Transmission Planning Technical Guide

Appendix C

Guidelines for Treatment of Demand Resources in System Planning Analysis

System Planning

October 6, 2014

Guidelines for Treatment of Demand Resources in System Planning Analyses

Through the Forward Capacity Market (FCM), Demand Resources (DR) can be procured to provide capacity and have future commitments similar to that of a generator. In order to reflect their impact on the system, these resources need to be modeled appropriately and consistently. This document provides guidelines for the modeling of Demand Resources in the various analyses conducted.

Additionally, the ISO publishes an Energy Efficiency (EE) forecast in the annual 10-year Capacity Energy Loads and Transmission (CELT) forecast. The EE forecast recognizes projected investment in energy efficiency through state-sponsored demand side management. The forecast covers the years in the 10-year load forecast horizon which are not covered by the cleared Forward Capacity Auction (FCA) commitment periods. For long-range analysis beyond the horizon of the last cleared FCA, the EE forecast is utilized in the study, when appropriate.

The discussions below are to be used in conjunction with the DR base case assumptions chart for modeling DR in the various base cases.

Demand Resources Overview

Demand Resources are installed measures that result in verifiable reductions in end-use consumption of electricity on the New England power system. There are currently two categories of DR in the FCM: Passive Demand Resources (Passive DR) and Active Demand Resources (Active DR).

Active DR

Active DR reduces their load based on ISO dispatch instructions under real-time system conditions. Active DR consists of Real-Time Demand Response resources (RTDR) and Real-Time Emergency Generation resources (RTEG). After June 2017, RTDR will no longer exist and will be replaced with Demand Response Capacity Resources (DRCR). DRCR will also be dispatchable load reduction with the additional requirement of bidding into the day-ahead energy market and will be integrated in the co-optimized dispatch model including acting as 10 and 30 minutes reserves.

- **RTDR** thru May of 2017, will be activated when the ISO forecasts/implements Operating Procedure No.4 – Action During a Capacity Deficiency (OP-4), Action 2 or higher. The ISO may forecast Action 2 or higher the day before the operating day and/or may implement OP-4, Action 2 or higher during the operation day.
- **DRCR** after May 31, 2017 will be activated based on economic dispatch/clearing in the energy market. Performance and penalties will be identical to those applied to generators.
- **RTEG** are distributed generation which have air permit restrictions that limit their operations to OP-4, Action 6 – an emergency action which also implements voltage reductions of five percent (5%) of normal operating voltage that require more than 10 minutes to implement.

From a modeling perspective the changing of RTDR to DRCR will not change how the particular class of Demand Resources is modeled in the base cases.

Passive DR

Passive DR reduce their energy demand (MW) during peak hours and are non-dispatchable. Passive DR can be composed of three types of measures: Energy Efficiency, Load Management, and Distributed Generation.

- **Energy Efficiency** involves installing more efficient equipment to achieve a continuous and permanent reduction in energy use. Such equipment can include the use of more efficient lighting, motors, refrigeration, HVAC equipment and control systems, and industrial process equipment. A significant portion of the Passive DR is composed of energy efficiency.
- **Load Management** involves measures, systems, or strategies by end-use customers to curtail their electrical usage during peak hours or shift electrical use to off-peak hours which reduce the amount of capacity needed during peak hours.
- **Distributed Generation** involves behind the meter generation resources that would reduce the amount of energy that would need to be produced by other capacity resources in New England.

Passive DR consists of two types of Resources: On-Peak and Seasonal Peak.

- **On-Peak Demand Resources** provide their load reduction during summer on-peak hours (1:00pm – 5:00pm in June, July, and August) and winter on-peak hours (5:00pm – 7:00pm in December and January).
- **Seasonal Peak Demand Resources** must reduce load during non-holiday weekdays when the real-time system hourly load is equal to or greater than 90% of the most recent "50/50" system peak load forecast for the applicable summer or winter season.

It should be noted that distributed generation shows up both as passive and active Demand Resources. This is because, as described in Section I.2.2 of the ISO New England Transmission, Markets and Services Tariff (the "Tariff"), "Distributed Generation is defined as generation resources directly connected to end-use customer load and located behind the end-use customer's meter, which reduce the amount of energy that would otherwise have been produced by other capacity resources on the electricity network in the New England Control Area during Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, or Real-Time Emergency Generation Event Hours, provided that the aggregate nameplate capacity of the generation resource does not exceed 5 MW, or does not exceed the most recent annual non-coincident peak demand of the end-use metered customer at the location where the generation resource is directly connected, whichever is greater. Generation resources cannot participate in the Forward Capacity Market or the Energy Markets as Demand Resources or Demand Response Resources, unless they meet the definition of Distributed Generation."

To further clarify the definition, Passive DR that is based on DG measures cannot participate in energy markets. Active DR that is based on DG measures may participate in energy markets as DR up to the minimum load at the facility (when the retail delivery point reads zero). Push back of energy from an active DR will be treated as generation for the purpose of energy. However, all the output from the generator, regardless of pushback is treated as capacity.

Energy Efficiency Forecast

The Forward Capacity Auction procures supply-side resources, including EE, on a three-year-ahead basis. In addition the ISO produces an EE forecast that estimates reductions in energy and demand from state-regulated utility Energy Efficiency programs for the years beyond the three-year Forward Capacity Auction. The EE forecast is published to accompany the traditional 10-year load forecast, typically in early spring of each year.

Energy Efficiency is a type of Passive DR that could be in the form of either On-Peak or Seasonal Peak Demand Resources. Since identical availability assumptions are made for the Seasonal Peak and On-Peak Demand Resources, the same assumption will be made for the EE forecast.

For System Planning studies, the Passive DR will be classified into the following categories:

1. **On-Peak Demand Resources** – Consists of the On-Peak Demand Resources cleared in the FCM
2. **Seasonal Peak Demand Resources** - Consists of the Seasonal Peak Demand Resources cleared in the FCM
3. **Forecasted Energy Efficiency** – Consists of forecasted Energy Efficiency (On-Peak and Seasonal Peak) programs for years beyond the three-year horizon of the FCM.

The EE forecast like the load forecast projects out to the 10^{th} year (for example 2021 is the last year in the 2012 CELT forecast). Typically, some long-range transmission planning studies like Transmission Need/Solution Steady State Analyses look out to the 11^{th} year (2022 for the 2012 CELT). In such cases, the load forecast is extrapolated assuming the same percentage of load growth from year 10 to 11 as was the load growth from years 9 to 10. A similar process is used to forecast the EE for year 11, where the percentage EE growth from year 9 to 10 is used to obtain the growth from years 10 to 11.

Demand Resources in System Planning Analyses

System Planning conducts various analyses, studies, assessments and calculations to ensure the continued reliability of the New England transmission system on both a short-range and long-range basis. For the purposes of this guideline, a short-range assessment typically looks approximately 3 years or less into the future. A long-range assessment typically looks 3 years into the future and beyond. These analyses are performed at various load levels including but not limited to 90/10 Peak Load, 50/50 Peak Load, and Off-Peak load.

Each supply resource in the FCM obtains a summer and winter Qualified Capacity (QC). The QC of a resource is the maximum obligation that the resource is allowed to take in the FCM. For each commitment period the resource obtains a Capacity Supply Obligation (CSO). The CSO is the MW of capacity obligation of a supply resource during all or a portion of the specific Capacity Commitment Period (CCP). The CSO is always less than or equal to the Qualified Capacity.

Short-Range Assessment

A short-range assessment looks approximately three years or less into the future and the FCM procures resources three years ahead of time. Hence, there is greater certainty about the resources that are or will be available in this timeframe. Since all the potential study years fall into one of the cleared Capacity Commitment Periods, and most of the passive DR participates in FCM, there is no need to incorporate any forecasted EE into this analysis. Also, the DR will have a CSO for the different timeframes in the three-year study period. Hence the CSO for both the passive and active DR will be available to be used for this analysis. However, some of the short-range assessments, like new Resource adequacy related studies, may be based on Qualified Capacities and hence the QC may be used.

The following list covers most of the different short-range assessments:

1. FCM De-list Steady State Analysis (Permanent and Non-Price Retirement)
2. FCM New Resource Qualification Initial Interconnection Analysis under the Network Capability Interconnection Standard Thermal Analysis
3. Overlapping Interconnection Impacts Thermal Analysis (FCM New Resource Qualification Overlapping Interconnection Impacts Analysis, Overlapping Interconnection Impacts Restudy Analysis, and Preliminary Analyses of Overlapping Interconnection Impacts under the Capacity Capability Interconnection Standard)
4. FCM De-list Steady State Analysis (Static, Dynamic, and Export)
5. Forward Capacity Market Transmission Security Analysis and Capacity Zone Formation
6. Installed Capacity Requirement, Maximum Capacity Limit, and Local Resource Adequacy Requirement Calculations
7. Tie Reliability Benefit Studies
8. NERC/NPCC Seasonal Resource Adequacy Assessments
9. Resource Adequacy Related Studies

Long-Range Assessment

A long-range assessment looks beyond the three-year Forward Capacity Market horizon. These timeframes do not fall into a cleared commitment period and hence the CSO is not available for these study years. Moreover, if there is a need for these resources in these future commitment periods the de-list bids supplied would not be accepted and hence the assumption is made that these resources will be available to their full Qualified Capacity. Also, the EE forecast will be used for the years which do not fall into a cleared FCM capacity commitment period.

The following list covers most of the different long-range assessments:

1. System Impact Study Steady State Analysis
2. Transmission Need/Solution Steady State Analysis and Market Resource Alternative Analysis
3. Transfer Limit Steady State Analysis
4. Steady State Analysis (Area Review, Bulk Power System Testing, and Interregional Analysis)
5. Short Circuit Analysis
6. Stability Analysis
7. NERC/NPCC Long-Term Resource Adequacy (LTRA) Assessments
8. Regional System Plan Capacity Resource Studies (Economic, Resource Adequacy, Fuel Diversity, Operable Capacity, Generation Emissions, etc.)

It must be noted that for the above types of analyses if the study year happens to fall into the three-year horizon then no forecasted EE will be assumed for the analysis. An example would be the System Impact Study for a generator that is coming into service in two years. This study would only utilize the Qualified Capacity of the cleared DR in the year of study. Even though the CSO for the resources may be available the QC will be utilized for consistency with the studies that look beyond three years

System Planning Analyses

The following sections summarize the various types of reliability analyses performed within system planning. Additionally, these sections describe the types of Demand Resources that will be modeled within each analysis.

System Planning analyses will be divided into short-range and long-range analyses to facilitate discussion of the DR assumptions.

A. Short-Range Analysis

A.1 FCM De-list Steady State Analysis (Permanent and Non-Price Retirement)

Analysis Overview: A Non-Price Retirement Request (NPR) is a binding request to retire a generator or Demand Resource from the FCM. Once retired as a result of a NPR, a generator's Interconnection Rights are terminated and any other generating assets that are associated (mapped) to the resource are also retired. For Demand Resources with an approved NPR, the Demand Resource will be retired from the FCM but any other associated Demand Resource assets are retired separately and may not be used to support new Qualified Capacity for the same CCP in which it was retired.

A Permanent De-list Bid (PDL) is a request to permanently remove all or part of a Resource from the FCM. An approved PDL does not result in the retirement of any associated (mapped) assets and a generator with an approved PDL will not have its Interconnection Rights (IR) terminated.

Typical Load Level(s): 90/10 Peak Load[1], Off-Peak, and Minimum Load

DR Represented in Analysis: Both NPR and PDL analyses will include the impact of Passive DR, RTDR, (DRCR after May 2017) and RTEG in Peak Load Level analyses, as these resources are intended to be available and utilized under these conditions. The existing Demand Resources (On-Peak, Seasonal Peak, RTDR, DRCR and RTEG) will be modeled at their Qualified Capacity (QC) level to begin the delist analysis. All resources with accepted de-list bids are modeled at their Qualified Capacity minus the de-listed amount.

Off-Peak and minimum load level testing is performed based on a fixed load level that is representative of historical data. Since the historical data includes the effect of Demand Resources, DR will not be explicitly modeled for off-peak load level conditions.

A.2 FCM New Resource Qualification Initial Interconnection Analysis under the Network Capability Interconnection Standard Thermal Analysis

Analysis Overview: As described in PP-10, the initial interconnection analysis is performed consistent with criteria and conditions described in PP-5-6. For the proposed New Generating Capacity Resource, if the thermal analysis has not been or will not be conducted as part of a Feasibility or System Impact Study under the L/SGIP, the objective of the initial interconnection thermal analysis to identify if any system upgrades are needed to satisfy Sections 3.2, 3.3, and 4 of PP-3 on a regional (i.e. New England Control Area) and sub-regional basis, subject to the conditions analyzed.

In accordance with Tariff Section III.13, the result of the initial interconnection analysis does not supersede, replace, or satisfy any of the requirements of Schedules 22 and 23 of Section II of the Tariff. The initial interconnection analysis is for the purpose of qualification for participation in the FCA only, and does not constitute a right or approval to interconnect, and does not guarantee the ability to interconnect.

Typical Load Level(s): 90/10 Peak Load

DR Represented in Analysis: The initial interconnection analysis includes the impact of RTDR (DRCR after May 2017) and Passive DR as these Demand Resources are intended to be available and utilized under these system conditions. The initial value for the DR before applying any performance factor is based on the following:

Passive DR and RTDR (DRCR after May 2017) = Qualified Capacities of existing DR entering the Auction

[1] Sensitivity analyses at load levels lower than 100% of the 90/10 peak New England Control area Load will be considered when such lower load levels might result in high voltage conditions, system instability or other unreliable conditions.

This analysis will exclude forecasted EE since the analysis pertains to an upcoming Forward Capacity Auction commitment period.

A.3 Overlapping Interconnection Impacts Thermal Analysis (FCM New Resource Qualification Overlapping Interconnection Impacts Analysis, Overlapping Interconnection Impacts Restudy Analysis, and Preliminary Analyses of Overlapping Interconnection Impacts under the Capacity Capability Interconnection Standard)

Analysis Overview: As described in PP-10, "the analysis of overlapping interconnection impacts under FCM is intended to determine if a proposed New Generating Capacity Resource or new active Demand Resource provides incremental capacity to the system in a manner that meets the Capacity Capability Interconnection Standard (CCIS) established in the Large/Small Generator Interconnection Procedures (L/SGIP)."

Typical Load Level(s): 90/10 Peak Load

DR Represented in Analysis: In accordance with PP-10, "starting with the qualification review for the fifth Forward Capacity Auction (FCA) for the Capacity Commitment Period (CCP) beginning June 1, 2014, Existing Demand Resources will be modeled in the base-case." Existing Demand Resources shall mean On-Peak, Seasonal Peak, RTDR, (DRCR after May 2017) and RTEG which have obtained an obligation in an FCA. The existing Demand Resources will be modeled at their capacity supply obligation (CSO) level from the previous auction.

This analysis will exclude forecasted EE since the analysis pertains to an upcoming Forward Capacity Auction commitment period.

A.4 FCM De-list Steady State Thermal Analysis (Static, Dynamic, and Export)

Analysis Overview: A Static De-list Bid is an option for an Existing Capacity Resource to remove capacity from the Capacity Market at higher prices where the delist bid is submitted in advance of the auction for a single CCP.

A Dynamic De-list Bid is an option for an Existing Capacity Resource to remove capacity from the Capacity Market at lower prices where the delist bid is submitted during the auction for a single CCP.

As described in Section III.13 of the Tariff, an Export De-list Bid is an option for an Existing Generating Capacity Resource within the New England Control Area other than an Intermittent Power Resource or an Intermittent Settlement Only Resource seeking to export all or part of its capacity during a CCP. An Export De-list Bid that is subject to a multiyear contract to sell its capacity outside the New England Control Area will be studied with the DR assumptions used for NPR and Permanent De-list Bids.

Typical Load Level(s): 90/10 Peak Load[2], Off-Peak, and Minimum Load

DR Represented in Analysis: Static, Dynamic, and Export Bid analyses are performed on a short-range basis and include the impact of Passive DR, RTDR, (DRCR after May 2017) and RTEG in Peak Load Level analyses, as these resources are intended to be available and utilized under these conditions.

Off-Peak and minimum load level testing is performed based on a fixed load level that is representative of historic data. Since the historic data includes the effect of Demand Resources, DR will not be explicitly modeled for the off-peak load level conditions.

The Demand Resources are modeled at their Qualified Capacity to start the de-list analysis. All resources with accepted de-list bids are modeled at their Qualified Capacity minus the de-listed amount.

This analysis will exclude forecasted EE since the analysis pertains to an upcoming Forward Capacity Auction commitment period.

A.5 Forward Capacity Market Transmission Security Analysis and Capacity Zone Formation

Analysis Overview: As described in PP-10, "Prior to each FCA, the ISO shall determine the capacity requirement of each import-constrained Load Zone or import-constrained subdivision of a Load Zone, by performing a Transmission Security Analysis. The Transmission Security Analysis will be performed in accordance with Section III.12.2.1.2 of Market Rule 1 and the assumptions described in Section 7.1 and Appendix A of this procedure." The analysis for Capacity Zone Formation is triggered by the aforementioned TSA analysis and hence the same assumptions will be utilized for the capacity zone formation.

Typical Load Level(s): 90/10 Peak Load

DR Represented in Analysis: These analyses are performed on a short-range basis and thus include the impact of Passive DR, RTDR, (DRCR after May 2017) and RTEG as these resources are intended to be available and utilized under these conditions.

These analyses will exclude forecasted EE since the analysis pertains to an upcoming Forward Capacity Auction commitment period.

These analyses utilize the Qualified Capacity for the Demand Resources.

A.6 Installed Capacity Requirement, Local Resource Adequacy Requirement, Local Sourcing Requirement, Maximum Capacity Limit and Demand Curve Parameters Calculations

Analysis Overview: The ICR is the amount of resources needed to meet the NPCC planning reliability requirements defined for the New England Control Area such that the probability of disconnecting non-interruptible customers (a loss of load expectation or "LOLE") no more than once every ten years (an

[2] Sensitivity analyses at load levels lower than 100% of the 90/10 peak New England Control area Load will be considered when such lower load levels might result in high voltage conditions, system instability or other unreliable conditions.

LOLE of 0.1 days per year). The methodology for calculating the ICR is set forth in Section III.12.1 of the Tariff. The ICR is calculated in advance of every FCA and Annual Reconfiguration Auction ("ARA").

In addition, Tariff Section III.12.1 states that the ISO shall determine, by applying the same modeling assumptions and methodology used in determining the Installed Capacity Requirement, the capacity requirement value for each LOLE probability specified in Section III.13.2.2 for the System-Wide Capacity Demand Curve.

As described in Tariff Section III.12.2, the ISO is required to calculate the capacity requirements for each modeled Capacity Zone associated with an upcoming FCA and ARAs. The Local Sourcing Requirement ("LSR") shall represent the minimum amount of capacity that must be procured within an import-constrained Load Zone and the Maximum Capacity Limit ("MCL") shall represent the maximum amount of capacity that can be procured in an export-constrained Load Zone to meet the ICR.

Typical Load Level(s): All Load Levels

DR Represented in Calculations: These analyses include the impact of Passive and Active DR Resources by modeling the DR Qualified Capacity as supply-side resources. The impact of all DR is included in the calculations since the ICR is a measure of the resources necessary to meet the 0.1 days per year reliability criterion including the load relief assumed obtainable from OP-4 actions, and DR are included in the resources used to meet the requirement. The DR Qualified Capacity is modeled in MW blocks by Load Zones and by type of DR with a performance assumption applied. Passive resources are assumed as 100% available. The active DR has an assumed forced outage rate based on the historical performance (both OP-4 events and performance audits) of DR with CSOs in the FCM.

This analysis excludes forecasted EE since the analysis is within the FCM timeline.

A.7. Tie Reliability Benefit Studies Calculations

Analysis Overview: As described in Tariff Section III.12.9, the ICR, LRA and MCL shall be calculated assuming appropriate tie benefits, if any, available from interconnections with adjacent Control Areas with which agreements providing for emergency support are in effect between the ISO and that adjacent Control Area, including but not limited to inter-Control Area coordination agreements, emergency aid agreements and the NPCC Regional Reliability Plan. The tie benefits study is conducted using the probabilistic General Electric ("GE") Multi-area Reliability Simulation ("MARS") program to model the expected system conditions of New England and its directly interconnected neighboring Control Areas of Québec, New Brunswick and New York. All of these Control Areas are assumed to be "At-Criteria," which means that the capacity of all three neighboring Control Areas is adjusted so that they would each have a LOLE of once in ten years (0.1 days per year LOLE).

Typical Load Level(s): All Load Levels

DR Represented in Calculations: These analyses include the impact of Passive and Active DR Resources by modeling the DR at their Qualified Capacities with a performance assumption applied. Passive DR is assumed as 100% available. The availability of active DR reflects their assumed forced outage rate based on the historical performance (both OP-4 events and performance audits) of DR with CSOs in the FCM.

This analysis excludes forecasted EE since the analysis is within the FCM timeline.

A.8. NERC/NPCC Deterministic Seasonal Resource Adequacy Assessments

Analysis Overview: These analyses are very similar to the NERC LTRA Analyses, only they are performed on a short-range basis, just prior to the upcoming summer or winter period. These seasonal assessments document:

1) The actual peak load of the most recent like season and the projected peak load of the season of interest,
2) The existing and future-planned summer and winter generation supply and Demand Resource capacity, and
3) Imports and exports.

Reserve margins are calculated from this information using a deterministic spreadsheet function. This is a regulatory submittal to comply with NERC/NPCC Reliability Requirements.

Typical Load Level(s): 50/50 Peak Load

DR Represented in Assessments: These analyses are performed annually for the upcoming summer or winter season. These NERC/NPCC Seasonal Assessments include the impacts of both Passive and Active DR. The DR is modeled in aggregate on a system-wide basis reflecting the amount of qualified resources. The Passive DR, which includes On-Peak and Seasonal Peak, is reflected in the Total Internal Demand. The Active DR is summarized into the category “Load as a Capacity Resource,” which includes RTDR (DRCR after for periods after May 2017) and RTEG. This Active DR capacity amount is then modeled as demand-side capacity within the deterministic spreadsheets, which is then used to calculate reserve margins. The Demand Resources will be modeled at their capacity supply obligation (CSO) level for the commitment period under study.

This analysis will exclude forecasted EE since the analysis pertains to a cleared Forward Capacity Auction commitment period.

A.9.Resource Adequacy Related Studies

Analysis Overview: Resource Adequacy related studies use two basic calculation methodologies. One methodology employs probabilistic mathematics reflecting probabilistic input assumptions and the other methodology employs deterministic mathematics reflecting deterministic input assumptions.

Typical Load Level(s): All Load Levels

DR Represented in Studies: In probabilistic studies, DR is modeled with the Qualified Capacity ratings and assumed forced outage rate. In deterministic studies, DR is modeled based on the Capacity Supply Obligations.

B. Long-Range Analysis

B.1. System Impact Study Steady State Analysis

Analysis Overview: A System Impact Study (SIS) Steady State Analysis is a rigorous assessment designed to ensure that new generation added to the region's transmission system or changes to the transmission system itself will not adversely impact its reliability or operating characteristics. This analysis assesses both the thermal and steady state voltage characteristics of the system under normal and postulated contingency conditions against a set of pre-defined performance criteria. Simulation results that fall outside of the performance criteria are then addressed to ensure that system reliability is maintained.

Typical Load Level(s): 90/10 Peak Load, Off-Peak and Minimum Load

DR Represented in Analysis: An SIS Steady State Analysis is performed on a long-range basis of the system and thus would include the impact of RTDR (DRCR after May 2017) and Passive DR in Peak Load Level (90/10) analyses as this Demand Resource is intended to be available and utilized under these system conditions.

The Passive DR (excluding EE forecast) and Active DR are modeled based on the most recently concluded Forward Capacity Auction. The initial value for the DR before applying any performance factor is based on the following:

Passive DR and RTDR (DRCR after May 2017) = Qualified Capacities of existing DR entering the Auction + Capacity Supply Obligation of new DR

The EE forecast is used based on the most recent CELT forecast. If the study year is within the three-year FCM horizon then no forecasted EE will be assumed for the analysis.

Off-Peak and minimum load level testing is performed based on a fixed load level that is representative of historic data. Since the historic data includes the effect of Demand Resources, DR will not be explicitly modeled for the off-peak load level conditions. The exception to this is if there is a significant generator known to be considered as a RTDR resource (DRCR after May 2017) which may impact the study results. RTDR (DRCR after May 2017), when it consists of a generator and is explicitly modeled, are to be included and treated consistent with other generators in the study area.

The impact of RTEG will not be included in a SIS Steady State Analysis because in general, long-range analyses should not be performed such that the system must be in an emergency state as required for the implementation of OP-4, Action 6.

B.2. Transmission Need/Solution Steady State Analysis and Market Resource Alternative Analysis

Analysis Overview: A Transmission Need/Solution Steady State Analysis assesses both the thermal and steady state voltage characteristics of the system under normal and postulated contingency conditions against a set of pre-defined performance criteria. Simulation results that fall outside of the performance criteria are then addressed to ensure that overall system reliability is maintained.

The Market Resource Alternative analysis is based on the results of the Transmission Need Steady State Analysis and is aimed at providing possible long-range alternative hybrid solutions to remove the thermal and voltage constraints identified in the Needs Analysis.

Typical Load Level(s): 90/10 Peak Load, Off-Peak and Minimum Load

DR Represented in Analysis: A Transmission Need/Solution Steady State Analysis is performed on a long-range basis of the system and thus would include the impact of Passive DR in Peak Load Level (90/10) analyses as this Demand Resource is intended to be available and utilized under these system conditions.

The Passive DR (excluding EE forecast) and Active DR are modeled based on the most recently concluded Forward Capacity Auction. The initial value for the DR before applying any performance factor is based on the following:

Passive DR and RTDR (DRCR after May 2017) = Qualified Capacities of existing DR entering the Auction + Capacity Supply Obligation of new DR

The EE forecast is used based on the most recent CELT forecast. If the study year is within the three-year FCM horizon then no forecasted EE will be assumed for the analysis.

Off-Peak and minimum load level testing is performed based on a fixed load level that is representative of historic data. Since the historic data includes the effect of Demand Resources, DR will not be explicitly modeled for the off-peak load level conditions. The exception to this is if there is a significant generator known to be considered as a DR resource which may impact the study results. DR, when it consists of a generator and is explicitly modeled, are to be included and treated consistent with other generators in the study area.

The impact of RTEG will not be included in a Transmission Need/Solution Steady State Analysis because in general, long-range analyses should not be performed such that the system must be in an emergency state as required for the implementation of OP-4, Action 6.

As the Market Resource Alternative analysis is based on the Transmission Need Steady State Analysis, the DR representation is the identical to its representation in the Needs analysis.

B.3. Transfer Limit Steady State Analysis

Analysis Overview: A Transfer Limit Steady State Analysis assesses both the thermal and steady state voltage characteristics of the system under normal and postulated contingency conditions against a set of pre-defined performance criteria. This analysis is performed to establish transmission interface limits which prevent thermal overloads or cascading thermal overloads or cascading voltage collapse from occurring on the system. Simulation results that fall outside of the performance criteria are then utilized to establish limits to ensure that overall system reliability is maintained.

Typical Load Level(s): 90/10 Peak Load and Off-Peak

DR Represented in Analysis: A Transfer Limit Steady State Analysis is performed on a long-range basis of the system and thus would include the impact of Passive DR in Peak Load Level (90/10) analyses as this Demand Resource is intended to be available and utilized under these system conditions.

The Passive DR (excluding EE forecast) and Active DR are modeled based on the most recently concluded Forward Capacity Auction. The initial value for the DR before applying any performance factor is based on the following:

Passive DR and RTDR (DRCR after May 2017) = Qualified Capacities of existing DR entering the Auction + Capacity Supply Obligation of new DR

The EE forecast is used based on the most recent CELT forecast. If the study year is within the three-year FCM horizon then no forecasted EE will be assumed for the analysis.

Off-Peak load level testing is performed based on a fixed load level that is representative of historic data. Since the historic data includes the effect of Demand Resources, DR will not be explicitly modeled for the off-peak load level conditions. The exception to this is if there is a significant generator known to be considered as a DR resource which may impact the study results. DR, when it consists of a generator and is explicitly modeled, are to be included and treated consistent with other generators in the study area.

The impact of RTEG will not be included in a Transfer Limit Steady State Analysis because in general, long-range analyses should not be performed such that the system must be in an emergency state as required for the implementation of OP-4, Action 6.

B.4. Steady State Analysis (Area Review, Bulk Power System Testing, and Interregional Analysis)

Analysis Overview: A Steady State Analysis assesses both the thermal and steady state voltage characteristics of the system under normal and postulated contingency conditions against a set of pre-defined performance criteria. Simulation results that fall outside of the performance criteria are then addressed to ensure that overall system reliability is maintained.

Typical Load Level(s): 90/10 Peak Load and Off-Peak

DR Represented in Analysis: A Steady State Analysis is performed on a long-range basis of the system and thus would include the impact of Passive DR and RTDR in Peak Load Level (90/10) analyses, as these Demand Resources are intended to be available and utilized under these system conditions.

The Passive DR (excluding EE forecast) and Active DR are modeled based on the most recently concluded Forward Capacity Auction. The initial value for the DR before applying any performance factor is based on the following:

Passive DR and RTDR = Qualified Capacities of existing DR entering the Auction + Capacity Supply Obligation of new DR

The EE forecast is used based on the most recent CELT forecast. If the study year is within the three-year FCM horizon then no forecasted EE will be assumed for the analysis.

Off-Peak load level testing is performed based on a fixed load level that is representative of historic data. Since the historic data includes the effect of Demand Resources, DR will not be explicitly modeled for the off-peak load level conditions. The exception to this is if there is a significant generator known to be considered as a DR resource which may impact the study results. DR, when it consists of a generator and is explicitly modeled, are to be included and treated consistent with other generators in the study area.

The impact of RTEG will not be included in these Steady State Analyses because in general, long range analyses should not be performed such that the system is operating in an emergency state, as required for the implementation of OP-4, Action 6.

B.5. Short Circuit Analysis

Analysis Overview: A Short Circuit Analysis evaluates the effect of a proposed project's impact on the system available fault current levels to determine the project's impact on the short circuit duty of circuit breakers and other system equipment.

Typical Load Level(s): Load Independent

DR Represented in Analysis: Only those Passive DR and RTDR (DRCR after May 2017) that are explicitly modeled as a generator will be included in Short Circuit Analyses. While Energy Efficiency and Load Management programs have little bearing on short circuit analyses, Distributed Generation can contribute to the fault level calculation in distribution networks. The fault level calculation in distribution networks in the presence of Distributed Generation is the sum of the maximum fault currents due to the transmission system through the network transformer and the various generators (or possibly large motors) connected to the distribution network.

In cases where the RTDR (DRCR after May 2017) is a generator, it will also contribute to the fault level calculation in the distribution network when the generator is operated in parallel with the system.

For short circuit analyses, RTEG is assumed to be disconnected from the system and therefore there is no fault current contribution from RTEG and therefore not modeled.

B.6. Stability Analysis

Analysis Overview: A Transient Stability Analysis looks at whether or not electrical machines will remain in synchronism with new steady state power angles after a major system disturbance such as the loss of generation, load, or a transmission line. This analysis also includes evaluation of the transient voltage response of the system as well as system damping.

Typical Load Level(s): 90/10 Peak Load and Off-Peak

DR Represented in Analysis: A Stability Analysis would include the impact of Passive DR and RTDR in Peak Load Level analyses, as these Demand Resources are intended to be available and utilized under these system conditions.

The Passive DR (excluding EE forecast) and Active DR are modeled based on the most recently concluded Forward Capacity Auction. The initial value for the DR before applying any performance factor is based on the following:

Passive DR and RTDR = Qualified Capacities of existing DR entering the Auction + Capacity Supply Obligation of new DR

The EE forecast is used based on the most recent CELT forecast. If the study year is within the three-year FCM horizon then no forecasted EE will be assumed for the analysis.

DR which is explicitly modeled as a generator will be treated consistent with other generators in the study area.

Off-Peak load level testing is performed based on a fixed load level that is representative of historic data. Since the historic data includes the effect of Demand Resources, DR will not be explicitly modeled for the off-peak load level conditions. The exception to this is if there is a significant generator known to be considered as a RTDR (DRCR after May 2017) resource which may impact the study results. DR, when it consists of a generator and is explicitly modeled, is to be included and treated consistent with other generators in the study area.

For Stability Analysis, RTEG is assumed to be disconnected from the system and therefore not modeled.

B.7. NERC Deterministic Long-Range Resource Adequacy (LTRA) Assessments

Analysis Overview: The NERC LTRA is an annual submittal that documents; 1) the actual and projected peak loads and energy demand, 2) the existing, future-planned and conceptual summer and winter supply and demand-side capacity, 3) imports and exports, and 4) the planned transmission information, such as voltage-level circuit-miles and transformers. Reserve margins are calculated from this information using a deterministic spreadsheet function. This is a regulatory submittal to comply with NERC Reliability Requirements.

Typical Load Level(s): 50/50 Peak Load

DR Represented in Assessments: This analysis is performed annually for a 10-year projection. The NERC LTRA includes the impacts of both Passive and Active DR. The DR is modeled in aggregate on a system-wide basis reflecting the amount of qualified resources. Passive DR, which includes On-Peak and Seasonal Peak, is reflected in the Total Internal Demand. The Active DR is summarized into the category "Load as a Capacity Resource," which includes RTDR (DRCR after May 2017) and RTEG. This Active DR capacity amount is then modeled as a demand-side capacity within the deterministic spreadsheets, which is then used to calculate reserve margins.

The Passive DR (excluding EE forecast) and Active DR are modeled based on the most recently concluded Forward Capacity Auction. The initial value for the DR before applying any performance factor is based on the following:

Passive DR = Qualified Capacities of existing DR entering the Auction + Capacity Supply Obligation of new DR

Active DR = Capacity Supply Obligations (CSOs) of existing and new DR at the end of the FCA

The EE forecast is used based on the most recent CELT forecast.

B.8. Regional System Plan Capacity Resource Studies (Economic, Resource Adequacy, Fuel Diversity, Operable Capacity, Generation Emissions, etc.)

Analysis Overview: Regional System Plan capacity resource studies use two basic calculation methodologies. One methodology employs probabilistic mathematics reflecting probabilistic input assumptions and the other methodology employs deterministic mathematics reflecting deterministic input assumptions.

Typical Load Level(s): All Load Levels

DR Represented in Studies: In probabilistic studies, DR is modeled with its Qualified Capacity ratings and assumed forced outage rate. The amount modeled depends on study assumptions and scenarios. In deterministic studies, DR is modeled based on its Qualified Capacity ratings. The amount modeled depends on study assumptions and scenarios.

The EE forecast is used based on the most recent CELT forecast.

Demand Response Modeling

DR is modeled explicitly in the base cases. This approach involves having independent negative loads at each load bus and will model an Active DR, passive DR, and forecasted EE component separately while maintaining constant power factor of the load at a particular bus. These negative loads will be discretely proportionate to the load at the bus with Passive DR and forecasted EE being based on a Load Zone and Active DR being based on a Dispatch Zone.

DR that are explicitly modeled in the base case as a generator will be denoted as being either a passive Demand Resource, a real-time Demand Resource, or a real-time emergency generator by the following convention. The generator associated with a Passive Demand Resource will have a machine ID of "P*" in the base case, the generator associated with a Real-Time Demand Resource will have a machine ID of "A*" in the base case, and the generator associated with a Real-Time Emergency Generator will have a machine ID of "E*" in the base case. The "*" will be replaced with a numerical identifier when modeled in the base case.

DR Performance De-rate Factor in System Planning Analyses

Passive DR are assumed to perform at 100% since passive DR consist of a significant portion of energy efficiency, which is considered always "in-service". In addition to EE, there is also base loaded DG in the Passive DR grouping, such as Combined Heat and Power (CHP), which also performs at many more hours than the peak hours. This value will not be altered each year, but will be held constant until sufficient operating data suggests that another value is warranted. This assumption of performance will be held for the passive DR that has cleared the FCM and for the forecasted EE. The active DR performance assumption must be split into two categories based on the type of system assessment being performed.

- **Short-range Assessments**:
    - In such short-range assessments, the performance assumption for the active DR will be based on the most recently available localized data but may be adjusted as needed to reflect known external factors not reflected in performance audits. Such factors may include but are not limited to asset performance relative to resource CSO and reported maximum interruptible capacity.
- **Long-Range Assessments**:
    - In such long-range assessments, active DR should be included based on the New England average, with all areas of New England using the same performance factor assumption but may be adjusted as needed to reflect known external factors not reflected in performance audits.
    - This value will be set at 75% which is based on historical performance of similar resources. This value will not be altered each year, but will be held constant until sufficient operating data suggests that another value is warranted.

The use of 75% of across New England for long-range assessments may warrant further review and the use of a historical average based upon localized data may be used in the future as consistent patterns of performance begin to appear.

How to use DR Capability Assumptions for Modeling DR as Independent Negative Loads

In order to determine the amount of Passive DR, Active DR, and forecasted EE capacity to include in a study as independent negative loads, a few calculations need to be made using available data.

Initial Value

The preceding sections have discussed the initial values for both the Passive and Active DR. This discussion includes factors like what type of DR will be used (Passive , RTDR , RTEG and forecasted EE) and whether the QC or the CSO will be the basis for the values.

If the Demand Resource consists of a large behind the meter generator (typically greater than 5 MW), and the particular generator has an impact on the study area/study in consideration, the resource will be explicitly modeled. Under this case, the correct initial value to use for that particular Demand Resource shall be consistent with the treatment of other generator assumptions which are documented outside of this guideline.

Initial Value Adjusted for Losses

Once the initial values, which do not include explicitly modeled Demand Resources (large behind the meter generators), are obtained as described above, they need to be adjusted to account for losses that may be included in these totals. This is referred to as the *Adjusted Initial Value*.

Transmission and Distribution Loss Factor Adjustments

Qualified Capacity values and Capacity Supply Obligation values for Demand Resources also include a transmission and distribution loss factor which represents the average avoided peak transmission and distribution losses. Average peak transmission and distribution losses in the New England electric system have been assumed to be 8%. If the power-flow program specifically calculates for losses, then the losses will need to be removed from the Demand Resource sub-type (Passive DR, RTDR, RTEG and forecasted EE) total. Transmission losses shall be assumed to be 2.5% and distribution losses are assumed to be 5.5%, with a Total Loss Factor of 8%.

Formula for Demand Reduction Value:

Demand Reduction Value (DRV) = Initial Value/ Total Loss Factor

Note – The transmission and distribution loss factor adjustment are only used as appropriate for the year and type of analysis being performed as described above.

DRV is the amount of load reduction at the customer meter. Since loads are represented in the network model at the low side of the distribution transformer with the distribution network equivalent, the savings from distribution loss reductions needs to be added back into the DRV values. For New England the assumption is 5.5% losses on the distribution network.

The new value obtained after adding back the distribution losses is the Adjusted Initial Value.

Formula for Adjusted Initial Value:

Adjusted Initial Value = Demand Reduction Value (DRV) * Distribution Loss Savings

Based on a 5.5 % distribution losses assumption, the Distribution loss savings is 1.055.

Applying the Performance Assumptions to the Adjusted Initial Value

The Adjusted Initial Value should be multiplied by the Performance Assumption to be used for the given analysis and Load Level.

The passive DR performance assumption is assumed to be 100% in both long-range and short-range assessments. The forecasted EE is always assumed to have a 100% performance assumption. The active DR performance assumption will depend on the type of system assessment being performed. For a short-range assessment and NPR and PDL analyses, the performance factor will be based on the most recently available localized data. For a long-range assessment, the performance factor will be 75%.

Obtaining the Passive DR, Active DR, and Forecasted EE Components to be Modeled as Independent Negative Loads

The assumption for whether a particular Demand Resource sub-type is utilized for analysis conducted at 90/10 peak load levels can be found using the chart that accompanies this guideline. For a majority of the off peak analysis a fixed load level that is representative of historic data is utilized. It is assumed that the DR is included in the fixed load level. For a few analyses the DR assumption for off-peak loads is dependent on the specific study and these will be handled on a case by case basis. An example would be the Tie Reliability Benefit Studies where the assumptions are updated via the PSPC process.

Combining the above steps, the formula below describes how to derive the amount of Passive DR, Active DR, and forecasted EE to be included in the given analysis as independently modeled negative loads. The formulas are only valid if the type of DR is included in the analysis. For example a Steady State SIS analysis would not include RTEG and hence RTEG formula and the associated negative loads will not be modeled in the basecases. Formulas for Negative Load Components:

Passive DR Component: (Adjusted Initial Value – explicitly modeled Passive DR) * Performance Assumption = Total Passive DR in a Load Zone that is to be Modeled as Independent Negative Loads. These negative loads will be modeled with a load ID of "P".

RTDR (DRCR after May 2017) Component: (Adjusted Initial Value – explicitly modeled RTDR (DRCR after May 2017)) * Performance Assumption = Total RTDR (DRCR after May 2017) in a Dispatch Zone that is to be Modeled as Independent Negative Loads. These negative loads will be modeled with a load ID of "A".

RTEG Component: (Adjusted Initial Value – explicitly modeled RTEG) * Performance Assumption * Distribution Loss Savings = Total RTEG in a Dispatch Zone that is to be Modeled as Independent Negative Loads with a load ID of "R".

Forecasted EE Component: Adjusted Initial Value * Performance Assumption = Total Forecasted EE in a Load Zone that is to be Modeled as Independent Negative Loads. These negative loads will be modeled with a load ID of "EE".

EXAMPLE:

Assume that an interregional steady state analysis is being performed for the 2016-2017 peak load period and an initial value of 150 MW of RTDR was given and there are no explicitly modeled resources. The total amount of negative loads that would be included in the model to account for these resources would be the following:

Demand Reduction Value (DRV) = Initial Value / Total New England Loss Factor

= 150 / 1.08 = 138.889 MW

Adjusted Initial Value = Demand Reduction Value (DRV) * Distribution Loss Savings

= 138.889 * 1.055 = 146.528

Negative Load Modeled in Case = (Adjusted Initial Value – explicitly modeled Active DR) * Performance Assumption

= (146.528 – 0) * 75% = 146.528 * 0.75

= 109.896 MW