NWE Forecast Assumptions for ATC Calculation

February 16, 2010

Implement mechanism to post load forecasts and load data. The Commission also will require Transmission Providers to post their underlying load forecast assumptions for all ATC calculations and, to post on a daily basis, their actual daily peak load for the prior day. FERC directs Transmission Providers to post load forecasts and actual daily peak load for both system wide load (including native load) and native load. The Commission directs Transmission Providers to work through NAESB to develop standards for consistent methods of posting the new requirements on OASIS.
413, 416
(18 CFR § 37.6(b)(3)(iv))

Index

Load Forecast Methodology Summary

NWE develops its peak load forecasts, conservation and demand-response data (“load forecast data”) from two sources – customer provided forecast and regression model forecast. First, NWE obtains load forecast data from its customers. Pursuant to FERC Reliability Standard MOD 016, which became effective in June 2007, NWE obtains the load forecast data from Load Serving Entities (LSE) within its Balancing Area. NWE obtains load forecast data from Network Customers and Point-to-Point Customers pursuant to NWE’s tariff and FERC Order 890, respectively. NWE asks that these load forecasts be adjusted for any MW savings from customers’ conservation programs. These peak load forecasts are summed, assuming they are time-coincident, to calculate the Balancing Area load forecast. NWE’s second source is a regression-based peak load forecast model that NWE has maintained over the years. The regression-based forecast results are adjusted for MW savings resulting from conservation programs. The loads within NWE’s Balancing Area are metered and tracked. That is, the loads are well defined. If the customer forecasts and NWE load forecast results are significantly different, NWE attempts to reconcile these differences. If NWE cannot reconcile these differences, NWE will choose which forecast to use in the study.

NWE obtains load forecast data for ten years of monthly data and annual data extending through a fifteen-year planning horizon.

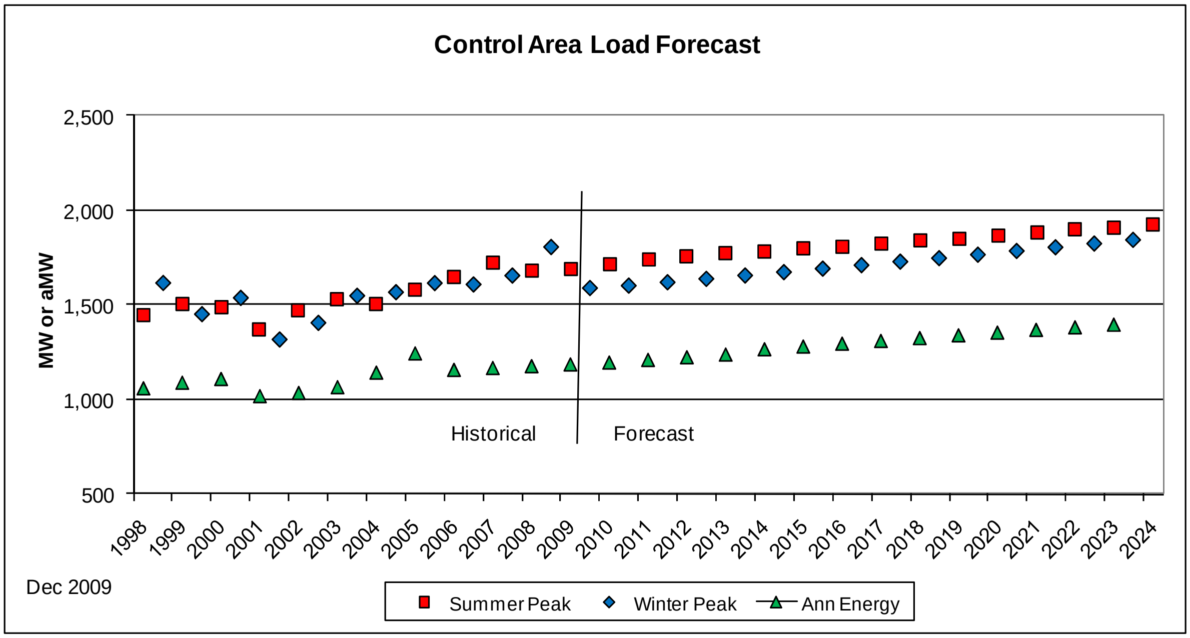
NorthWestern Energy (NWE) uses a peak load forecast that is based on a 50% probability of being exceeded (i.e., 1-in-2 assumption). The forecast may be adjusted up to a 1-in-10 or 1-in-20 (i.e., 10% and 5% probability, respectively) to capture heavy peak load conditions. A 1-in-2 (50% probability of being exceeded) and a 1-in-10 (10% probability of being exceeded) summer and winter peak load forecast within the Balancing Area is used.

The Balancing Area peak load forecast is adjusted to reflect demand response resource reductions, conservation reductions and other appropriate peak load modifying sources.

Once a Balancing Area load forecast is developed, this forecast is disaggregated to the load buses in NWE’s Balancing Area. There are two types of load buses: 1) a load bus where the load does not change over time (e.g., a single large industrial load bus); and 2) a load bus where the load changes over time (e.g., residential load). NWE uses its knowledge of load characteristics along with regression analysis to extrapolate the individual load bus data in time. The load bus forecasts are summed and compared to the Balancing Area load forecast. If the two forecasts do not match, NWE adjusts the changing load bus forecasts until the two forecasts are the same.

Predictions

NWE's latest forecast is the December 2009 forecast. This forecast was developed through linear regression with the default supply Demand Side Management (DSM) targets applied. The 2009 forecast data received from NWE's customers (LSE data) pursuant to FERC Standard MOD-016 was not complete enough to be used, but continues to improve in quality. The following graphic displays the control area load forecast assuming normal temperature. The summer peak is forecast to be slightly higher than the winter peak.



The following table present the data displayed in the preceding graphic.

	Control Area Load Forecast - W/DSM					
	Peak MW				Annual Energy	
	Winter		Summer		avg MW	
Actual	98-99	1615	1998	1448	1998	1058
	99-00	1450	1999	1508	1999	1087
	00-01	1536	2000	1490	2000	1107
	01-02	1316	2001	1370	2001	1017
	02-03	1404	2002	1467	2002	1034
	03-04	1547	2003	1533	2003	1064
	04-05	1566	2004	1502	2004	1140
	05-06	1614	2005	1580	2005	1241
	06-07	1607	2006	1644	2006	1155
	07-08	1654	2007	1724	2007	1164
	08-09	1805	2008	1678	2008	1174
Forecast	09-10	1588	2009	1685	2009	1183
	10-11	1601	2010	1713	2010	1193
	11-12	1619	2011	1740	2011	1207
	12-13	1637	2012	1757	2012	1221
	13-14	1654	2013	1771	2013	1235
	14-15	1672	2014	1784	2014	1249
	15-16	1691	2015	1797	2015	1262
	16-17	1709	2016	1811	2016	1277
	17-18	1728	2017	1825	2017	1292
	18-19	1746	2018	1838	2018	1306
	19-20	1764	2019	1852	2019	1321
	20-21	1784	2020	1866	2020	1335
	21-22	1804	2021	1881	2021	1350
	22-23	1823	2022	1896	2022	1364
	23-24	1843	2023	1911	2023	1377
	24-25		2024	1926	2024	1391
	CAGR	1.1%		0.8%		1.1%
	Per Yr	18.2		15.2		13.9

The monthly peak load forecast is displayed in the following graphic. A monthly shape factor was developed and applied to the winter and summer peak load forecasts to develop the non-peak month peak forecast.

Control Area Peak MW - W/DSM	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2009											1618	1749
2010	1588	1462	1399	1283	1307	1553	1713	1620	1453	1345	1423	1538
2011	1601	1474	1410	1293	1318	1577	1740	1645	1476	1356	1435	1551
2012	1619	1490	1426	1308	1333	1592	1757	1661	1490	1371	1451	1568
2013	1637	1506	1442	1322	1347	1605	1771	1674	1502	1386	1467	1585
2014	1654	1523	1458	1337	1362	1617	1784	1686	1513	1401	1483	1603
2015	1672	1539	1473	1351	1377	1629	1797	1699	1524	1417	1499	1620
2016	1691	1556	1490	1366	1392	1641	1811	1712	1536	1432	1515	1638
2017	1709	1573	1506	1381	1407	1654	1825	1725	1547	1448	1532	1656
2018	1728	1590	1522	1396	1422	1666	1838	1738	1559	1463	1548	1674
2019	1746	1607	1538	1411	1437	1679	1852	1751	1571	1479	1565	1691
2020	1764	1624	1555	1426	1453	1691	1866	1764	1583	1495	1582	1709
2021	1784	1642	1572	1441	1469	1705	1881	1778	1595	1511	1599	1728
2022	1804	1660	1589	1457	1485	1718	1896	1792	1608	1528	1617	1747
2023	1823	1678	1606	1473	1501	1732	1911	1807	1621	1544	1634	1766
2024	1843	1696	1624	1489	1517	1746	1926	1821	1634	1561		

This forecast information will be supplied to WECC and other entities as NWE's control area load forecast.

Forecast Data & Assumption for Linear Regression

NWE's data includes all load within NWE's control area and counts LSE, choice load (e.g., large industrial customers) and cooperative load only once in the data.

NWE linear regression load forecast uses linear regression techniques to develop its annual energy load forecast and seasonal peak load forecasts. The dependent variable is the load and the independent variables are explanatory variables (e.g., population, temperature, etc.). Three linear regression models are developed – winter season peak load, summer season peak load and annual energy load. An 18-year database is used to estimate the regression equation coefficients. The regression equation specification and coefficients are updated annually. The estimated models are then used to forecast the seasonal peak loads and the annual energy load by forecasting the independent variables into the future. These forecasts use expected or average conditions (i.e., 1-in-2). Applying historical monthly load shapes to the results of the regression-based forecasts develops the non-peak load months and the monthly energy loads forecasts.

The load forecast is reviewed annually and updated as necessary. The linear regression coefficients may change through these updates, and the model specification (i.e., the independent variables) may change as additional data is added to the historical database. However, over the years NWE has not seen significant changes in model specification or estimated coefficients.

The modeling assumption used to develop the load forecast models is that trends in the historical data could be used to develop a linear regression model to forecast energy and peak load. The independent variables data starting in the year 1990 is used to develop the energy and peak forecast models. The independent variables include the following.

- Winter Heating Degree Day (Hdd)
- Month Energy (Mth E)
- Summer Maximum Temperature (Max Temp)
- Population
- Large Industrial Load (Lg Ind)

2009 Forecast Models for Linear Regression Forecast

NWE System Peak and Net Energy For Load (Energy) Forecasting Models use linear regression techniques to develop its forecasting models.

The winter peak load regression equation adjusted by DSM:

$\text{Winter Peak}_t = 35.8 + 3.43\ \text{Hdd}_t + 7.71\ \text{Trend}_t - 104.9\ \text{BPA\&RPC>ASiMI}_t + 1.006\ \text{Mth E}_t - 119.8\ \text{Dummy}_t$

$\text{Winter Peak}_t = \text{Winter Peak}_t - \text{DSM}_t$

The summer peak load regression equation adjusted by DSM:

$\text{Summer Peak}_t = -792.9 + 7.02\ \text{Max Temp}_t + 1.08\ \text{Mth E}_t - 218\ \text{D05}_t + 0.254\ \text{Peak}_{t-1}$

$\text{Summer Peak}_t = \text{Summer Peak}_t - \text{DSM}_t$

The annual energy regression equation adjusted by DSM:

$$\text{Annual Energy}_t = -232.8 + 0.00102\ \text{Population}_t + 1.33\ \text{Lg Ind}_t + 50.1\ \text{D95}_t$$

$$\text{Annual Energy}_t = \text{Annual Energy}_t - \text{DSM}_t$$

The month energy model:

$$\text{Mth E}_t = \text{Annual Energy}_t * \text{Average Monthly Shape Factor}_{(1999:2009)}$$

See the “Model” tab in EnergyReport09.xls and PeakReport09.xls for evidence of these models.

Control area forecast is derived from the above model’s forecast results by adding the load forecast of other utilities load in NWE control area and subtracting NWE load that is in other utilities control area. NWE’s Control Area Forecast Equations:

$$\text{Control Area Winter Peak Load Forecast}_t = \text{Winter Peak}_t + \sum(\text{Non CA Winter Peak Load})_t$$

$$\text{Control Area Summer Peak Load Forecast}_t = \text{Summer Peak}_t + \sum(\text{Non CA Summer Peak Load})_t$$

$$\text{Control Area Annual Energy Load Forecast}_t = \text{Annual Energy}_t + \sum(\text{Non CA Energy Load})_t$$

The load forecast for other utilities load in NWE’s control area is coordinated with that entity. See the “Control Area” tab in EnergyReport09.xls and PeakReport09.xls for evidence of these models.

Forecast Uncertainties for Linear Regression Model

The method used to forecast the right-hand side variables (or independent variables) shown in the above models follow these techniques.

- The historical temperature data are computed as the average of six weather stations in NWE’s control area. The forecast for the Hdd and Max Temp independent variables is set equal to the historical average (1990-2008 data). This represents a 1-in-2 forecast.
- The population forecast is based on U.S. Census forecast for Montana. The forecast growth of 1.02% is approximately equal to the 1990-2008 historical average growth of 1.06%.
- The large industrial load forecast (Lg Ind) is developed from a linear regression model using 1996-2008 data. The data was started in 1996 due to the large industrial load step change prior to that time. This auto regressive regression model is:

  $$\text{Lg Ind}_t = 188.7 + 6.4 * \text{Lg Ind}_{t-1}$$

  This model yields a forecast growth rate of 2.0%.
- The load serving entity, NWE’s Default Supply, develops Demand Side Management (DSM) forecast. NWE transmission planning receives the DSM forecast from Default Supply and subtracts it from the regression-based energy and peak load forecast results.

See the “Model” tab in the EnergyReport09.xls and PeakReport09.xls files for evidence of these forecasts.

Varying one or more of these independent variables develops different forecasts. For example, other forecasts based on a different temperature assumption, such as a 1-in-10 temperature, are computed statistically from the historical data. These forecasts are developed assuming a normal distribution and mean and standard deviation from 1990-2008 data.

Population is another variable that is varied to develop either high or low load forecasts based on population. Population also acts as a surrogate for economic growth. For some base cases developed for power flow and stability studies, WECC will specify either a high load or low load that is derived from the base 1-in-2 forecast. Factors such as 80% of load or 110% of load are specified. If the instructions specify that the base case is to be a 1-in-10 or 1-in-20 temperature, then the model's temperature independent variable will be varied to accommodate the request. The summer and winter peak models estimated peak load temperature MW per degree change is shown in the following table.

Season	MW Change per Degree	Forecast Average System Temperature
Winter	3.4	-4 degrees
Summer	7.2	95 degrees

ATC/OTC Load Forecast Assumptions

NWE uses the forecast methodology, models and assumptions describe above in calculating the Operating Transfer Capability (OTC). The OTC is the Total Transfer Capability (TTC). The TTC is the basis for calculating the Available Transfer Capability (ATC). The load forecast is reviewed annually and updated as necessary.

Given the load forecast, the WECC System Review Work Group (SRWG) defines the base case assumptions used for the seasonal OTC calculations. The load forecast is varied as needed by SRWG to ensure the various paths are stressed for the OTC studies. Examples of the first five parts of the latest "Case Descriptions" are shown below. Part IV of each Case Description specifies the load forecast that NWE and other entities must use in developing the OTC base case. Note that the load in NWE control area is not considered to be in the Northwest, but is in the "elsewhere" load specification. NWE uses 100% load forecast unless specified otherwise. This represents a 1-in-2 forecast.

2010-2011 HEAVY WINTER – 10-11 HW2-OP
CASE DESCRIPTION

I. CASE DUE DATES: To Area Coordinator: December 18, 2009
To Staff: January 22, 2010

II. PURPOSE: **TO REPRESENT ANTICIPATED OPERATING CONDITIONS WITH HEAVY FLOWS FROM NORTHWEST TO CALIFORNIA.**

III. ITEMS TO BE PREPARED:

From Case	2009-10 HW2 Operating Case
Stability Data	Master Dynamics File (1)
Significant Changes	2009-10 HW2 Operating Case

IV. LOADS: 100% of winter peak (1-in-2) in the Northwest, 90-100% of winter peak elsewhere.

V. TIME: Late afternoon (1600 to 1800 hours), winter conditions.

2010-2011 LIGHT WINTER – 10-11 LW1-OP
CASE DESCRIPTION

I. CASE DUE DATES: To Area Coordinator: January 1, 2010
To Staff: February 5, 2010

II. PURPOSE: **TO REPRESENT ANTICIPATED OPERATING CONDITIONS WITH HIGH FLOWS INTO THE NORTHWEST.**

III. ITEMS TO BE PREPARED:

From Case	2009-10 LW1 Operating Case
Stability Data	Master Dynamics File (1)
Significant Changes	2009-10 LW1 Operating Case

IV. LOADS: 60-65% of winter (1-in-2) year peak in the Northwest, 60-80% of winter peak elsewhere.

V. TIME: Early morning (0200 to 0500 hours), winter conditions.

2011 HEAVY SPRING – 11 HSP1-OP
CASE DESCRIPTION

I. CASE DUE DATES: To Area Coordinator: February 12, 2010
To Staff: March 19, 2010

II. PURPOSE: **TO REPRESENT ANTICIPATED OPERATING CONDITIONS WITH HIGH FLOWS FROM NORTHWEST TO CALIFORNIA.**

III. ITEMS TO BE PREPARED:

From Case	2010 HSP1 Operating Case
Stability Data	Master Dynamics File (1)
Significant Changes	2010 HSP1 Operating Case

IV. LOADS: 100% of spring peak.

V. TIME: Spring conditions (1600 to 1800 hours), spring conditions.

2011 HEAVY SUMMER – 11HS2-OP
CASE DESCRIPTION

I. CASE DUE DATES: To Area Coordinator: August 13, 2010
To Staff: September 17, 2010

II. PURPOSE: **TO REPRESENT ANTICIPATED OPERATING CONDITIONS WITH HEAVY FLOWS TO CALIFORNIA FROM THE NORTHWEST AND MODERATE FLOWS ELSEWHERE.**

III. ITEMS TO BE PREPARED:

From Case	2010 HS3 Operating Case
Stability Data	Master Dynamics File (1)
Significant Changes	2010 HS3 Operating Case

IV. LOADS: 100% of summer peak.

V. TIME: Late afternoon (1600 to 1800 hours), summer conditions.

2011 LIGHT SUMMER – 11LS1-OP
CASE DESCRIPTION

I. CASE DUE DATES: To Area Coordinator: August 27, 2010
To Staff: October 1, 2010

II. PURPOSE: **TO REPRESENT ANTICIPATED OPERATING CONDITIONS DURING LIGHT LOAD PERIODS. MODERATE FLOWS FROM THE NORTHWEST TO CALIFORNIA AND MODERATE TO HEAVY FLOWS FROM IDAHO/MONTANA TO THE NORTHWEST.**

III. ITEMS TO BE PREPARED:

From Case	2010 LS1 Operating Case
Stability Data	Master Dynamics File (1)
Significant Changes	2010 LS1 Operating Case

IV. LOADS: 65-75% of summer peak.

V. TIME: Early morning (0200 to 0500 hours), summer conditions.