SOP-OUTSCH.0040.0010 - Create Demand Forecast

Contents

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ISO new england	© *ISO New England Inc. 2023*	*Procedure: Create Demand Forecast*
	Process Name: Create Demand Forecasts	
	Procedure Number: OUTSCH.0040.0010	*Revision Number: 24*
	Procedure Owner: Thomas Knowland	*Effective Date: December 12, 2023*
	Approved By: Director, Operations	*Valid Through: December 12, 2025*

1.   Objective

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

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 demand forecast 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 that are combined to develop a New England demand forecast.

3.   Responsibilities

1. The Forecaster is responsible for executing this procedure including:

- Developing all of the following:

    o   An initial hourly forecast incorporating all of the load forecast models for the New England demand by 0530 for the current and next six days

    o   A second hourly forecast incorporating all of the load forecast models for the New England demand by 0930 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

- Communicating the initial and updated demand forecast to ISO staff and the Local Control Centers (LCCs)

4.   Controls

1. The Create Demand Forecast process and subsequent demand forecasts are peer reviewed and validated daily by the Off Shift Forecaster and/or designated analyst.

5. Instructions

5.1 Accumulation of Load Data and Weather data

5.1.1 Time to Perform Demand Forecast

1. The Forecaster shall perform this procedure during the morning hours in order to publish the initial forecast of New England demand results by 0530 and an updated forecast of New England demand by 0930.

> **NOTE**
>
> The weather data obtained is described in Attachment A - Weather Data.

5.1.2 Historical Data

1. The Forecaster shall perform the following:

   A. Verify that the load forecast data is imported into the forecast analysis software.

5.1.3 Weather Forecast Data

1. The Forecaster shall perform the following:

   A. Retrieve the weather forecast vendors' weather forecasts, as identified in Attachment A - Weather Data.

   B. Review the multiple vendor weather forecasts for convergence or divergence and if divergent, compare the vendor outputs with other sources such as the National Weather Service and internet/media weather forecasts.

> **NOTE**
>
> The "Load Forecast Status" report is emailed daily to the Forecasters.

   C. Review the daily "Load Forecast Status" report, determine the accuracy of each vendor over the past seven days, and consider forecasts that may be developed by the Forecast Analyst (Meteorologist).

   D. Based on an analysis of all provided weather inputs, verify that the best available weather forecast is updated as the input to the ISO demand forecast.

NOTE

The Behind-The-Meter Photovoltaic (BTMPV) data obtained is described in Attachment C - BTMPV Data.

5.1.4 BTMPV Forecast Data

1. The Forecaster shall perform the following:

   A. Retrieve the BTMPV forecast vendors' eight zone BTMPV forecasts, as identified in Attachment C - BTMPV Data.

   B. Review the multiple vendor BTMPV forecasts for convergence or divergence and if significantly divergent, compare the vendor outputs with available irradiance forecasts from the Weather Viewer and/or National Weather Service model irradiance forecasts

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NOTE

The "BTMPV Status Report" report is emailed daily to the Forecasters.

   C. Review the daily "BTMPV Status Report" report, determine the accuracy of each vendor over the past seven days, and consider guidance that may be developed by the Forecast Analyst (Meteorologist).

   D. Based on an analysis of all provided BTMPV inputs, verify that the best available BTMPV forecast is updated as the input to the ISO demand forecast.

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5.2   Execute Load Forecast Models

> **NOTE**
>
> This process will run all load forecast models with a single user action within the ISO NE Load Forecast application. The outputs are eventually blended with all other Load Forecast models to derive a final Load Forecast.
>
> The Artificial Neural Network ("ANN") application integrates current day OIS Log 7 demand and either the Effective Temperature during the heating months or the Temperature Humidity Index 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.
>
> "Fast" learners, lean more heavily on the most recent historical demand and weather data [i.e., the past two (2) days].
>
> "Regular" learners, weigh the most recent past demand and weather data evenly.
>
> The "Metrix ND" application calculates demand for a 7-day period, Day 1 through Day 7.

1. To run the Load Forecast, the Forecaster shall perform the following from the Load Forecast menu of the "ISO NE Load Forecast" application:

   A. Click the "Execute Forecast Models" menu item to open the window to run the desired models when they are selected:

      (1) ANN – All Active ANN/H models

      (2) ANNRC – All active ANN/H reconstituted models

      (3) Metrix – Metrix ND

      (4) MetrixDI – MetrixND Direct Input

      (5) MetrixRC – MetrixND Reconstituted

      (6) ZLF – MetrixND Zonal Load Forecast

   B. Verify the desired weather service and forecast time are selected

   C. Click the "Execute" button to initiate

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5.3 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 and identify days that closely fit the forecast weather conditions by using the following 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 forecast demand difference between HE24 of the current day and HE24 of the day prior to the similar day does **not** exceed Z MW

   - Total daily precipitation (independent of other criteria)

   A. Based on the results of the screening criteria, the Forecaster shall verify the "Simday" program selects up to five (5) days as the basis for the development of the "Simday" demand forecast.

> **NOTE**
>
> A Forecaster has the ability to manually choose and select similar days which will bypass the program automated selection process.
>
> For example: This can be performed for days preceding or immediately following holidays, where a Forecaster might want to look only at Sundays prior to Labor Day, as opposed to a random sampling of Sundays before and after Labor Day.

   B. If **no** days were identified, the Forecaster shall expand the screening criteria until the application identifies at least one similar day.

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

   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.

        (5) Behind-the-meter Photovoltaic (BTM PV) output.

        (6) Wet Bulb Temperature

        (7) Wind Speed

        (8) Wind Direction

        (9) Irradiance

3. The Forecaster shall perform the following actions:

    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 and obtain the final aggregate "Similar Day Load Forecast".

    D. Save the final weighted "Similar Day Load Forecast".

5.4   Import External Models

1. Select the Upload External Forecast item in the Sim Day / External Forecast menu of the ISO-NE Load Forecast application

2. Select which model is to be uploaded in the Select Model dropdown box

3. Select which file is to be uploaded in the File Name selection box

4. Verify, using the validation messages and the load chart provided, that the model that was uploaded is reasonable

5. Press the Upload button to finish uploading the CSV file

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5.5 Final Adjustments to Demand Forecast

1. In the Load Forecast menu of the Load Forecast software, the Forecaster shall select the "Create Combined Load Forecast" menu item, then select the correct starting date, and perform the following:

   A. Review the graphical and tabular information for model convergence / divergence.

   B. Review the daily "Load Forecast Status" report and determine the accuracy of each model over the past seven days. As necessary, review the forecast analysis software for additional information or longer historical information

   C. Assign a weighting factor to each model, or the previous Load Forecast, by using one of the following determinations:

NOTE

Each model is assigned a default weighting factor by the Load Forecast software

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   - Apply a lower weighting factor if the model is **not** performing accurately (i.e., it is divergent from other models), or it is **not** responding well to changing weather or other conditions.

   - Apply a higher weighting factor if it is determined that forecast conditions are remaining consistent with current conditions and the model is performing very accurately.

   - If it is desired to maintain the previous forecast for the selected day, apply a 1 weight to the previous forecast and 0 for all of the forecast models.

   D. Compare the resultant final demand forecast output with the previous day final demand forecast output for consistency:

   (1) If the outputs are widely divergent, investigate as to why, e.g., due to higher or lower temperatures or dew points.

   E. Make manual adjustments out to seven days as necessary

   F. After reviewing the individual seven days and selecting final weighting factors for each model output, select the "Save and Export" function.

5.6   Communications

> **NOTE**
>
> The demand forecast is automatically posted to the ISO external website during the final approval process. The emails are sent either as part of the Create Seven-Day Capacity Margin Forecast Process or using the Forecast Analysis program.

1. The Forecaster shall perform the following communication actions:

   A. Verify the final demand forecast is published to the ISO external website and Energy Management System (EMS).

   B. Email a copy of the forecast to recipients as defined by the software and any additional recipients, as requested.

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 if either one of the following conditions exist:

   - The difference between the actual and forecast demand values exceeds 400 MW, and the deviation is expected to continue throughout the forecast period

   - 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 consider any significant special societal factors affecting the forecast demand period and if judged appropriate, update the demand forecast as necessary.

4. The Forecaster shall update the current weather and most recent demand data and rerun the computer models per the appropriate sections of this procedure.

5.8   Reconstitution of Actual Demand

1. Each day prior to the start of the demand forecast process for the next Operating Day, the Forecaster shall complete the actions required for reconstitution of the actual hourly demand as follows:

   A. Using Attachment B - Reconstitution of the ISO Actual Hourly Demand, update the "Daily Demand Forecast Reconstitution Excel" spreadsheet.

6.   Performance Measures

This procedure is properly followed as evidenced by the following:

- The Forecaster completes and posts both of the following:

    o The initial demand forecast to the ISO external website and EMS by 0530 each day

    o The second demand forecast to the ISO external website and EMS by 0930 each day

- Whenever the conditions stated in Step 5.7.1. require a demand forecast update, the Forecaster completes and posts an updated demand forecast in accordance with Step 5.6.

7.   References

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

8. Revision History

Rev No	Date	Reason	Contact
- -	05/21/19	For previous revision history, refer to Rev 20 available through Ask ISO	Thomas Knowland
21	05/21/19	Biennial Review completed by procedure owner; Made the following updates to reflect software changes for incorporating PV information: 5.1.2.1.A: Removed reference to Historical Load Logs, added reference to forecast analysis software; 5.1.2.1.B: Changed "booklet" to "binder"; 5.1.2.1.C: Removed reference to Historical Load Log; 5.1.3.1: Added Forecast Analyst to the performer of actions; 5.1.3.1.C: Removed step to change weather weighting factors; 5.1.3.1.D: Moved to step C and changed title from Meteorologist to Forecast Analyst; 5.2.1: Changed wording for accessing the MetrixND zonal forecast software to align with new application; 5.3.1: Added criteria to include precipitation; 5.3.2.C.5: Added reference to BTM PV adjustment; 5.4.1: Changed wording for accessing the MetrixND regional forecast software to align with the new application; 5.5.1: Changed wording for accessing the ANN forecast software to align with the new application; 5.6.1: Changed wording for accessing the Combine Load Forecast software to align with the new application; Truncated the Revision History per SOP-RTMKTS.0210.0010 Section 5.6;	Thomas Knowland
22	04/30/21	Biennial Review. Updated Section 5.2 to combine Sections 5.4, 5.5 and 5.6 into single section Added in NOTE for Section 5.2 Added in new Section 5.4	Thomas Knowland
23	04/27/23	Sections 5.4, 5.5 and 5.6 remain separate Added in NOTE for Section 5.2 Added in new Section 5.1.4 Updated Section 5.1 to add Combined BTMPV procedure Added Attachment C – BTMPV Data Added Section 4.1	Thomas Knowland
24	12/12/23	Review completed to reflect software and procedure changes from WISE implementation and minor wording changes: 5.1.2: Removed B and C, as printing items is no longer needed 5.1.3.1: Removed "Forecast Analyst" from process procedure 5.1.3.1.A: Removed "eight city" reference, as specific number of cities is not needed 5.1.4.1: Removed "Forecast Analyst" from process procedure 5.3.2.C: Added new weather types for Simday adjustment drop-down list Attachment A - Weather Data: Updated table and information to show new data from the WISE implementation	Thomas Knowland

9. Attachments

Attachment A - Weather Data

Attachment B - Reconstitution of the ISO Actual Hourly Demand

Attachment C - BTMPV Data

Attachment A - Weather Data

Three weather services (Data Transmission Network, AccuWeather, Atmospheric G2) provide the weather data used by ISO. Data is provided for 23 locations.:

City Name	State	Airport
Boston	MA	KBOS
Hartford	CT	KBDL
Bridgeport	CT	KBDR
Providence	RI	KPVD
Burlington	VT	KBTV
Concord	NH	KCON
Portland	ME	KPWM
Worcester	MA	KORH
Taunton	MA	KTAN
Bedford	MA	KBED
Providence NW	RI	KSFZ
Hartford Brainard	CT	KHFD
Springfield	MA	KCEF
Rutland	VT	KRUT
Bangor	ME	KBGR
Pittsfield	MA	KPSF
Barnstable	MA	KHYA
Lawrence	MA	KLWM
Stamford	CT	KHPN
Waterbury	CT	KOXC
Manchester	NH	KMHT
Fitchburg	MA	KFIT
Beverly	MA	KBVY

The following parameters are provided:

- Dry bulb temperature (°F)

- Dew point (°F)

- Effective Temperature (EFF): January 1st – April 30th

  October 1st – December 31st

  Temperature Humidity Index (THI): May 1st – September 30th

- Wet bulb temperature (°F)

- Wind direction (bearing, degrees)

- Wind speed (mph)

- Sky cover (0-100%)

- Precipitation (inches/hr, two decimal place resolution)

- Irradiance (W/m²)

Attachment B - Reconstitution of the ISO Actual Hourly Demand

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

- The OP-4 Action (Action 6) where a voltage reduction requiring more than ten minutes has been implemented
- The OP-4 Action (Action 8) where a voltage reduction requiring less than ten minutes has been implemented
- The OP-4 Actions (Action 10 and Action 11) where Public and/or Governor Appeals have been implemented via radio and television

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NOTE

All hourly reconstitution values for OP-4 Actions are entered manually by the Forecaster using the ISO Load Forecast application, Load Adjustments function.

The Forecaster shall perform the reconstitution 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. 0.00 % 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 shall develop hourly value based on review of forecast demand versus actual demand for all hours of the Operating Day.

    B. For appeals issued by 0700 during the Operating Day

        i. Forecaster shall develop hourly value based on review of forecast demand versus actual demand for all hours of the Operating Day.

    C. For appeals issued by 1200 during the Operating Day (For Winter period only)

        i. Forecaster shall develop hourly value based on review of forecast demand versus actual demand for all hours of the Operating Day.

NOTE

Hourly data reconstitution values for the dispatch of Demand Response Resources (DRRs) are automatically bridged from the Baseline Telemetry System (BLTS) to the ISO Load Forecasting application on a daily basis.

Attachment C - BTMPV Data

Three BTMPV forecast services (Energy & Meteo Systems, Energy Forecasting Solutions and DNV) provide the BTMPV forecast data used by ISO. Data is provided for the eight New England load zones as follows:

Location
ME (Maine)
NH (New Hampshire)
VT (Vermont)
CT (Connecticut)
RI (Rhode Island)
SEMA (Southeast Massachusetts)
WCMA (West-central Massachusetts)
NEMABOS (Northeast Massachusetts & Boston)

The following parameters are provided:

- BTMPV generation in MW
- Global Horizontal Irradiance (GHI) in W/m^2