ISO New England Manual for

Measurement and Verification of Demand Reduction Value from Demand Resources

Manual M-MVDR

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ISO New England Manual for

Measurement and Verification of Demand Reduction Value from Demand Resources

Table of Contents

Section 5: Measurement and Verification Approach

Section 6: Establishing Baseline Conditions

Section 7: Statistical Significance

Section 8: Performance Calculations

Section 9: Monitoring Parameters and Variables

Section 10: Measurement Equipment Specifications

Section 16: Responsible Parties

Section 17: Measurement and Verification Plan Format

Revision History

ISO New England Manual for

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List of Figures and Tables

Introduction

Welcome to the ***ISO New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources***. In this introduction, you will find the following information:

- What you can expect from this ISO New England Manual (see "About This Manual").

About This Manual

The ***ISO New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources*** is one of a series of manuals. The manual provides guidance and required criteria for the measurement and verification of performance of Demand Resources participating in the wholesale electric markets administered by the ISO pursuant to Section III.8A, Section III.13 and Appendix III.E1 of Market Rule 1. A copy of the Market Rule and ISO Tariff may be obtained from the ISO website at www.iso-ne.com.

This manual was written assuming that the reader has read the Market Rule before or in conjunction with using this manual. Terms that are capitalized in this manual shall have the meaning ascribed to them in the Market Rule or ISO Tariff.

The reader is referred first to the Market Rule for an explanation and information regarding that aspect of the operation of the FCM or requirements for complying with the FCM. This manual provides additional implementation or other detail for those provisions of the Market Rule which require the Market Participant to take an action. Manual provisions are developed and refined through the NEPOOL stakeholder processes. Manuals are not filed with or approved by the Federal Energy Regulatory Commission. In the event of any conflict between a Market Rule provision and this manual, the text of the Market Rule provision governs.

To demonstrate performance, qualified Market Participants shall comply with the Measurement and Verification standards defined in this manual. The measured and verified electrical energy reductions during Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, or Real-Time Emergency Generation Event Hours or audits are the basis of payments and charges to Market Participants.

Section III.13.1.4 of Market Rule 1 requires Project Sponsors to submit a Measurement and Verification Plan, and Measurement and Verification Documents. The plan and documents shall be reviewed and subject to approval by ISO New England. The ***ISO New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources*** describes the content of the Measurement and Verification Plan necessary to comply with the requirements established in Section III.13.1.4. This manual specifies required information, details, approaches, methodologies, conditions, calculations, variables, parameters, monitoring, validations, reporting, certifications, responsibilities, and plan format for measurement and verification of performance to be used for On-Peak Demand Resources, Seasonal Peak Demand Resources, Real-Time Demand Response Resources,

Real-Time Emergency Generation Resources and provides information concerning how certain data must be submitted and how Real-Time Demand Response Resources and Real-Time Emergency Generation Resources are dispatched. This manual is divided into the following Sections:

Section 1: Overview
Section 2: Project Information
Section 3: Project General Assumptions
Section 4: Equipment, Measure, and Practice Detail
Section 5: Measurement and Verification Approach
Section 6: Establishing Baseline Conditions
Section 7: Statistical Significance
Section 8: Performance Calculations
Section 9: Monitoring Parameters and Variables
Section 10: Measurement Equipment Specifications
Section 11: Monitoring Frequency and Duration
Section 12: Data Validation, Retention and Management
Section 13: Performance Reporting
Section 14: Independence and Auditing
Section 15: Measurement and Verification Supporting Documents
Section 16: Responsible Parties
Section 17: Measurement and Verification Plan Format

Section 1: Overview

1.1 Special Provision for Real-Time Demand Response and Real-Time Emergency Generation Resources Communications Compliance

Real-Time Demand Response and Real-Time Emergency Generation Resources and their associated Demand Assets receive dispatch instructions through a Demand Designated Entity (DDE). The DDE is identified in Customer and Asset Management System (CAMS) by the Project Sponsor. The communication mechanism between the ISO and DDE is specified in ISO New England Operating Procedure No. 18, Metering and Telemetering Criteria. The communication mechanism specified in ISO New England Operating Procedure No. 18 is abbreviated "ISO CFE/RTU" in this manual.

1.2 Special Provision for On-Peak Demand Resources, Seasonal Peak Demand Resources, Real-Time Demand Response Resources, Real-Time Emergency Generation Resources Registration

On-Peak Demand Resources, Seasonal Peak Demand Resources, Real-Time Demand Response Resources, and Real-Time Emergency Generation Resources qualified for participation in the Forward Capacity Market shall consist of demand reduction measures registered as Demand Assets in CAMS. All criteria and requirements for Asset registration are contained in other ISO New England Manuals not limited to the ***ISO New England Manual for Registration and Performance Auditing, M-RPA***.

1.3 Reserved

Section 2: Project Information

2.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan each of the measures, systems, processes and/or strategies that make up its Project.

The Measurement and Verification Plan shall include how each of the measures, systems, processes and/or strategies will be installed and operated to result in additional and verifiable reductions in end-use demand 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.

The Project description in the Measurement and Verification Plan and other Measurement and Verification Documents associated with the Project shall be consistent with the Project description in the Project Sponsor's New Demand Resource Show of Interest Form submission, including the *New Demand Resource Project Description* form found on the ISO website.

2.2 General Requirements

The Project Sponsor shall specify in its Measurement and Verification Plan each of the following[1]:

(1) Lead Market Participant;

(2) Project contact name, phone and e-mail;

(3) Resource name and ID;

(4) Project name and ID;

(5) Project Sponsor's Market Participant status;

(6) Demand Resource type (On-Peak Demand Resource, Seasonal Peak Demand Resource, Real-Time Demand Response Resource, or Real-Time Emergency Generation Resource);

(7) Load Zone for On-Peak and Seasonal Peak Demand Resources, Load Zone for Real-Time Demand Response and Real-Time Emergency Generation Resources for the first delivery period starting on June 1, 2010, or Dispatch Zone for Real-Time Demand Response and Real-Time Emergency Generation Resources for the delivery periods after June 1, 2011 and later within which the Project will be located;

(8) Project Location, including the name and address of the retail customer(s) where the Project will be implemented for projects including Distributed Generation or Energy Efficiency implemented at a single facility with a demand reduction greater than 5 MW or all other measures if known at the time the Measurement and Verification Plan is submitted to the ISO subject to the provisions in Section 12.2 of this manual;

(9) Program Name, describing overall program or operation of Demand Resource, for example (residential lighting);

(10) Measures, end uses, systems, processes or strategies that will be implemented;

(11) Types of facilities in which the measures, systems, processes or strategies will be implemented;

(12) Customer classes and end-uses served;

(13) Types of measures that will be implemented including but not limited to, energy efficiency, load management, Distributed Generation Demand Response, Emergency Generation;

[1] Some of the required information is submitted through the Forward Capacity Market Tracking System (FCTS) interface. As a result, some of the information is inherently indentified by the registered user inputting the information (such as Project Sponsor and by default their Market Participant status).

(14) Directly metered or stipulated/sampled measures;

(15) Weather sensitive measure;

(16) Estimated demand reduction (MW) per measure and/or per customer facility (measured at the customer meter), including supporting documentation (e.g., engineering estimates or documentation of verified savings from comparable projects) to substantiate the reasonableness of the estimated capacity that the Project Sponsor intends to offer into the Forward Capacity Auction;

(17) Estimated total Demand Reduction Value of the Project;

(18) The date by which the Project Sponsor expects to reach commercial operation;

(19) Status under the ISO generation interconnection procedures, if applicable;

(20) A description of the typical qualifications and experience of the Project Sponsor's Project team members and subcontractors that will be directly involved in measurement and verification activities.

For Projects where one or more of the requirements identified in items (8) thru (13) listed above are not explicitly known at the time the Project Sponsor submits its Measurement and Verification Plan to the ISO for review and approval, the Project Sponsor shall provide best approximations of proposed activity with respect to programs, measures, customer classes served and location. The manner in which project development efforts will be pursued shall be consistent with the approach identified in the Project Sponsor's *New Demand Resource Project Description*, Customer Acquisition Plan, Measurement and Verification Plan, Funding Plan and operable Capacity Analysis as defined in the Market Rule submitted to the ISO as part of the Project Qualification Process.

The Project Sponsor shall provide to the ISO information that demonstrates the products, services, systems, processes, and measures actually installed or affected are functionally equivalent to those identified in its Measurement and Verification Plan as part of Critical Path Schedule Monitoring.

2.3 Additional Requirements for Distributed Generation

For Projects involving the use of Distributed Generation measures for On-Peak Demand Resource, Seasonal Peak Demand Resource, Real-Time Demand Response Resource, and Real-Time Emergency Generation Resources, the Project Sponsor shall include the following information in the *New Demand Resource Project Description* form submitted during the New Capacity Show of Interest Submission Window and related details in the Measurement and Verification Documents submitted by the New Capacity Qualification Deadline:

(1) The aggregate nameplate capacity of the Distributed Generation;

(2) The most recent annual non-coincident peak demand (absent Distributed Generation output) of the end-use metered customer at the location where the Distributed Generation is directly connected;

(3) The Distributed Generation output during the most recent annual non-coincident peak;

(4) An estimate of the monthly average hourly load at the metering point in accordance with Market Rule 1 for each month of the Capacity Commitment Period (absent Distributed Generation output) of the end-use customer to which the Distributed Generation is directly connected; and

(5) An estimate of the Distributed Generation's monthly average hourly output for each month of the Capacity Commitment Period.

Section 3: Project General Assumptions

3.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan any variables that affect the Project's electrical energy usage or Distributed Generation output (such as outside temperature, time of day, process changes, occupancy, etc.) that will be measured or monitored and used in the determination of the Project's performance during Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, or Real-Time Emergency Generation Event Hours.

3.2 Requirements for All Demand Resources

The Project Sponsor shall specify in its Measurement and Verification Plan all substantive assumptions for the Project's performance, including but not limited to, baseline energy usage, post measure installation energy usage, process changes, and measure life.

If one or more of the variables that will be measured or monitored and/or assumptions that will be used in the determination of the Project's Demand Reduction Value during Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, and Real-Time Emergency Generation Event Hours are not known at the time the Project Sponsor submits its Measurement and Verification Plan to the ISO for review and approval, the Project Sponsor may provide alternative information and/or forecasts and specify the portion of the performance associated with such variables and/or assumptions and explain the basis for such forecasts.

Section 4: Equipment, Measure, and Practice Detail

4.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan a description of the equipment, measures, and/or practices to be implemented for the On-Peak Demand Resource, Seasonal Peak Demand Resource, Real-Time Demand Response Resource, and Real-Time Emergency Generation Resources.

4.2 Requirements

The Project Sponsor shall provide in its Measurement and Verification Plan and Measurement and Verification Documents specifications of the equipment or types of equipment for projects being installed and/or modified. The equipment, measure, and practice specifications may include, but is not limited to, engineering analysis utilized to specify equipment, program design measures and/or practices, or applications of equipment, measure, or practice relative to end use or processes in the facility.

For Projects involving changes to business practices or strategies, the Project Sponsor shall specify the practice or strategy that will affect the facility's energy usage during the Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, and Real-Time Emergency Generation Event Hours relative to baseline conditions.

Section 5: Measurement and Verification Approach

5.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan which of the approved methodologies or combination of methodologies identified in Section 5.2 are proposed for use in determining its performance values.

If the Project Sponsor elects a methodology other than those listed, the Project Sponsor shall include in its Measurement and Verification Plan acceptable justification for the methodology or combination of methodologies proposed for its Project. Project Sponsors shall provide references not limited to: engineering practices in the Measurement and Verification literature, reference reports, local, state or federal manuals or code to demonstrate that it's proposed Measurement and Verification approach is appropriate for the Demand Resource type and will produce accurate and reliable performance values.

5.2 Acceptable Measurement and Verification Methodologies

This manual contains the minimum standards required for measurement and verification methodologies for On-Peak Demand Resource, Seasonal Peak Demand Resource, Real-Time Demand Response Resource, and Real-Time Emergency Generation Resource.

5.2.1 Option A: Partially Measured Retrofit Isolation/Stipulated Measurement

Option A may involve an equipment specific retrofit or replacement, new installation or a system level Measurement and Verification assessment. The approach is intended for measures where either performance factors (such as lighting wattage) or operational factors (such as operating hours) can be measured on a spot or short-term basis during baseline establishment and post-installation periods, or for measures for which a measured proxy variable can, in combination with well-established algorithms and/or stipulated factors, can provide an accurate estimate of the Demand Resource's performance.

Option A methodology consists of the following:

(1) The factors, parameters, and/or variables not measured can be stipulated based on assumptions, analysis of historical data, or manufacturer's data. If a stipulated factor is subject to change over the Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, and/or measure life of the Demand Resource, the Project Sponsor shall specify how the changes will be factored into the calculation of the performance value.

(2) Option A involves measuring a variable other than electrical demand (MW) and using that variable in the calculation of the Demand Resource's performance (MW). Measurements can include short-term or long-term end-use metering of a variable such as current (amperage) and voltage to calculate demand, equipment operating status (on/off), equipment operating times, equipment quantities (i.e., number of units installed, cubic feet of insulation installed) or facilities served where the performance value per facility is constant.

(3) Option A requires that a correlation be established between the metered/monitored proxy variable and electrical demand (MW). The Project Sponsor may establish the correlation by conducting short-term monitoring or a series of spot measurements of both stipulated parameters, and correlating the data sets (e.g., by performing a regression analysis) to determine the functional relationship between the two parameters.

(4) Engineering correlations may also be specified using documented engineering algorithms or as part of an engineering simulation.

(5) Equipment manufacturer's data, equipment data compiled by a recognized industry group or equipment data compiled as part of a State-sponsored demand side

management program (i.e., lighting fixture wattage tables) may be used in combination with the other measurements, variables or factors as identified above to calculate the Demand Resource's performance. Data from a manufacturer shall be determined in a manner consistent with standards established by a recognized United States government agency or national recognized industrial manufacturing association.

5.2.2 Option B: Retrofit Isolation/Metered Equipment

Option B involves a retrofit or system-level Measurement and Verification assessment. The approach is intended for retrofits with performance factors and operational factors that can be measured at the component or system level using interval electrical demand meters, as defined in Section 10 of this manual, installed on the affected end-use. Option B shall be used for Real-Time Demand Response Assets and Real-Time Emergency Generation Assets and On-Peak Demand Resources and Seasonal Peak Demand Resources consisting of Distributed Generation pursuant to ISO New England Manual M-28 unless an alternative methodology is approved by the ISO in accordance with Section 5.3 of this manual. Any alternative methodology must comply with the requirements in Market Rule 1.

Option B methodology consists of the following:

(1) Spot or short-term electrical demand measurements can only be used when variations in operations are not expected to change over the measure life.

(2) When temporal variations are expected, electrical demand measurements shall be made over a period of time sufficient to represent performance during the Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, and Real-Time Emergency Generation Event Hours and across the measure life of the project.

(3) This method may be applied when the electrical loads to be impacted by the Project are small relative to the building load, a facility does not currently have whole-premise interval metering, or if end-use electrical demand data can be readily obtained from a building energy management or control system.

(4) The Project Sponsor shall take into consideration any interactive effects that may alter electrical loads on other end-use equipment being monitored.

5.2.3 Option C: Whole Facility/Regression

Option C estimates Demand Resource performance by analyzing the overall energy use in a facility and identifying the impact of the implemented measure on the total building or facility energy use patterns. The evaluation of whole-building or facility level metered data is completed using techniques ranging from simple billing comparison to multivariate regression analysis.

Option C methodology consists of the following:

(1) Demand Resource performance is measured using whole-premise interval meters during the Demand Resource On-Peak Hours or Demand Resource Seasonal Peak Hours.

(2) Option C is applicable to measures that cannot be measured directly, such as insulation or other building envelope measures.

(3) Option C should not be used if the performance value is expected to be small relative to the total facility load, due to the small "signal-to-noise ratio,"

5.2.4 Option D: Calibrated Simulation

Option D involves calibrated computer simulation models of component or whole building energy usage to determine measure energy savings. Engineering simulation models (such as DOE-2) can model both residential buildings (homes, apartments and condominiums) as well as more complex commercial buildings. Operational simulations can be used for industrial processes that take into account the specifics of the process addressed by the energy efficiency actions. Both engineering and operational simulations are made more powerful by calibrating these methods to actual MW and MWh data from the site or process being examined, even if these data are available for a monitoring period shorter than or different from the required Demand Resource On-Peak Hours or Demand Resource Seasonal Peak Hours. Short-term metering and monitoring are methods that produce data that can be used to adjust engineering simulations. This approach is generally termed "calibrated engineering simulations." Linking simulation inputs to baseline and post-installation conditions completes the calibration. Characterizing baseline and post-installation conditions may involve metering performance and operating factors both before and after the retrofit. Long-term whole-building energy use data may be used to calibrate the simulations.

5.3 Alternative Measurement and Verification Methodologies

The Project Sponsors may propose alternative methodologies not listed in Section 5.2. Project Sponsors proposing alternative methodologies shall demonstrate that the alternative methodologies will be equivalent to one of the accepted methodologies described in Section 5.2 above, conform to Market Rule 1, and demonstrate justifiable need for deviation from the acceptable methodologies described in Section 5.2 based on unique Project requirements. Alternative measurement and verification methodologies are subject to approval by the ISO.

5.4 Other Acceptable Methodological Techniques

In addition to the acceptable methodological approaches described above, several techniques may be applied to one or more of the methods described in Section 5.2. The following describe other acceptable methodological techniques.

5.4.1 Engineering Calculations and Audit Results

The Project Sponsor may use engineering algorithms to calculate the project's performance value during the Demand Resource On-Peak Hours, and Demand Resource Seasonal Peak Hours. Engineering algorithms shall be supplemented with data collected on the energy-consuming equipment affected by the measures.

5.4.2 Load Shape Analyses

The Project Sponsor may use verifiable measure hourly load shapes to calculate a project's performance during the Demand Resource On-Peak Hours, or Demand Resource Seasonal Peak Hours. Measure load shapes shall be based on actual metering data, load research, and/or simulation modeling.

Values for monthly or annual energy savings, whether from engineering calculations, analysis of billing data, simulation modeling or other means described in this manual, can be combined with information on verifiable measures to produce values for electrical energy reduction (MWh) during the Demand Resource On-Peak Hours, and Demand Resource Seasonal Peak Hours. Measure load shapes shall be based on actual metering data, load research (meeting the requirements in Section 15 of this manual), and/or simulation modeling.

5.5 Additional Supplemental Requirements

The Project Sponsor shall specify methods to comply with each of the applicable requirements listed below.

(1) Project Sponsors using Option D for existing buildings, systems, processes, or equipment shall calibrate the simulation model to actual MW or MWh data from the buildings, systems, processes, or equipment being modeled.

(2) Projects that include the use of Distributed Generation shall follow Option B and directly measure the electrical demand (MW) output of the Distributed Generation; however, if the Distributed Generation is a Real-Time Emergency Generation Asset and no other Demand Resource is at the facility, direct measurement of the entire facility load is an acceptable meter configuration (see acceptable metering configurations described in Section 5.6 in this manual).

(3) If statistical sampling is used to determine any variables, factors, parameters, engineering factors, or load shapes used in the calculation of Demand Resource performance values, the statistical sampling shall satisfy the requirements described in Section 7.

5.6 Metering Configurations for Demand Resources Defined as Real-Time Demand Response or Real-Time Emergency Generation[2]

Acceptable metering configurations for Real-Time Demand Response and Real-Time Emergency Generation Resources are described in Section 12.3.3 of Manual M-28 and are illustrated below. The ISO may at its discretion approve alternative metering configurations or alternate uses of the acceptable metering configurations listed below. The performance values calculated for Demand Response Assets using metering configurations that include load reduction shall be calculated as the difference between the adjusted Demand Response Baseline and the actual metered usage of the facility. However, for facilities with Distributed Generation at the site, determination of total facility load (load actually served from the grid plus load served from the Distributed Generation) must be measured as provided in Section III.E1.2.1 of Market Rule 1. A Project Sponsor proposing to use the alternative configuration shall demonstrate that the alternative configuration will be equivalent to one of the preferred configurations.

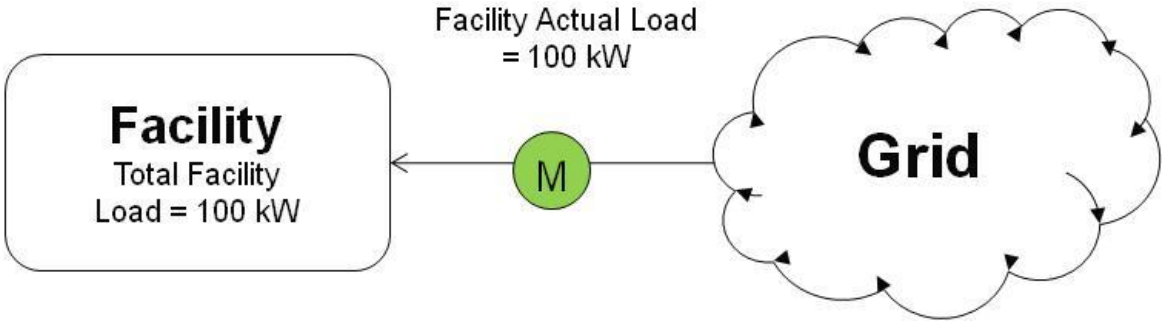
The Facility Metered Load (FML) is the electricity used at a facility that is purchased from the grid.

The Total Facility Load (TFL) is the total electricity used at a facility inclusive of that purchased from the grid and that produced on-site from Distributed Generation.

TFL = FML + Distributed Generation

5.6.1 Load reduction only with no Distributed Generation at the facility

Exhibit 5.1: Load reduction only with no Distributed Generation at the facility

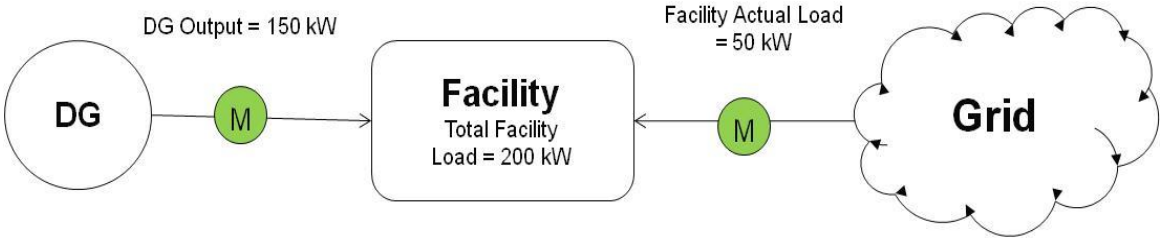


For facilities subscribing only the load, performance for each hour shall be calculated in accordance with Sections III.E1 and III.8A of Market Rule 1.

[2] RTEG is a defined term in Section III.1.3 of Market Rule 1.

5.6.2 Distributed Generation output directly metered (includes Real-Time Emergency Generation Assets that are directly metered)

Exhibit 5.2: Distributed Generation output directly metered



Performance for Real-Time Demand Response Assets shall be calculated in accordance with Sections III.E1 and III.8A of Market Rule 1.

For Real-Time Emergency Generation Assets metered at the generator, performance for each hour shall be calculated as:

$$P_h = OG_h$$

Where: P_h = performance for the hour

OG_h = Metered Distributed Generator output for the hour

For Real-Time Demand Response Assets consisting of Distributed Generation and metered at the generator, performance for each hour shall be calculated as:

$$P_h = AO - CB_h$$

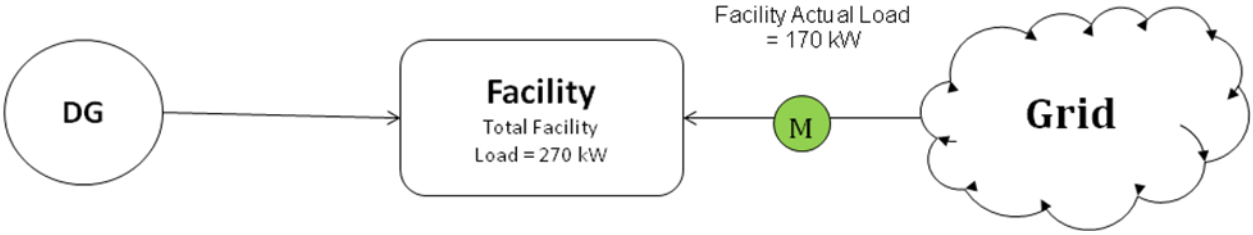
Where: P_h = performance for the hour

AO = actual output for the DG

CB_h = Customer Baseline for the hour as calculated using the methodologies defined in Section 6 of this manual.

5.6.3 Distributed Generation only used to reduce load at the facility (applies to facilities with Real-Time Emergency Generation Assets only)

Exhibit 5.3: Distributed Generation only used to reduce load at the facility



For facilities subscribing only a Real-Time Emergency Generation Asset where the generator output is not metered, but the Real-Time Emergency Generation operation is isolated from the grid, the performance for each hour shall be calculated as:

$$P_h = CB_h - AL$$

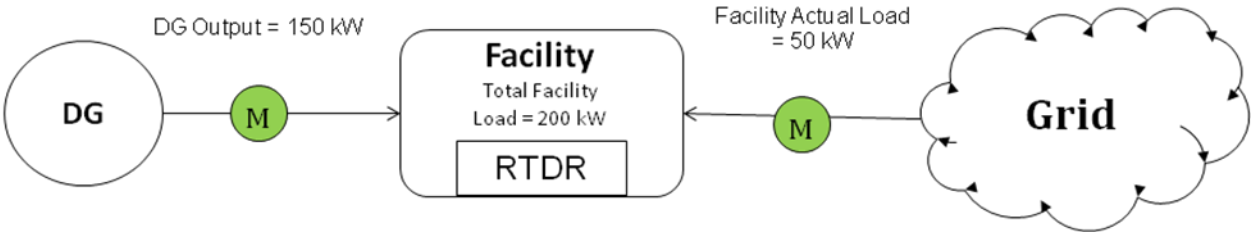
Where: P_h = performance for the hour

CB_h = Customer Baseline for the hour as calculated using the methodologies defined in Section 6 of this manual.

AL = actual load for the hour

5.6.4 Load reduction with Distributed Generation located at the facility

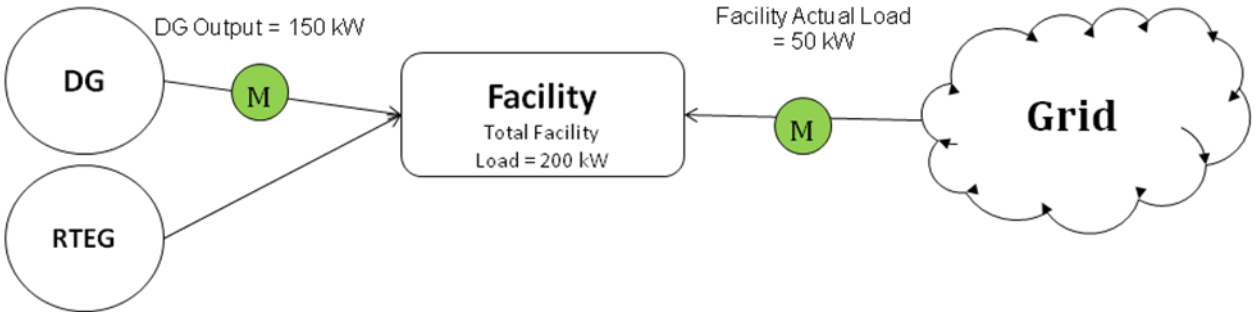
Exhibit 5.4: Load reduction with Distributed Generation located at the facility



Performance of Real-Time Demand Response Assets shall be calculated pursuant to Sections III.E1 and III.8A of Market Rule 1.

5.6.5 Distributed Generation used to reduce load at the asset and directly metered Distributed Generation used at another on-site asset

Exhibit 5.5: Distributed Generation used to reduce load at the asset and directly metered Distributed Generation used at another on-site asset



Performance of Real-Time Demand Response Assets shall be calculated pursuant to Sections III.E1 and III.8A of Market Rule 1.

For facilities using both a Real-Time Emergency Generation Resource and other Distributed Generation as separate Assets, the Real-Time Emergency Generation Asset must be directly metered.

5.6.6 Load Reduction pursuant to a Measurement and Verification Plan (includes Statistical Sampling)

Where the load reduction of a Real-Time Demand Response Asset is provided from an aggregation of direct load control, the performance for each interval shall be calculated in accordance with an approved Measurement and Verification methodology. The performance shall be reported to the ISO in real-time by the DDE through the ISO CFE/RTU. This Measurement and Verification methodology shall not be applicable to Distributed Generation.

Section 6: Establishing Baseline Conditions

6.1 Descriptions

The Project Sponsor shall specify in its Measurement and Verification Plan the methodology used to determine baseline conditions for the measures comprising its Project. Baseline conditions are defined as the load (MW) that would have existed, but for the implementation of a demand reduction measure that affected such measure's load in use during Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours. Real-Time Demand Response Resources and Real-Time Emergency Generation Resources must establish, maintain, and adjust Demand Response Baselines as provided in Section III.8A of Market Rule 1. Baseline conditions may be used synonymously with the term Demand Response Baseline for Real-Time Demand Response Assets and Real-Time Emergency Generation Assets in this manual.

The Project Sponsor shall identify in its Measurement and Verification Plan any and all equipment, systems, practices or strategies or type of the aforementioned, whose alteration from its baseline condition operation will lead to reduced demand during the Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, and Real-Time Emergency Generation Event Hours.

6.2 General Requirements for Baseline Conditions for All Demand Resources

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with each of the applicable requirements listed below.

(1) For Projects where the Demand Reduction results from measures involving variable load equipment or equipment whose operation is time-dependent or weather-dependent, the baseline conditions shall be calculated for each hour across the Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours.

(2) For Projects where Demand Reduction is actively controlled by the Project Sponsor, facility personnel, or an energy management system, results from measures involving variable load equipment or equipment whose operation is time-dependent or weather-dependent and baseline conditions are calculated based on historical hourly load or output data, the Project Sponsor shall demonstrate that the variance in the historical hourly load or output data used in the calculations of baseline conditions comply with the statistical reliability criteria set forth in Section 7.2 of this manual.

(3) For Projects where the Demand Reduction is actively controlled by the end-use facility personnel, or an energy management system and baseline conditions are calculated using a rolling average of historical hourly load or output data over some period prior to the Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours, the Project Sponsor shall exclude historical hourly loads or output coincident with the Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours from the baseline condition calculations.

(4) For Projects in which existing and operating equipment is removed from service during the defined Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours or has its electrical usage reduced during the defined Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours, the baseline conditions shall be the load (MW) of that operating equipment across the Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours, prior to such equipment removal or reduced use.

(5) For Projects in which failed equipment is replaced by a more efficient equivalent or by an alternative strategy for delivering comparable equipment operation or process function or output, the baseline condition shall be the nameplate rating of the equipment meeting the level of efficiency required by applicable state code, federal product efficiency standard, or standard practice, whichever is most stringent. If there is no applicable state code or federal energy efficiency standard, then standard practice shall be used as the basis for establishing baseline conditions and shall be documented in the Measurement and Verification Plan.

(6) For Projects in which operating equipment is replaced with a more efficient equivalent unit, the baseline condition is the MW load of that operating equipment across the

Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours. In the absence of a measured baseline, the baseline values shall be level of efficiency required by applicable state code or federal energy efficiency standard or standard practice if there is no applicable state code or federal energy efficiency standard. If applicable, the Project Sponsor shall indentify the method by which the baseline condition may be adjusted over the Measure Life. If standard practice is used as the basis for the baseline condition, it shall be documented in the Measurement and Verification Plan.

(7) For Emergency Generation Projects metered at the generator output, (Demand Resources whose operation is limited to loss of external power to the facility or the implementation by the ISO of voltage reduction of 5% requiring more than 10 minutes to implement), the baseline condition electricity output shall be zero.

(8) For Emergency Generation Projects metered at the customer billing meter or a sub-meter within the facility, the Project Sponsor is required to submit real-time five minute data from the billing meter or sub-meter within the facility as described above.

(9) For all Demand Resources, Project Sponsors shall indicate compliance with Baseline Methodologies as well as specify Performance Measure Methodology consistent with North American Energy Standards Board (NEASB) Business Practices for Measurement and Verification of Wholesale Electricity Demand Response:

(a) Baseline Type-I: A Baseline performance evaluation methodology based on a Demand Resource's historical interval meter data which may also include other variables such as weather and calendar data. (Required for Real-Time Demand Response, and Real-Time Emergency Generation Resources).

(b) Baseline Type-II: A Baseline performance evaluation methodology that uses statistical sampling to estimate the electricity usage of an aggregated Demand Resource where interval metering is not available on the entire population.

(c) Metering Generator Output: A performance evaluation methodology, used when a generation asset is located behind the Demand Resource's revenue meter, in which the Demand Resource’s performance is based, in whole or in part on the output of the generation asset. (Distributed Generation, including Real-Time Emergency Generation Resources, are required to use one of the metering configurations defined in Section 5 of this manual.)

(10) Real-Time Demand Response Resources, Real-Time Demand Response Assets, and Real-Time Emergency Generation Resources are required to comply with the Demand Response Baseline (Section III.8A) and metering provisions (primarily in Appendix III.E1.2) of Market Rule 1.

6.3 Requirements for Demand Resources Involving New Construction or Major Renovations

For new construction or major renovation Projects, the baseline conditions shall be equal to the load during the applicable Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours of equipment meeting the level of efficiency required by:

(1) Applicable state code or federal energy efficiency standard, or

(2) Standard practices, provided the Project Sponsor can document the standard practices in the Measurement and Verification Plan, if there are no applicable state codes or federal energy efficiency standards, or

(3) Standard practices that are less stringent than applicable state code or federal energy efficiency standards, provided the Project Sponsor can document the less stringent standard practices by providing a study, report or analysis conducted in a manner consistent with the requirements in Section 7 and other applicable Sections of this manual, or

(4) Standard practices that are more stringent than applicable state code or federal energy efficiency standards, provided the Project Sponsor can document the more stringent standard practices in the Measurement and Verification Plan.

6.4 Requirements for Real-Time Demand Response and Real-Time Emergency Generation Assets

The requirements for determining baseline conditions (Demand Response Baseline calculation) for Real-Time Demand Response Resources and Real-Time Emergency Generation Resources are in Section III.8A of Market Rule 1.

Section 7: Statistical Significance

7.1 Description

The Project Sponsor shall demonstrate in its Measurement and Verification Plan that statistical sampling will meet or exceed the statistical precision and accuracy requirements as identified in the Market Rule and in this Section. The Measurement and Verification Plan shall include a description of the methods used to mitigate and adjust for the potential types of bias resulting from statistical methods. Where monitoring is specified over the measure life, the Measurement and Verification Plan shall demonstrate how accuracy and precision will be maintained over the measure life.

7.1.1 Requirements

(1) All Project Sponsors shall include a description of methods used to achieve precision and accuracy requirements applicable to the measurement and verification approach.

(2) If the measurement and verification methodology includes the use of measurement and verification reference documents including but not limited to, engineering estimates, load profiles, measure life, and coincidence factors, shall provide justification for use in the measurement and verification methodology.

(3) If the measurement and verification methodology includes calculations based on engineering-based direct measurements, measurement of proxy variables or simulations, the Project Sponsor shall include methods to control relevant types of bias including, but not limited to: (a) accuracy and calibration of the measurement tools described elsewhere in this manual); (b) measurement error; (c) engineering model bias; (d) modeler bias; (e) deemed parameter bias; (f) meter bias; (g) sensor placement bias; and (h) sample selection bias or non-random selection of equipment and/or circuits to monitor.

(4) If the measurement and verification methodology includes calculations using regression or statistical analyses, the Project Sponsor shall include methods to control relevant types of bias including, but not limited to: (a) model misspecification; (b) statistical validity; (c) error in measuring variables; (d) autocorrelation; (e) heteroscedasticity; (f) collinearity; (g) outlier data points; and (h) missing data.

(5) If the measurement and verification methodology includes any form of population sampling, survey or interview data, the Project Sponsor shall include methods to control relevant types of bias including, but not limited to: (a) construct validity; (b) sampling frame versus population; (c) selection bias (for a sample and for a census attempt where not all sites within the census received usable data); (d) non-response bias; (e) error in measuring variables; (f) sample homogeneity relative to project (external validity); (g) outlier data points; and (h) missing data.

(6) All requirements in Section 7 shall be included in the Measurement and Verification Plan and included in a sampling plan attached to the Measurement and Verification Plan as part of the supporting Measurement and Verification Documents.

7.2 Statistical Sampling

Sampling the total population of demand reduction measures is permitted, provided the population estimates derived from sampling achieve 10% relative precision with no less than 80% confidence interval. Additional statistical sampling requirements as it relates to precision and accuracy are described below.

7.2.1 General Requirements

If sampling will be conducted, the Project Sponsor shall include each of the following general sampling conditions:

(1) A description of the population to be sampled,

(2) The required sample size in accordance with this manual,

(3) The estimated sample size, plus contingencies for sampling bias, as described in Section 7.2.2,

(4) All assumptions and calculations for determining the sample size, and

(5) The method for selecting sample points.

7.2.2 Sample Size Requirements

If population sampling will be conducted, the Project Sponsor shall satisfy each of the requirements listed below for determining the sample size:

(1) Where one or more samples are used, the required sample size(s) shall be based upon achieving 10% relative precision with an 80% confidence level. If a Demand Resource Project consists of multiple facilities or measures and the Project Sponsor uses multiple sample sets to estimate the aggregated Demand Resource performance, the estimate shall have the minimum a precision and accuracy requirement applied to (1) each sample or combination of samples used, (2) the combination of all samples, or (3) stratified samples as described in Section 7.2.2(2).

(2) If the Demand Resource's performance value is estimated from a sample drawn from two or more strata, the overall sample size shall be based upon achieving 10% relative precision with an 80% confidence interval. Strata shall be defined as any subset of the Project's population that is based on operation constants, variables and characteristics. The concept of strata includes, but is not limited to: measures, practices, equipment, programs in a state sponsored demand side management portfolio or subsets of an entire population of affected equipment at a facility having similar operating characteristics.

(3) All sampling calculations shall incorporate methods to compensate for potential data loss through,

(a) Over sampling

(b) Sample site replacement in the course of the study,

(c) Demonstration that precision and confidence targets will still be met with a smaller sample size.

(4) The Project Sponsor shall identify methods for controlling bias in sample selection including, but not limited to random sampling, census or rolling census for each sample and strata used.

(5) The Coefficient of Variation (c.v.) used to derive the required sample size shall be the measured c.v. for the primary measurement including all its error components.

(6) The Project Sponsor shall identify methods for controlling bias attributed to the c.v. as it relates to sample size determination.

(7) If a c.v. from a prior Measurement and Verification Plan or supporting document approved by ISO New England is not available for the primary measurement applicable to the segments of sites, installed measures, and/or strategy, the Project Sponsor shall use a default value for the initial c.v., not less than 0.5 for homogeneous samples (samples from populations that are uniform with respect to operation constants, variables and characteristics) and 1.0 for heterogeneous samples (samples from populations that are variable with respect to operation constants, variables and characteristics), until such time that a c.v. can be estimated from the Project sample population.

(8) If a method such as stratified ratio estimation is used to take advantage of supporting information for the population, the c.v. may be adjusted to take account of the added efficiency of the stratification and estimation methodology and must still meet the requirements in Section 7.2.2.

7.2.3 Sample Size Calculation Requirements

The formulas below shall be used for the calculation of required sample size and precision. Alternative sample size determination may be used provided they meet the minimum requirements set forth in Section 7.2.2 and are documented in the Measurement and Verification Plan.

(1) The Project Sponsor shall calculate the sample number to achieve a precision of 10% using the following equation, utilizing a *t* value of 1.282, which corresponds to a two tailed 80% confidence interval of an infinite population, where

n’ = number of samples in an infinite population

c.v. = coefficient of variation as set by a default value or where it is known, and

r.p = precision

$$n' = \left\{ \frac{1.282 \times c.v.}{r.p.} \right\}^2$$

(2) The sample size (n) for the finite population (N) less than 200 shall be calculated using the following equation, where

n' = number of samples in an infinite population

$$n = \frac{n'}{1 + \frac{n'}{N}}$$

7.3 Sample Size Recalibration Based on Monitoring Data

In the absence of a reliable c.v. the Project Sponsor may use a default c.v. as described in Section 7.2.2. However, once performance data has been collected, the Project Sponsor shall demonstrate that the level of precision and accuracy is met using the sampling methodology by calculating the relative precision with a new estimate of the c.v.

7.3.1 Sample Recalibration Requirements

(1) The Project Sponsor shall calculate and report (as determined by ISO New England) the relative precision of sampling studies based on the measured estimate of the sample coefficient of variation calculated using the following equations, where:

$\overline{x}$ = sample mean,

s = standard deviation, and

n' = number of samples in an infinite population.

$$c.v. = \frac{s}{\overline{x}}$$

$$r.p. = \frac{1.282 \times c.v}{\sqrt{n'}}$$

(2) Where a study design is based on a finite population (*N*) less than 200, the relative precision of the sampling study shall be calculated using the following equation, where:

n = number of samples in a finite population, and

N = total number of units in the population

$$r.p. = \sqrt{1 - \frac{n}{N}} \frac{1.282 \times c.v}{\sqrt{n}}$$

(3) If a method such as stratified ratio estimation is used to take advantage of supporting information for the population, the estimated c.v. and achieved relative precision may be adjusted to take account of the added efficiency of the stratification and estimation methodology.

7.4 Sampling Over Load Zones or Dispatch Zones

If the Project Sponsor conducts sampling for a population of similar Demand Assets spanning multiple Load Zones or Dispatch Zones, the Project Sponsor shall include in its Measurement and Verification Plan the requirements listed below:

7.4.1 Requirements

(1) The Project Sponsor shall demonstrate that the accuracy and precision requirements discussed above apply to the overall population of Demand Assets being studied, rather than to the Project or Projects within each individual Load Zone or Dispatch Zone.

(2) The Project Sponsor shall demonstrate the method for controlling any bias attributed to sampling across Load Zones or Dispatch Zones.

Section 8: Performance Calculations

8.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan methodologies for calculation of the Demand Resource's performance value during the applicable Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours for the Project. Such information shall be provided in supporting documents and attached to the Measurement and Verification Plan as supporting Measurement and Verification Documents. The description shall include, but not be limited to the following factors used in the performance value calculations:

(1) Equations and Formulas

(2) Assumptions

(3) Manufacturers Equipment Specifications

(4) Direct Measurement Data

(5) Indirect Measurement Data

(6) Engineering Factors, Parameters and Other Variables

If the one or more of the factors listed above are not known or not available at the time the Project Sponsor submits its Measurement and Verification Plan to the ISO, the Project Sponsor shall specify when the unknown or unavailable factors will be known and available. Further, the Project Sponsor shall indicate if the absence of known factors would at any time during the performance hours in a Commitment Period, cause the statistical precision and accuracy of the performance value to fall below the minimum requirement established in the Market Rule and Section 7 of this manual.

The Demand Reduction Values for On-Peak Resources, Seasonal Peak Resources, Real Time Demand Response Resources and Real Time Emergency Generator Resources shall be calculated in accordance with Market Rule 1.

Performance value calculations On-Peak Resources, Seasonal Peak Resources, Real Time Demand Response Resources and Real Time Emergency Generator Resources must be reflective of asset mappings and un-mappings effective in a given month and will take into account the valid audit or event performance contributions from assets mapped to each resource in the month, but will not take into account performance from assets that are not mapped to the Resource in the month.

8.2 Requirements

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with the following requirements:

(1) The reported monthly performance shall achieve at least a 10% relative precision at an 80% confidence level.

(2) If baseline conditions are used in the calculation of Demand Resource performance, the Project Sponsor shall make adjustments to the baseline conditions to reflect operating conditions at the time of the Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, or Real-Time Emergency Generation Event Hours.

(3) Formulas used by the Project Sponsor to determine performance shall include any modifying factors, including, but not limited to, coincidence with applicable performance hours, realization rate, measure life, and equipment failure rate.

(4) If a Demand Resource project consists of multiple sites and/or measures, the Project Sponsor may calculate the aggregated performance during the applicable performance hours for each asset as the sum of all measured performance, provided that each measured performance achieves at least a 10% relative precision at an 80% confidence level, or the aggregated performance achieves at least a 10% relative precision at an 80% confidence level.

(5) If sampling will be conducted, the Project's aggregated performance in each Load Zone or Dispatch Zone shall be calculated from the measured data of the sample, consistent with the methodologies indicated in the sampling plan.

Section 9: Monitoring Parameters and Variables

9.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with requirements relative to the variables that will be measured, monitored, counted, recorded, collected, and maintained to determine the Project's performance during Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, and Real-Time Emergency Generation Event Hours.

The Project Sponsor shall specify in its Measurement and Verification Plan if alternative variables other than kW, MW, kWh or MWh will be measured, monitored, recorded, collected and maintained.

9.2 Requirements

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with each of the requirements listed below. When equipment manufacturer, model, serial number and age are not readily available, the Project Sponsor must specify alternative means of acquiring or estimating the required information.

(1) For Projects affecting **HVAC Systems,** the Project Sponsor shall, at a minimum, collect and maintain the following information:

(a) On HVAC equipment: equipment capacity, quantity, manufacturer, model and serial numbers, and age.

(b) On HVAC system controls: location of zones, temperature set-points, control set-points and schedules, and any special control features.

(2) For Projects affecting **Building Envelope,** the Project Sponsor shall, at a minimum, collect, maintain and report on all key variables effecting savings associated with the measures.

(3) For Projects affecting **Interior or Exterior Lighting Systems,** the Project Sponsor shall, at a minimum, collect and maintain the following information: number and types of lamps and ballasts, with nameplate data.

(4) For Projects affecting **Major Electric Consuming Equipment,** the Project Sponsor shall, at a minimum, collect and maintain the following information: equipment capacity, quantity, manufacturer, model and serial numbers and age.

(5) For Projects affecting **Weather Sensitive Electrical Loads including HVAC**, where temperature, humidity or degree-days will be used in the calculation of performance, the Project Sponsor shall collect and maintain representative site weather data, either measured on-site or obtained for a nearby site, from the National Climatic Data Center. On-site measurement equipment shall satisfy the measurement equipment requirements described in Section 10 of this manual.

(6) For Projects that include Distributed Generation, including Real-Time Emergency Generation Resources, the Project Sponsor shall measure and record the electrical output of the generator during Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, or Real-Time Emergency Generation Event Hours (as appropriate) using an interval meter that satisfies the measurement equipment requirements described in Section 10 of this manual. Additionally, the Project Sponsor shall report in a manner specified by ISO New England:

(a) The most recent annual non-coincident peak demand (absent Distributed Generation output) of the end-use metered customer at the location where the Distributed Generation is directly connected for each year that the Distributed

Generation participates in the FCM along with the output of the Distributed Generation during the most recent annual non-coincident peak; and

(b) The monthly average hourly load of the end-use customer to which the Distributed Generation is directly connected separately from the Distributed Generation's monthly average hourly output for each month of the Capacity Commitment Period.

(c) For Projects that include Real-Time Demand Response Resources, the Project Sponsor shall measure and record the electrical output of the generator during all intervals.

9.3 Requirements for Real-Time Demand Response Resources and Real-Time Emergency Generation Resources

For Real-Time Demand Response Resources and Real-Time Emergency Generation Resources, the Project Sponsor shall specify compliance with the following metering and telemetry requirements.

(1) Receive dispatch instructions from the ISO through direct communication with Demand Designated Entities (DDE).

(2) Transmit in real-time, five-minute interval data (for all intervals in an operating day) from the DDE to ISO through the direct communication link between the DDE and the ISO.

9.3.1. Direct Communication Between ISO and DDE

The dispatch of Real-Time Demand Response and Real-Time Emergency Generation Resources will be communicated from the ISO to the DDE as prescribed in ISO New England Operating Procedure No. 18, Metering And Telemetering Criteria, (available on the ISO website). The DDE will be responsible for determining which Real-Time Demand Response Assets and Real-Time Emergency Generation Assets to dispatch to fulfill the Resource's dispatch instruction.

Dispatch instructions issued by ISO New England to a DDE for the dispatch of Real-Time Demand Response Resources or Real-Time Emergency Generation Resources shall be directed to end-use customers by the DDE.

Failure of a Project Sponsor to establish a DDE for a Real-Time Demand Response Resource or Real-Time Emergency Generation Resource may result in a zero Demand Reduction Value for those Resources. Inadequate management of the ISO CFE/RTU, and failure to provide telemetering of Real-Time Demand Response Assets or Real-Time Emergency Generation Assets, may also result in the removal of the performance of those Demand Assets from the Demand Reduction Values.

9.3.2 Real-Time Demand Response Resources

(1) The ISO will issue Dispatch Instructions to specific Real-Time Demand Response Resources in Real-Time Demand Response Event Hours or Real-Time Demand Response Dispatch Hours. The Dispatch Instruction shall include the amount (MW) of load reduction (up to the Resource's net CSO) that the ISO determines is required. The ISO may additionally issue Dispatch Instructions in real-time that reduce or increase the amount dispatched.

(2) A Project Sponsor shall manage its Real-Time Demand Response Assets that are mapped to a Real-Time Demand Response Resource as of the first of a month such that

the Real-Time Demand Response Resource shall be capable of responding to Dispatch Instructions requiring 100% of the net Capacity Supply Obligation.

(3) Real-Time Demand Response Resources will receive a separate Dispatch Instruction indicating the end of the Deployment Period[3] when it can restore its loads to Normal Operations[4].

9.3.3 Real-Time Emergency Generation Resources

(1) The ISO shall issue Dispatch Instructions to Real-Time Emergency Generation Resources to curtail (including the Reduction Deadline) and restore loads to Normal Operations during Real-Time Emergency Generation Event Hours. Dispatch Instructions shall apply to specific Real-Time Emergency Generation Resources. The amount of Real-Time Emergency Generation Resources dispatched for each Real-Time Emergency Generation Event Hour will be the amount the ISO determines is necessary to meet the capacity deficiency.

(2) A Project Sponsor shall manage its Real-Time Emergency Generation Assets that are mapped to a Real-Time Emergency Generation Resource as of the first of a month such that the Real-Time Emergency Generation Resource complies with Dispatch Instructions.

(3) Real-Time Emergency Generation Resources will receive a separate Dispatch Instruction indicating the end of the Deployment Period when it can restore its loads to Normal Operations.

[3] Defined term in NAESB Wholesale Demand Response Standards.
[4] Defined term in NAESB Wholesale Demand Response Standards.

Section 10: Measurement Equipment Specifications

10.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with requirements for measurement, monitoring and/or data recording device type that will be used to measure, monitor and record data for each parameter and variable indicated in the Project Sponsor's Measurement and Verification Plan pursuant to Section 9 of this manual.

The Project Sponsor may specify in its Measurement and Verification Plan and or Measurement and Verification Documents alternatives to the requirements in this Section provided the alternatives meet the minimum specifications, function and quality for measurement, monitoring and/or data recording devices that will be installed and operated to measure, monitor and/or record data from each of the parameters and variables indicated in the Project Sponsor's Measurement and Verification Plan pursuant to Section 9 of this manual.

10.2 Requirements

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with the following requirements:

(1) All solid-state measurement, monitoring and data recording equipment shall meet or exceed the relevant standards set by the American National Standard Institute ("ANSI") or equivalent standard for the equipment.

(2) Measurement, monitoring and data recording equipment that is directly measuring watt-hour, volt-hour, volt-ampere-hours, reactive volt-ampere-hour, and the associated demand components should conform to ANSI or equivalent standards for the equipment.

(3) Instruments or transducers for the analog or digital measurement of volt, volts-squared, amperes, amperes-squared, phase angle, volt-amperes, watts, and reactive volt-amperes should conform to ANSI or equivalent standards for the equipment.

(4) Data recorders that are recording pulses from measurement and monitoring devices shall utilize a pulse rate within the resolution capabilities of the recorder.

(5) All measurement, monitoring and data recording equipment installed on electric circuits with significant harmonics shall meet the relevant standards provided by the Institute of Electrical and Electronics Engineers (IEEE).

(6) Any measurement or monitoring equipment that directly measures electrical demand (MW) shall be a true RMS[5] measurement device with an accuracy of no less than ±2%.

(7) Any measurement or monitoring equipment that directly measures electrical demand from three-phase devices shall be installed such that measurements are taken on all three-phases to account for any phase imbalance or an equivalent method that can measure electrical demand using two phases.

(8) Any measurement or monitoring equipment that directly measures electrical demand on circuits with significant harmonics shall have a digital sampling rate of at least 2.6 kHz as defined in the relevant IEEE Standards.

(9) Any measurement or monitoring equipment of proxy variables that do not directly measure electrical demand, including but not limited to voltage, current, temperature, flow rates and operating hours, shall have an accuracy rating such that the overall accuracy of the calculated demand (MW) using the proxy variables is not less than ± 2%.

[5] Root Mean Square

(10) Any measurement or monitoring equipment of current (amps) and nominal voltage used to calculate electrical demand shall include the power factor of the end-uses in the demand (MW) calculations.

(11) Data recorders shall be synchronized in time, within an accuracy of ± 2 minutes per month, with the National Institute of Standards and Technology ("NIST").

(12) All measurement, monitoring and data recording equipment shall be calibrated by the Project Sponsor or its independent calibration contractor in such a way to meet or exceed the Federal Energy Management Program ("FEMP") Measurement and Verification Guidelines, applicable American Society of Heating, Refrigeration and Air Conditioning Engineers ("ASHRAE") standards, NIST, or equivalent standard for the equipment.

(13) The Project Sponsor shall ensure that all measurement, monitoring and data logging equipment shall be maintained in such a way as to meet or exceed industry and manufacturer maintenance standards.

(14) The Project Sponsor shall maintain documentation on all measurement, monitoring and data recording equipment maintenance and calibration activities. Documentation and records shall be maintained as specified in Section 12 of this manual.

(15) The Project Sponsor shall provide to ISO, upon request, measurement equipment maintenance, calibration and testing records to demonstrate that the Project Sponsor's measurement equipment is calibrated and maintained in accordance the requirements described in this manual.

(16) Interval metering devices shall collect electricity usage data at a frequency of 15 minutes or less.

(17) The Project Sponsor may propose alternative methods to demonstrate the measurement, monitoring and data recording equipment used in the determination of performance of the Demand Resource provided it satisfies the accuracy, calibration and maintenance standards described in this manual subject to ISO approval.

10.3 Requirements for Demand Resources Defined as Real-Time Demand Response or Real-Time Emergency Generation

10.3.1 Telemetering Requirements

The term Interval Meter as used with respect to Real-Time Demand Response Assets and Real-Time Emergency Generation Assets in this manual refers to a meter that records energy usage (or generation) on at least a five minute interval basis and may store energy usage (or generation) at a smaller interval. For Real-Time Demand Response Resources and Real-Time Emergency Generation Resources, the Project Sponsor shall comply with the requirements established in Market Rule 1, ISO New England Operating Procedure No. 18, Metering And Telemetering Criteria, and the ISO New England Manuals.

Section 11: Monitoring Frequency and Duration

11.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with requirements for monitoring frequency and duration of each monitoring parameter and variables indicated in the Project Sponsor's Measurement and Verification Plan pursuant to Section 9 of this manual.

11.2 Requirements

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with the following requirements:

(1) The duration and frequency of metering and monitoring shall be sufficient to ensure an accurate representation of the amount of electrical demand used or generated during periods in which baseline conditions are measured and during Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, and Real-Time Emergency Generation Event Hours.

(2) All measurements shall be taken at typical system conditions within the time periods and frequency that shall demonstrate coincidence with the Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, and Real-Time Emergency Generation Event Hours.

(3) If independent parameters, such as but not limited to: temperature, humidity, or heating degree days are used in the calculation of performance values, the Measurement and Verification Plan shall specify methods to ensure the measurement is performed over a duration and frequency sufficient to accurately represent the amount of electrical demand used or generated during periods in which baseline conditions are measured and during Demand Resource On-Peak Hours and Demand Resource Seasonal Peak Hours.

(4) The Project Sponsor may propose alternative methods for monitoring frequency and duration for each monitoring parameter and variable indicated in the Project Sponsor's Measurement and Verification Plan pursuant to Section 9 of this manual providing the proposed methodology meets all the minimum requirements specified in Market Rule 1 and Section 11 of this manual.

11.3 Reserved

Section 12: Data Validation, Retention and Management

12.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with the requirements for systems, processes and methods for validation, estimation of missing, and maintenance of all data used in the calculation of performance values for Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, and Real-Time Emergency Generation Event Hours.

12.2 Requirements

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with the following requirements:

(1) For Demand Resource Projects targeting customer facilities with greater than or equal to 10 kW of demand reduction per facility, the Project Sponsor shall maintain the following:

(a) Retail customer's address,

(b) The retail customer's utility distribution company,

(c) Utility distribution company account identifier such as account number or meter number,

(d) Measures installed, and

(e) The corresponding monthly Demand Reduction Values until the end of the Measure Life, the Demand Asset is retired, or until the Demand Resource is permanently De-Listed or retired from the FCM.

(2) For Demand Resource Projects targeting customer facilities with less than 10 kW of demand reduction per facility, the Project Sponsor shall have the option of maintaining records as described above for customer facilities with greater than or equal to 10 kW of demand reduction per facility, or maintaining records of aggregated demand reduction and measures installed by Load Zone, Dispatch Zone and Meter Domain for each Demand Resource type.

(3) The Project Sponsor shall validate all measured data used in the Demand Reduction Value calculations. Data that has failed validation may not be used in any Demand Reduction Value calculation.

(4) For Projects involving an individual facility, generator or energy consuming equipment, the Project Sponsor shall conduct the following validation checks on any interval data from an individual facility:

(a) Time Check: The Project Sponsor shall validate that the measurement devices time clock is within ± two minutes of the true time as defined by the National Institute of Standards and Technology.

(b) Sum Check: The Project Sponsor shall validate that the difference between the sum of the values recorded over the intervals and the value recorded by the meter over the same time period is within plus or minus two percent. This check may be done on either usage or pulse data, provided the data scaling is consistent throughout the period.

(c) High/Low Check: The Project Sponsor shall establish minimum and maximum expected values for each Demand Asset, facility, or measure. The minimum and maximum values shall be based on equipment ratings or historical equipment and/or facility usage data. The Project Sponsor shall identify any and all interval data that is greater than the maximum expected value or less than the minimum expected value. Any such interval data shall be deemed to fail validation.

(d) Zero Value Check: The Project Sponsor shall identify any and all interval data with a value equal to zero. The Project Sponsor shall verify whether or not the zero value is the correct value for that interval. If the Project Sponsor determines that the zero value is incorrect, the Project Sponsor shall substitute a corrected or estimated non zero value for the zero value, or shall indicate that the data is incorrect and will be excluded from performance calculations. Under no circumstances shall the Project Sponsor substitute a zero value for missing interval data.

(e) The Project Sponsor shall identify all estimated data used in the Demand Reduction Value calculations, as well as the methodology used to develop the estimate. Any such estimates must be communicated to the ISO along with the methodology for developing them.

(f) The Project Sponsor shall classify all data that has passed validation and is used in the Demand Reduction Value calculations as either: (i) actual data, (ii) estimated data or (iii) missing data. The data classification shall be stored along with the data values in the Project Sponsor's data retention and management system described in Section 12.1.

(g) If meter data is found to be inaccurate, the Project Sponsor shall promptly notify the ISO.

12.3 Reserved

Section 13: Performance Reporting

13.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with the requirements for monthly data performance reporting.

13.2 Requirements

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with the following requirements:

On a monthly basis, the Project Sponsor shall report for each of its On-Peak and Seasonal Peak Demand Assets registered with the ISO the performance and meter data or performance applicable to the Demand Resource in the Obligation Month.

(1) For Real-Time Demand Response and Real-Time Emergency Generation Assets the Project Sponsor shall provide to the ISO real time interval data per ***ISO New England Manual for Market Rule 1 Accounting, M-28*** and Operating Procedure No. 18 necessary for the ISO to calculate the performance of each Asset pursuant to Market Rule 1 Section III.8A.

(2) The Project Sponsor shall report the performance of Demand Assets according to the submission and timing requirements described in ***ISO New England Manual for Market Rule 1 Accounting, M-28***.

(3) The Project Sponsor may report revised performance (in MW) for each Demand Asset according to the submission and timing requirements described in ***ISO New England Manual for Market Rule 1 Accounting, M-28***.

(4) Performance data for On-Peak and Seasonal Peak assets that are not Distributed Generation shall be submitted through the CAMS. Performance data for On-Peak and Seasonal Peak assets that are Distributed Generation shall be submitted through the Settlement Market System metering interface.

(5) The Project Sponsor shall provide to the ISO on a monthly basis work sheets, engineering calculations, reference materials, meter readings, and any other data necessary to support the reported performance values for each of its On-Peak and Seasonal Peak Demand Assets. The ISO may update the reported performance based on its review of the supporting documentation provided with the submittals or through an audit as provided in Market Rule 1 Section III.13.6.1.5.4.

(6) For Demand Resources using Statistical Sampling, the Project Sponsor shall provide to the ISO, as part of its Annual Certification of Accuracy of Measurement and Verification Documents as specified in Section 14.2 of this manual, a statement that the Demand Reduction Value complies with the minimum statistical significance requirements described in Section 7.2.2 of this manual. The Project Sponsor shall specify any deviations from minimum statistical significance requirements and any and all actions taken to correct deviations.

(7) For Demand Resources other than Real-Time Demand Response Resources or Real-Time Emergency Generation Resources where performance values are derived using baseline conditions, the Project Sponsor shall provide to the ISO on a monthly basis a

description of any and all adjustments made to baseline conditions used in the performance value calculations.

(8) For Distributed Generation, Project Sponsors shall report the Facility Metered Load at the metering point in accordance with Market Rule 1 for purposes of calculating the actual demand reduction and pushback to the grid during Demand Resource On-Peak Hours, Demand Resource Seasonal Peak Hours, Real-Time Demand Response Event Hours, or Real-Time Emergency Generation Event Hours (as appropriate) as described in Section 5 of this manual and Section 12.3.3 of ***ISO New England Manual for Market Rule 1 Accounting, M-28***.

13.3 Reserved

Section 14: Independence and Auditing

14.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan compliance with requirements for measurement and verification processes that will be conducted by independent third-parties. An independent third-party is a party that is not an Affiliate of the Project Sponsor, that has no financial interest in the outcome of the certification, and that is qualified in the measurement and verification of Demand Resource measures.

The Project Sponsor shall specify in its Measurement and Verification Plan that the Project Sponsor shall provide an Annual Certification to the ISO that the Demand Resource projects continue to perform in accordance with the submitted Measurement and Verification Plan and with the Measurement and Verification Documents reviewed and approved by the ISO for the applicable Capacity Commitment Period.

14.2 Requirements

The Project Sponsor shall indicate in its Measurement and Verification Plan compliance with the following requirements:

(1) The Project Sponsor shall provide to the ISO an Annual Certification of Accuracy of Measurement and Verification Documents, with a statement certifying that the Projects for which the Project Sponsor is requesting compensation continue to perform in accordance with the submitted Measurement and Verification Documents approved by the ISO. Acceptable methods for satisfying the Annual Certification of Accuracy of Measurement and Verification Documents include, but are not limited to, certification by a state public utility commission with jurisdiction over the Project, or an auditor that is not an Affiliate of the Project Sponsor, that has no financial interest in the outcome of the certification, and that is qualified in the measurement and verification of Demand Resource measures.

(2) The Project Sponsor shall cooperate in any unannounced audits or tests of a Demand Resource conducted by the ISO. Audits may be conducted on a periodic basis, or at the ISO's discretion should the ISO have a reason to suspect a deficiency in the Project Sponsor's compliance with any requirement. On site audits will be coordinated with the Project Sponsor and scheduled during normal business hours.

(3) The Project Sponsor shall allow the ISO to audit testing and calibration records, and order and witness the testing of metering and measurement equipment installed pursuant to the Demand Resource's approved Measurement and Verification Plan

(4) The Project Sponsor shall be responsible for all expenses associated with installing, maintaining, calibrating and testing the metering, data recording and measurement equipment installed pursuant to the Demand Resource's approved Measurement and Verification Plan.

(5) The Project Sponsor shall also comply with the requirements in Market Rule 1, Section III.13.6.1.5.4 and ***ISO New England Manual for Registration and Performance Auditing, M-RPA*** for registration, audit, and testing.

14.3 Reserved

Section 15: Measurement and Verification Supporting Documents

15.1 Description

The Project Sponsor shall provide a list in its Measurement and Verification Plan of all reports, studies, specifications and other documents referenced in its Measurement and Verification Plan. Such documents shall be submitted as Measurement and Verification Documents.

15.2 Requirements

The Project Sponsor shall indicate in its Measurement and Verification Plan compliance with the following requirements:

(1) All reports, studies, specifications and other documents referenced in the Project Sponsor's Measurement and Verification Plan shall have been prepared and published within five years of the Measurement and Verification Plan's submission date to the ISO.

(2) The Project Sponsor shall specify in its Measurement and Verification Plan adequate justification for use and relevance of reports, studies, specifications and other documents referenced in the Project Sponsor's Measurement and Verification Plan published more than five years from the time of the Measurement and Verification Plan's submission. Additional justification for use of out of date documents shall be submitted in addendums to the Measurement and Verification Documents by the New Capacity Qualification deadline or Existing Capacity Qualification deadline for the applicable Forward Capacity Auction for reports, studies, specifications and other documents referenced in the Project Sponsor's Measurement and Verification Plan that become out of date during after a Capacity Commitment Period and shall be subject to ISO approval.

(3) The Project Sponsor shall provide to the ISO electronic copies (and upon request hardcopies) of any and all reports, studies, specifications and other documents referenced in its Measurement and Verification Plan.

Section 16: Responsible Parties

16.1 Description

The Project Sponsor shall specify in its Measurement and Verification Plan the parties involved in various aspects of the Project.

16.2 Requirements

The Project Sponsor shall specify in its Measurement and Verification Plan the parties involved in various aspects of the Project, including but not limited to the names or titles of the parties, professional qualifications, and typical responsibilities in the following area:

(1) Project Management

(2) Measure Implementation

(3) Measure Operation and Maintenance

(4) Measurement Equipment Calibration and Testing

(5) Monthly Performance Calculations

(6) Data Validation, Retention and Management

(7) Monthly Performance Reporting

(8) Independent Project Auditing

(9) Quality Assurance

Section 17: Measurement and Verification Plan Format

17.1 Description

The Project Sponsor shall prepare and submit its Measurement and Verification Plan in a format and manner as specified by ISO New England.

17.2 Requirements

The Project Sponsor's Measurement and Verification Plan shall contain all information as specified in this manual in a format specified by the ISO[6]. In each Section, Project Sponsor shall specify required elements of its proposed plan and indicate compliance with all the applicable requirements specified in this manual:

(1) Project Information

(2) Equipment, Measure, and Practice Description

(3) Project General Assumptions

(4) Measurement and Verification Approach

(5) Establishing Baseline Conditions / Metering Scheme

(6) Statistical Significance

(7) Performance Calculations

(8) Monitoring Parameters and Variables

(9) Measurement Equipment Specifications

(10) Monitoring Frequency and Duration

(11) Data Validation, Retention and Management

(12) Performance Reporting

(13) Independence and Auditing

(14) Measurement and Verification Documents

(15) Responsible Parties

[6] The Measurement and Verification Plan form for Demand Resources is available on the ISO website. http://www.iso-ne.com.

Revision History

Approval

Approval Date: April 13, 2007 Effective Date: April 13, 2007

Revision History

Revision: 1 - Approval Date: August 2, 2007

Section No.	Revision Summary
List of Figures and Tables…..	Added "ISO New England Business Procedures" to the Table 1.1 title.
Introduction…	Added "ISO New England Business Procedures" to this section.
Table 1.1……	Added "ISO New England Business Procedures" to the title and adds "Ancillary Service Schedule No. 2 Business Procedure" to the Transmission column.
A2.4(7) & A4.4……	Replaced "90 days following the dispatch day" with "the 101 day Data Reconciliation Process deadline".

Revision: 2 - Approval Date: May 7, 2010

Section No.	Revision Summary
Entire Manual revised to reflect the Forward Capacity Market as contained in Section III.13 of Market Rule 1.	

Revision: 3 - Approval Date: May 6, 2011

Section No.	Revision Summary
6.4.1……..	Added a reference to Section 6.4.1.1(4)(a) for the location of the Customer Baseline adjustment description to the first sentence and deleted the second and third sentences.
6.4.1.1(4)(a)(i)..	Added reference to dispatch results from a Demand Response audit, deleted reference to a Real-Time Price Response event being initiated, and clarified that the actual usage would occur before the first Reduction Deadline in the dispatch day.
6.4.1.1(4)(a)(ii).	Clarified that the actual usage would occur before the first Reduction Deadline in the dispatch day.
6.4.1.1(4)(a)(iii)	Deleted the reference to a Real-Time Price Response Asset and clarified that the actual usage would occur for the two hours commencing two and a half hours before the first Reduction Deadline in the dispatch day.
6.4.1.1(4)(a)(iv)	Added a new subsection (iv) describing the Customer Baseline adjustment for a Real-Time Price Response Asset participating in the Day-Ahead Load Response Program or a Real-Time Price Response event occurring in the dispatch day.
6.4.1.1(4)(a)(v).	Previous subsection (iv) becomes the new subsection (v).
6.4.1.1(4)(a)(vi)	Previous subsection (v) becomes the new subsection (vi) and the previous content is replaced with a new sentence detailing the application of the Customer Baseline

adjustment for the second and subsequent consecutive event days when there are multiple consecutive dispatch days for an asset.

Revision: 4 -	Approval Date: June 1, 2012
Section No.	Revision Summary
1.3…….	Deleted the special provision for Real-Time Demand Response Assets.
2.3(4)……	Added the phrase "at the metering point in accordance with Market Rule 1".
5.1……..	Deleted the first sentence of the second paragraph.
5.2.2……	Replaced Distributed Generation with an explanation of which Assets this section applies to and added references to Market Rule 1 and the ISO New England Manuals. Deleted subsection (5).
5.3……...	Added a required demonstration of conformance with Market Rule 1 and that the alternate methods are subject to approval by the ISO.
5.4.1 & 5.4.2..	Deleted Real-Time Demand Response Event Hours.
5.6……..	Replaced Customer Baseline with Demand Response Baseline and added a reference to Section III.E.2.1 of Market Rule 1. Deleted the language on six acceptable metering configurations.
5.6.1……	Replaced the formula with a reference to Section III.E.2.1 of Market Rule 1.
5.6.2……	Replaced formula with a reference to Section III.E.2.1 for Real-Time DR Assets but retained formula for RTEG Assets metered at the generator. Added a new formula for Real-Time Demand Response Assets consisting of Distributed Generation metered at the generator.
5.6.3……	Revised section heading and replaced Distributed Generation with Real-Time Emergency Generation Asset.
5.6.4……	Revised Section heading and replaced formula with references to Sections III.E.2.1 and III.8 of Market Rule 1.
5.6.5……	Revised drawing and replaced formula with references to Sections III.E.2.1 and III.8 of Market Rule 1.
5.6.6……	Replaced "hour" with "interval".
6.1……..	Deleted references to Real-Time Demand Response Event Hours and RTEG Event Hours. Added a reference to Section III.8 of Market Rule 1 for baselines.
6.2(10)……	Added this new subsection for Real-Time Demand Response Resources, Real-Time Demand Response Assets, and Real-Time Emergency Generation Resources and application of Section III.8 of Market Rule 1 for baselines and Section III.E.2 of Market Rule 1 for metering.
6.4……..	Revised section heading to delete the reference to the Real-Time Price Response Program. Added a reference to Section III.8 of Market Rule 1.
8.1……..	Deleted Real-Time Demand Response Event Hours and RTEG Event Hours.
9.3.2……	Deleted subsection (1) and revised subsection (2) to eliminate advance notice dispatch.
10.3.1…….	Added references to Market Rule 1 and ISO New England Manuals. Deleted several subparagraphs.
10.3.2…….	Deleted section.

11.2……	Deleted subsection (2). Revised subsection (4) to delete references to Real-Time Demand Response Event Hours and RTEG Event Hours. In subsection (5) added a reference to Market Rule 1.
11.3……	Deleted section.
12.2.4…….	Added in subsection (d) an exclusion from reporting for incorrect data. In subsection (e) added a requirement that estimated data used in the Demand Reduction Value calculations and the methodology used to develop the estimated data are to be communicated to the ISO. In subsection (g) added a requirement to notify the ISO of metering inaccuracies found.
12.3……	Deleted section.
13.2……	Deleted in subsection (1) the last sentence. In subsection (6) added a reference to Section III.13.6.1.5 of Market Rule 1. In subsection (8) added an exclusion for Real-Time Demand Response Resources and Real-Time Emergency Generation Resources. In subsection (9) added a reference to the metering point and a reference to ISO New England Manual M-28.
13.3……	Deleted section.
14.2(5)……	Added a reference to Market Rule 1.
14.3……	Deleted section.

Revision: 5 -	Approval Date: November 8, 2013
Section No.	Revision Summary
2.1, 2.2 & 2.3……..	Updated the project description submission and timing components to be consistent with Section III.13.1.4.2(a) of Market Rule 1.

Revision: 6 -	Approval Date: April 4, 2014
Section No.	Revision Summary
Various Manual Sections ……	Replaced “Demand Reduction Value” with “performance”, “Section III.8” with “Section III.8A”, “Appendix III.E” with “Appendix III.E1”.
8.1……...	Added On-Peak Resource and Seasonal Peak Resource references to this subsection.
9.2(6)(c)…….	Added a new subsection (c).
13.2(1)……	Added a new subsection (1).
13.2(4)……	Deleted previous subsection (4).