


# System Operating Procedures

SOP-OUTSCH.0040.0010

Create Demand Forecast

Effective Date: May 2, 2011  
Revision No. 14

	© ISO New England Inc. 2011	<b>Procedure: Create Demand Forecast</b>
	Process Name: Develop Demand Forecasts	
	Procedure Number: OUTSCH.0040.0010	Revision Number: 14
	Procedure Owner: Steve Gould	Effective Date: May 2, 2011
	Approved By: Director, Operations	Valid Through: March 17, 2013


# SOP-OUTSCH.0040.0010 - Create Demand Forecast

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## 1. Objective

The objective of this procedure is to define the process for the development and update of the ISO New England forecast of hourly demand. This procedure documents the responsibilities of the ISO New England (ISO) Forecaster with regard to the development of the ISO forecast demand.

Compliance with this procedure forms the basis for planning reliable ISO system operation and directly impacts Market operations.

## 2. Background


ISO is responsible for developing the New England hourly forecast demand for the current and next six days. Forecast weather conditions are used in conjunction with historical weather observations and demand data. The data is analyzed utilizing both a similar day and artificial neural network applications and are combined to develop a New England demand forecast.

## 3. Responsibilities

1. The Forecaster is responsible for executing this procedure including:
  - Developing an hourly forecast for the New England demand by 1000 the day ahead for the current and next six days
  - Periodically updating the demand forecast to reflect weather forecast updates and/or deviations between actual and forecast demand
  - Publishing the initial New England demand forecast on the ISO New England Web site by 1000 each day or when a Cold Weather Event is declared, by 0700 the day prior to the Cold Weather Event day
  - Publishing the updated New England demand forecast on the ISO New England Web site upon completion
  - Communicating the initial and updated demand forecast to ISO staff and the Local Control Centers (LCC).

## 4. Controls

None.

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## 5. Instructions

### 5.1 Accumulation of Data

#### 5.1.1 Time to Perform Demand Forecast

1. The Forecaster will normally perform this procedure during the morning hours in order to publish the results by 1000.
2. When a Cold Weather Event has been declared in accordance with SOP-RTMKTS.0050.0007 – Perform Cold Weather Condition Operations, the Forecaster shall perform this procedure the day prior to the Cold Weather Event day in order to publish results by 0700.

#### NOTE

The weather data obtained is described in Attachment A – Weather Data.

#### 5.1.2 Historical Data


1. The Forecaster shall:
  - A. Ensure that actual weather observations and actual demand data are properly logged and archived.
  - B. Print a copy of hourly weather observation and place in seasonal weather booklet.
  - C. Print and place actual hourly ISO demand in the ISO New England Unadjusted Loads booklet (Red book).

#### 5.1.3 Forecast Data

1. The Forecaster shall:
  - A. Retrieve the 3 weather forecast vendors' eight city weather forecast, as identified in Attachment A - Weather Data.
  - B. Review multiple vendors for convergence or divergence and if divergent, check other sources such as the internet/media.
  - C. Set vendor weight factors and aggregate into single ISO forecast.

#### NOTE

The weather services will develop 3 curves and 1 average curve to create a combined forecast.

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## 5.2 Run Similar Day Load Forecast (Simday)

### NOTE

The Similar Days Load Forecast (Simday) software application is used to identify the days that meet the screening criteria.

1. The Forecaster shall select the “Execute Simday” application to identify days that closely fit the forecasted weather conditions. The Forecaster shall use the following:
  - A. Initial screening criteria:
    - Day(s) of the week (Sun, Mon, Tue-Wed-Thurs, Fri, Sat, and holiday)
    - Number of days to look ahead and number of days to look back in the historical database
    - Average effective temperature difference is less than X degrees
    - Largest absolute temperature difference for any hour is less than Y degrees
    - The forecasted demand difference between hour 24 of the current day and hour 24 of the day prior to the similar day does not exceed Z MW

### NOTE


When determining the number of days to look back or ahead, the sociological factors such as schools in session, after Thanksgiving but prior to Christmas, and Standard versus Daylight Savings Time must be accounted for.

For example: When forecasting Tuesday, December 5, 2000, the Forecaster can look back to Tuesday, November 28, 2000, and look ahead to Thursday, December 21, 2000.

The current rule of thumb is X=8, Y=10, and Z=1000.

B. Based on the results of the screening process, select up to five (5) days as the basis for the development of the Simday demand forecast.

C. If no days were identified, expand the screening criteria until the application identifies at least one similar day.


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2. The Forecaster shall adjust the demand of each hour of the selected days to reflect:

- A. Demand growth or reduction.
- B. Demand difference in the hour preceding the forecast period.
- C. Differences in the forecast weather and the actual weather of the selected days:
  - (1) Temperature [Effective Temperature (EFF) winter, Temperature Humidity Index (THI) summer].
  - (2) Dew point (summer only).
  - (3) Cloud cover.
  - (4) Precipitation.

3. The Forecaster shall:

- A. Determine adjustments to account for all other factors based on knowledge and experience or, if necessary, via further study of the individual factors.
- B. Review graphical representation of adjusted load data.
- C. Set weighting factors of individual adjusted historical loads to obtain the final aggregate “Similar Day Load Forecast”.
- D. Save the final weighted “Similar Day Load Forecast”.

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### 5.3 Run Metrix ND Demand Forecast

1. The Forecaster shall select the “Execute Metrix ND” application.

#### NOTE

The “Metrix ND” application automatically utilizes either the EFF during the heating months or the THI during the summer months as the input driver for the development of the hourly demand values.

The “Metrix ND” program calculates demand for a 7-day period, Day 1 through Day 7. The outputs are eventually compared to the Artificial Neural Network (ANN) model and “Simday” outputs.

### 5.4 Run Artificial Neural Network (ANN) Demand Forecast

1. The Forecaster shall select the “Execute ANN” application and perform the steps required for a multiple model forecast in the “ANN” application.


#### NOTE

The “ANN” application integrates current day Log 7 demand and either the EFF during the heating months or the THI during the summer months as the input drivers for the development of the hourly demand values.

The “ANN” application calculates demand for a 7-day period, Day 1 through Day 7

The “ANN” application will develop multiple demand forecast models.

- Two of these models are “fast” learners, leaning more heavily on the most recent historical demand and weather data.
- The other two models are “regular” learners, weighing the most recent past demand and weather data evenly.


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## 5.5 Final Adjustments to Demand Forecast

1. After creating a combined demand forecast incorporating the Simday, Metrix and ANN outputs the Forecaster shall:
  - A. Review the graphical and tabular information for model convergence / divergence.
  - B. Review the daily “Load Forecast Status” report, which is emailed daily from the Forecast Database, to determine the accuracy of each model over the past seven days.
  - C. Assign a weighting factor to both the “Simday” forecast, the ANN forecast model and the Metrix ND model as follows:
    - Normally each approach will be assigned a factor for each model
    - If it is recognized that weather factors not recognized by the ANN and/or Metrix ND software (cloud cover, precipitation, etc.) or factors other than weather will significantly impact the demand, apply a lower weighting to the ANN and/or Metrix ND forecast
    - If it is recognized that forecast conditions are remaining consistent with current conditions and ANN and/or Metrix ND is performing very accurately, apply a higher weighting to the ANN and/or Metrix ND forecast
  - D. Review resultant final demand forecast.
  - E. Make adjustments out to seven days as necessary by manually deriving the individual daily peak demand values based on the temperature and dew point data provided and override the forecast values in the spreadsheet.
  - F. Save the final load forecast into the “Load Forecast Database”.

**NOTE**

SOP-OUTSCH.0040.0020 - Create Seven-Day Capacity Margin Forecast, utilizes the ANN / Metrix ND output for Day 3 through Day 7.


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## 5.6 Communications

### NOTE

The demand forecast is automatically posted to the ISO web site during the final approval process.

1. The Forecaster shall:
  - A. Post the final demand forecast to the ISO Web site and Energy Management System (EMS) by 1000 hours for initial forecast and updates upon completion.
  - B. Deliver the forecast to the following:
    - LCCs (normally faxed as requested)
    - Short-Term Outage Coordinator/Engineer (normally emailed)
    - Operations Support Engineers (normally emailed)
2. If a Cold Weather Event has been declared in accordance with SOP-RTMKTS.0050.0007 – Perform Cold Weather Condition Operations, the Forecaster shall post the final demand forecast to the ISO website and EMS by 0700.

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## 5.7 Demand Forecast Update

### 5.7.1 Update Conditions

1. The Forecaster shall continuously review the trending of current day demand as compared to the forecast demand.
2. The Forecaster shall update the demand forecast under either of the following conditions:
  - A. The difference between the actual and forecast demand values exceeds 400 MW, and the deviation is expected to continue throughout the forecast period, or
  - B. The latest weather forecast shows significant change in one or more of the parameters from the previous forecast and in the judgment of the Forecaster an update is warranted
3. The Forecaster shall give consideration to any significant special sociological factors affecting the forecast demand period and in the judgment of the Forecaster update the demand forecast as necessary.


### 5.7.2 Accumulate Data for Update

1. The Forecaster shall ensure the following steps have been performed:
  - A. The initial load forecast has been performed per Step 5.1 through 5.5.
  - B. Updated weather data is available. Print outs of previous day demand is obtained and pertinent information has been logged in the ISO New England Unadjusted Demand Book in the Forecast cabinet for future reference (refer to Attachment A - Weather Data).
2. The Forecaster shall perform the following steps using the computer-based demand forecasting tools:

#### NOTE


Since the last hour demand data is in the process of being updated during the first 10 minutes of an hour, it may be inaccurate and should not be saved.

- A. After the first ten (10) minutes of an hour has expired,
  - (1) Save: the today demand data up to the last available hour.
  - (2) Import the most recent weather data as identified in Attachment A - Weather Data.

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**5.7.3 Update Artificial Neural network (ANN) Demand Forecast**

3. Update the current weather and most recent loads and report the data out to ANN and Metrix ND.
1. The Forecaster shall execute the Metrix ND program and perform the steps required for a single forecast Metrix ND model in accordance with Section 5.3.
2. The Forecaster shall execute the ANN program and perform the steps required for a multiple forecast ANN model in accordance with Section 5.4.
3. The Forecaster shall make final adjustments to the demand forecast in accordance with Section 5.5.
4. The Forecaster shall save the final demand forecast into the “Load Forecast Database”.

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## 5.8 Manual Demand Forecast Updates


### NOTE

Demand forecast updates for the current day (Day 1) cannot be performed using the “Simday” software tools due to design limitations.

5. If the Forecaster determines the ANN and the Metrix ND forecasts are not accurate, the Forecaster shall manually perform the current day (Day 1) forecast updates as follows:
  - A. Retrieve the previously used and most current weather forecast data.
  - B. Using the applicable EFF and THI temperature differences between the weather forecasts, calculate the load percentage adjustment.
  - C. Using the “demand percentage adjustment” calculate a new “demand forecast update”.
6. The Forecaster shall save the final demand forecast into the “Forecast Database”.
7. When a manual adjustment is made, the Forecaster shall input the forecast into the MSS MOI input tab as needed.

## 5.9 Reconstitution of Actual Demand

1. The Forecaster shall update the Daily Demand Forecast Re-Constitution Excel spreadsheet as defined in Attachment B - Re-Constitution of the ISO Actual Hourly Demand.
2. The Forecaster shall complete the actions required for re-constitution of the actual hourly demand each day prior to the start of the demand forecast process for the next Operating Day.

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## 6. Performance Measures

This procedure is deemed to be properly followed as evidenced by the following:

- The forecaster will complete and post the initial demand forecast to the ISO Web site and Energy Management System (EMS) by 1000 hours each day or when a Cold Weather Event is declared, by 0700 the day prior to the Cold Weather Event Day
- Whenever the conditions stated in Step 5.7.1. require a demand forecast update, the forecaster will complete and post an update demand forecast in accordance with Steps 5.7.2 and 5.7.3

## 7. References

ISO New England Inc. Transmission, Markets and Services Tariff, Market Rule 1

ISO New England Manual for Market Operations Manual M-11 (Manual 11)


SOP-OUTSCH.0040.0020 - Create Seven-Day Capacity Margin Forecast

ISO New England Operating Procedure No. 4 - Action During a Capacity Deficiency (OP-4)


SOP-RTMKTS.0050.0007 - Perform Cold Weather Condition Operations

## 8. Revision History

Rev. No.	Date	Reason	Contact
0	03/01/03	Original	Joe Mercer
1	07/07/03	Revised to include changes since SMD implementation	Joe Mercer
2	12/19/03	Changes to the Controls and Performance Measures sections	Joe Mercer
3	02/01/05	Updated SOP for RTO terminology, changed Procedure Owner	Seamus McGovern
4	02/02/05	Revised to include 3 weather services used	Seamus McGovern
5	03/29/05	Revised to incorporate the VELCO Local Control Center	Seamus McGovern

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6	09/30/05	Revised to address Forecast Audit. Incorporate the Metrix ND model.	Seamus McGovern
7	11/28/05	Revised to include changes in MR1 App H (Cold Weather)	Seamus McGovern
8	05/05/06	Updated for Control Room Forecaster Split, removed Cold Weather Conditions actions (MR1 App H retired)	Steve Weaver
9	11/30/06	Revised to include changes in MR1 App H (Cold Weather)	Steve Weaver
10	04/04/07	Revised as part of annual review	Steve Weaver
11	03/26/08	Annual Review by Procedure Owner. Defined in step 5.2.2.C the following acronyms for later use: Effective Temperature as EFF and Temperature Humidity Index as THI. Correct steps referenced in 5.7.3.1 and 5.7.3.2. Replaced Section 6 – Performance Measures. Correct the Weather Company names currently used & the weighting factors used at Logan Airport and Bradley Field Appendix A.	Steve Weaver
12	03/17/09	Revised for periodic review	Steve Weaver
13	06/01/10	Biennial review by procedure owner; Changed SOP title to Create Demand Forecast and made consistent use of demand in place of load; Global editorial changes to be consistent in use of approved terms, acronyms and to improve clarity by changes in grammar, punctuation, etc. Added section 5.9 Re-Constitution of Actual Demand. The responsibility to perform the reconstitution task has been transferred from Planning to the Forecaster. Added Attachment B Daily Load Re-Constitution Worksheet to provide directed action for the re-constitution process.	Steve Weaver
14	05/02/11	Corrected typo for Valid Through: date in Headers; Updated copyright date and Procedure Owner: in Headers; Changed pagination format to “X of Y”; Modified 3.1 1 <sup>st</sup> bullet (replaced “each day” with “the current and the next six days”; Step 5.1.2.1.A added “...data...”; Step 5.2.1.A last bullet added a space between “Z” & “MW”; Step 5.2.1.C. added “...the...”; 5.3.1. NOTE replaced “...and...” with “...or...” in 1 <sup>st</sup> paragraph; 5.4.1. NOTE replaced “...and...” with “...or...” in 1 <sup>st</sup> paragraph; NOTE prior to step 5.7.2.2.A replaced “...save...” with “...saved...”;	Steve Gould


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## 9. Attachments

Attachment A - Weather Data

Attachment B - Re-Constitution of the ISO Actual Hourly Demand



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## Attachment B - Re-Constitution of the ISO Actual Hourly Demand

When ISO has actually implemented the following OP-4 Actions:

- The OP-4 Action where a voltage reduction requiring more than ten minutes has been implemented
- The OP-4 Action where a voltage reduction requiring less than ten minutes has been implemented
- The OP-4 Actions where Public and/or Governor Appeals have been implemented via radio and television

The Forecaster shall perform the re-constitution of the actual ISO hourly demand as follows.

1. For voltage reduction requiring > 10 Minutes
  - A. 1.0% of ISO demand for first hour
  - B. 0.5 % of ISO demand for second hour
  - C. % of ISO demand for all subsequent hours
2. For voltage reductions requiring < 10 Minutes
  - A. 1.5% of ISO demand for first hour
  - B. 0.75 % of ISO demand for second hour
  - C. 0.00 % of ISO demand for all subsequent hours
3. For Public and Governor Appeals
  - A. For appeals issued prior to the Operating Day
    - i. Forecaster develops hourly value based on review of forecast demand versus actual demand for all hours of the Operating Day.
  - B. For appeals issued by 7:00 a.m. during the Operating Day
    - i. Forecaster develops hourly value based on review of forecast demand versus actual demand for all hours of the Operating Day.
  - C. For appeals issued by 12:00 p.m. during the Operating Day (For Winter period only)
    - i. Forecaster develops hourly value based on review of forecast demand versus actual demand for all hours of the Operating Day.

All hourly data re-constitution values are entered manually by the Forecaster using the ISO Load Forecast application Load Adjustments function.