1.201 0.01  1.3 0.01
 0.0000      0.0000      0.0000      0.0000      1.0000
 0.5000      1.1000      0.0000/
```

```
993084101 'VTGTPAT' 930841 930841 D3 -1 1.2 0.16 0.0 /
993084102 'VTGTPAT' 930841 930841 D3 -1 1.1 2 0.0 /
993084103 'VTGTPAT' 930841 930841 D3 0.5 5 1.1 0.0 /
993084104 'VTGTPAT' 930841 930841 D3 0.88 5 3 0.0 /
993084105 'FRQTPAT' 930841 930841 D3 56.5 100 0.16 0.0 /
993084106 'FRQTPAT' 930841 930841 D3 58.5 100 300 0.0 /
993084107 'FRQTPAT' 930841 930841 D3 -100 61.2 300 0.0 /
993084108 'FRQTPAT' 930841 930841 D3 -100 62 0.16 0.0 /

///NEP-22-G03-015
933891 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933891 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933891 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993389101 'VTGTPAT' 933891 933891 D3 -1 1.2 0.16 0.0 /
993389102 'VTGTPAT' 933891 933891 D3 -1 1.1 2 0.0 /
993389103 'VTGTPAT' 933891 933891 D3 0.5 5 1.1 0.0 /
993389104 'VTGTPAT' 933891 933891 D3 0.88 5 3 0.0 /
993389105 'FRQTPAT' 933891 933891 D3 56.5 100 0.16 0.0 /
993389106 'FRQTPAT' 933891 933891 D3 58.5 100 300 0.0 /
993389107 'FRQTPAT' 933891 933891 D3 -100 61.2 300 0.0 /
993389108 'FRQTPAT' 933891 933891 D3 -100 62 0.16 0.0 /

///NEP-22-G03-016
993891 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/993891 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

993891 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

999389101 'VTGTPAT' 993891 993891 D3 -1 1.2 0.16 0.0 /
999389102 'VTGTPAT' 993891 993891 D3 -1 1.1 2 0.0 /
999389103 'VTGTPAT' 993891 993891 D3 0.5 5 1.1 0.0 /
999389104 'VTGTPAT' 993891 993891 D3 0.88 5 3 0.0 /
999389105 'FRQTPAT' 993891 993891 D3 56.5 100 0.16 0.0 /
999389106 'FRQTPAT' 993891 993891 D3 58.5 100 300 0.0 /
999389107 'FRQTPAT' 993891 993891 D3 -100 61.2 300 0.0 /
999389108 'FRQTPAT' 993891 993891 D3 -100 62 0.16 0.0 /

///NEP-22-G03-017
983891 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/983891 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/
```

```
983891 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

998389101 'VTGTPAT' 983891 983891 D3 -1 1.2 0.16 0.0 /
998389102 'VTGTPAT' 983891 983891 D3 -1 1.1 2 0.0 /
998389103 'VTGTPAT' 983891 983891 D3 0.5 5 1.1 0.0 /
998389104 'VTGTPAT' 983891 983891 D3 0.88 5 3 0.0 /
998389105 'FRQTPAT' 983891 983891 D3 56.5 100 0.16 0.0 /
998389106 'FRQTPAT' 983891 983891 D3 58.5 100 300 0.0 /
998389107 'FRQTPAT' 983891 983891 D3 -100 61.2 300 0.0 /
998389108 'FRQTPAT' 983891 983891 D3 -100 62 0.16 0.0 /

///NEP-22-G03-001
    933631 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8
        @!/ -------- ICONS ------
        @!/ 1.RateFlag   2.PQpriority
                0           0
        @!/ -------- CONS ------
        @!/ 1.Tg        2.Tflt      3.Iqrmax     4.Iqrmin   5.rrpwr
                0.006       0.006       30.00       -30.00      10.00
        @!/ 6.Te        7.Imax
                0.006       1.00/
@!/---------------------------------------------------------------------------------------------
  933631 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
        @!/ -------- ICONS ------
        @!/ 1.PFflag     2.Vflag       3.Qflag      4.Pflag     5.PQflag     6.VcmpFlag
                0            0             0           0                                     0           0
        @!/ -------- CONS ------
        @!/ 1.Vdip         2.Vup          3.Trv          4.dbd1        5.dbd2
                0.8500         1.4000         0.0060        -0.001         0.001
        @!/ 6.Kqv          7.Iqh1         8.Iql1         9.Vref0       10.Iqfrz
                2.0000         2.0000        -2.0000         0.0000        0.0000
        @!/ 11.Thld        12.Thld2       13.Tp          14.QMax       15.QMin
                0.0000                        0.0000                        0.0060         1.0000       -1.0000
        @!/ 16.Vmax        17.Vmin        18.Kqp         19.Kqi        20.Kvp
                1.2000        -1.2000         1.0000         5.0000        1.0000
        @!/ 21.Kvi         22.Vbias       23.Tiq           24.dPmax      25.dPmin
                5.0000         0.0000                  0.0060         30.000       -30.000
        @!/ 26.Pmax        27.Pmin        28.Imax        29.Tpord      30.Vq1
                1.0000        -1.0000         1.2000         0.0250        0.1000
        @!/ 31.Iq1         32.Vq2         33.Iq2         34.Vq3        35.Iq3
                1.0000         1.1000         1.0000         0.0000        0.0000
        @!/ 36.Vq4         37.Iq4         38.Vq5         39.Iq5        40.Vq6
     0.0000         0.0000         0.0000         0.0000         0.0000
        @!/ 41.Iq6         42.Vq7         43.Iq7         44.Vq8        45.Iq8
     0.0000         0.0000         0.0000         0.0000         0.0000
        @!/ 46.Vq9         47.Iq9         48.Vq10        49.Iq10       50.Vp1
     0.0000         0.0000         0.0000         0.0000         0.1000
        @!/ 51.Ip1         52.Vp2         53.Ip2         54.Vp3        55.Ip3
     1.0000         1.1000         1.0000         0.0000         0.0000
        @!/ 56.Vp4         57.Ip4         58.Vp5         59.Ip5        60.Vp6
     0.0000         0.0000         0.0000         0.0000         0.0000
        @!/ 61.Ip6         62.Vp7         63.Ip7         64.Vp8        65.Ip8
     0.0000         0.0000         0.0000         0.0000         0.0000
        @!/ 66.Vp9         67.Ip9         68.Vp10        69.Ip10       70.Rc
     0.0000         0.0000         0.0000         0.0000         0.0000
        @!/ 71.Xc          72.Tr1         73.Kc          74.Ke         75.Vblkl
     0.0000         0.0060         0.0000         1.0000         0.5000
        @!/ 76.Vblkh       77.Tblk
     1.1000         0.0000/

993363101 'VTGTPAT' 933631 933631 D3 -1 1.2 0.16 0.0 /
993363102 'VTGTPAT' 933631 933631 D3 -1 1.1 2 0.0 /
993363103 'VTGTPAT' 933631 933631 D3 0.5 5 1.1 0.0 /
993363104 'VTGTPAT' 933631 933631 D3 0.88 5 3 0.0 /
993363105 'FRQTPAT' 933631 933631 D3 56.5 100 0.16 0.0 /
993363106 'FRQTPAT' 933631 933631 D3 58.5 100 300 0.0 /
```

```
993363107 'FRQTPAT' 933631 933631 D3 -100 61.2 300 0.0 /
993363108 'FRQTPAT' 933631 933631 D3 -100 62 0.16 0.0 /

///NEP-22-G03-033
933681 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933681 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933681 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993368101 'VTGTPAT' 933681 933681 D3 -1 1.2 0.16 0.0 /
993368102 'VTGTPAT' 933681 933681 D3 -1 1.1 2 0.0 /
993368103 'VTGTPAT' 933681 933681 D3 0.5 5 1.1 0.0 /
993368104 'VTGTPAT' 933681 933681 D3 0.88 5 3 0.0 /
993368105 'FRQTPAT' 933681 933681 D3 56.5 100 0.16 0.0 /
993368106 'FRQTPAT' 933681 933681 D3 58.5 100 300 0.0 /
993368107 'FRQTPAT' 933681 933681 D3 -100 61.2 300 0.0 /
993368108 'FRQTPAT' 933681 933681 D3 -100 62 0.16 0.0 /

///NEP-22-G03-020
933901 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933901 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933901 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993390101 'VTGTPAT' 933901 933901 D3 -1 1.2 0.16 0.0 /
993390102 'VTGTPAT' 933901 933901 D3 -1 1.1 2 0.0 /
993390103 'VTGTPAT' 933901 933901 D3 0.5 5 1.1 0.0 /
993390104 'VTGTPAT' 933901 933901 D3 0.88 5 3 0.0 /
993390105 'FRQTPAT' 933901 933901 D3 56.5 100 0.16 0.0 /
993390106 'FRQTPAT' 933901 933901 D3 58.5 100 300 0.0 /
993390107 'FRQTPAT' 933901 933901 D3 -100 61.2 300 0.0 /
993390108 'FRQTPAT' 933901 933901 D3 -100 62 0.16 0.0 /

///NEP-22-G03-021
993901 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/993901 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

993901 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
```

```
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

999390101 'VTGTPAT' 993901 993901 D3 -1 1.2 0.16 0.0 /
999390102 'VTGTPAT' 993901 993901 D3 -1 1.1 2 0.0 /
999390103 'VTGTPAT' 993901 993901 D3 0.5 5 1.1 0.0 /
999390104 'VTGTPAT' 993901 993901 D3 0.88 5 3 0.0 /
999390105 'FRQTPAT' 993901 993901 D3 56.5 100 0.16 0.0 /
999390106 'FRQTPAT' 993901 993901 D3 58.5 100 300 0.0 /
999390107 'FRQTPAT' 993901 993901 D3 -100 61.2 300 0.0 /
999390108 'FRQTPAT' 993901 993901 D3 -100 62 0.16 0.0 /

///NEP-22-G03-044
930851 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/930851 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

930851 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993085101 'VTGTPAT' 930851 930851 D3 -1 1.2 0.16 0.0 /
993085102 'VTGTPAT' 930851 930851 D3 -1 1.1 2 0.0 /
993085103 'VTGTPAT' 930851 930851 D3 0.5 5 1.1 0.0 /
993085104 'VTGTPAT' 930851 930851 D3 0.88 5 3 0.0 /
993085105 'FRQTPAT' 930851 930851 D3 56.5 100 0.16 0.0 /
993085106 'FRQTPAT' 930851 930851 D3 58.5 100 300 0.0 /
993085107 'FRQTPAT' 930851 930851 D3 -100 61.2 300 0.0 /
993085108 'FRQTPAT' 930851 930851 D3 -100 62 0.16 0.0 /

///NEP-22-G03-043
990851 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/990851 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

990851 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

999085101 'VTGTPAT' 990851 990851 D3 -1 1.2 0.16 0.0 /
999085102 'VTGTPAT' 990851 990851 D3 -1 1.1 2 0.0 /
999085103 'VTGTPAT' 990851 990851 D3 0.5 5 1.1 0.0 /
999085104 'VTGTPAT' 990851 990851 D3 0.88 5 3 0.0 /
999085105 'FRQTPAT' 990851 990851 D3 56.5 100 0.16 0.0 /
999085106 'FRQTPAT' 990851 990851 D3 58.5 100 300 0.0 /
999085107 'FRQTPAT' 990851 990851 D3 -100 61.2 300 0.0 /
999085108 'FRQTPAT' 990851 990851 D3 -100 62 0.16 0.0 /
```

This appendix has been redacted for Critical Energy/
Electric Infrastructure Information (CEII).

Appendix D – N-0 and N-1 Thermal and Voltage Results

This appendix has been redacted for Critical Energy/
Electric Infrastructure Information (CEII).

Appendix E – Stability Analysis Plots

WMA Group 3 cluster stability plots_pdf.zip

This appendix has been redacted for Critical Energy/
Electric Infrastructure Information (CEII).

Appendix F – PSCAD Analysis Report

Western MA DER Group 3 PSCAD Report 5_20_2022.pdf