Rocky Mountain Power
Exhibit RMP___(RMM-3)
Docket No. 16-035-__
Witness: Robert M. Meredith

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF UTAH

ROCKY MOUNTAIN POWER

Exhibit Accompanying Direct Testimony of Robert M. Meredith

Benchmark of Utah Residential Distributed Generation Production Shape to National Renewable Energy Laboratory's PVWatts® Distributed Generation Shape

November 2016

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Prepared and Published by the Load Research Group

October 6, 2016

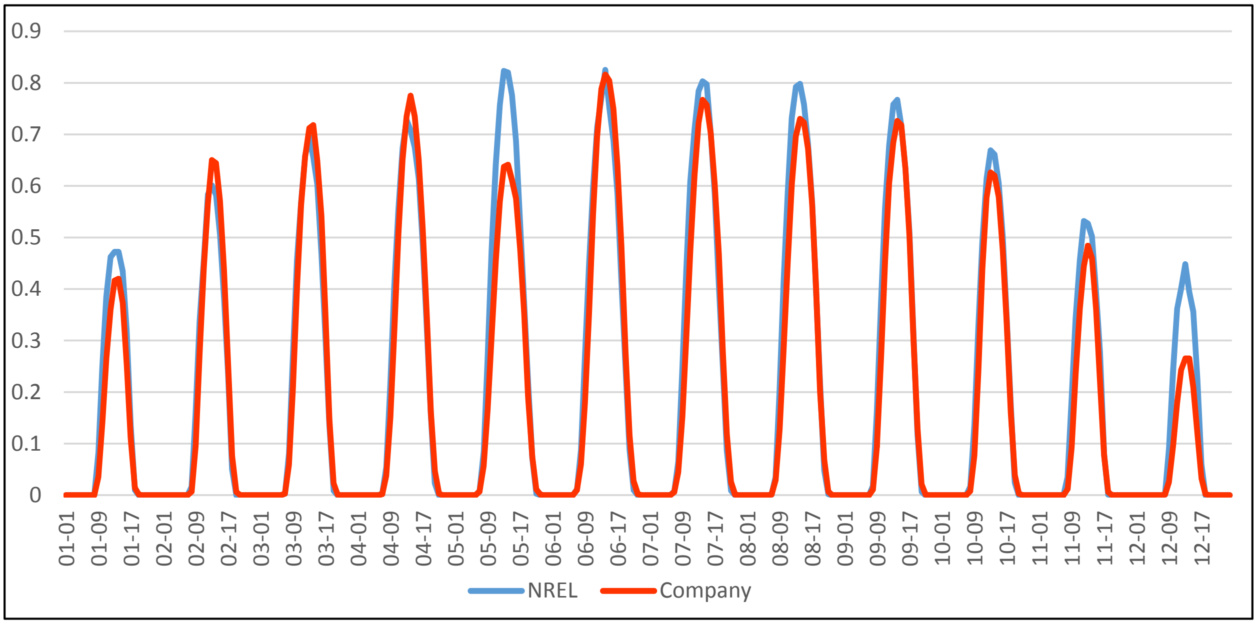
Background

In order to benchmark the residential distributed generation production shape, the Company compared our findings to the hourly shapes from National Renewable Energy Laboratory's ("NREL") online PVWatts® calculator. NREL's PVWatts® Calculator is a web-based application developed by NREL that estimates the electricity production of a grid-connected roof- or ground-mounted photovoltaic system. PVWatts® uses a number of sub-models to predict overall system performance, and includes several built-in parameters.[1] PVWatts® requires hourly data for one year for two components of solar irradiance (beam and diffuse), ambient dry bulb temperature, and wind speed at 10 meters above the ground. The PVWatts® web application interacts with three online databases to access solar resource data and does not allow users to specify their own weather data. Typical year solar resource data uses a single year's worth of hourly data to represent solar radiation and meteorological data collected over a historical period of multiple years. Each PVWatts® typical year file contains months of data selected from different years in the data collection period. For example, data for a given site might contain 1995 data for the month of February, 2001 data for March, 1998 data for April.[2]

As illustrated in Figure A-1, both the residential distributed generation production curve and the PVWatts® curve exhibit similar behavior and shape. However, the residential distributed generation curve during the months of May and December are lower than the PVWatts® curve. A possible explanation for this was found by evaluating average hourly cloud cover data for Salt Lake City over the 8am to 7pm timeframe. The Company found that, on average, the percentage of cloud cover on an hourly basis in Salt Lake City during May 2015 was 67 percent.[3] Whereas, the five-year average for May over the 2011 to 2015 period is 55 percent. Indicating that May 2015 was cloudier than normal. Similarly, the percentage of cloud cover on an hourly basis over the 8am to 7pm timeframe was 66 percent for Salt Lake City in December 2015. Whereas, the five-year average for December over the 2011 to 2015 period is 60 percent.[4]

[1] Dobos, Aron P., September 2014, NREL, PVWatts® Version 5 Manual, Website (http://pvwatts.nrel.gov/pvwatts.php) accessed October 4, 2016.
[2] PVWatts®, PVWatts® Documentation/Solar Resource Data, Website (http://pvwatts.nrel.gov/pvwatts.php#help_resource_typicalyear) accessed October 6, 2016.
[3] MDA Federal Weather Data, Salt Lake City Airport
[4] Ibid.

Figure A-1 Hourly Average Power Generation for Utah NEM and NREL



In order to provide more than a visual comparison of the two data, the Company, elected to compare the two samples by constructing a linear regression. A regression assesses whether the predictor variables (the Company residential distributed generation production shape) account for variability in a dependent variable (the PVWatts® production shape). By treating the PVWatts® generation data as the dependent variable and the residential distributed generation production sample data as the independent variable the Company can measure how representative the sample data is to the PVWatts® data.

The regression model produces numerous statistics that provide an indication of how representative the two datasets are of one another. A description of these statistics and how they indicate a relationship between the data are provided below.

Regression Model Fit

- *Adjusted R-squared, or the coefficient of determination*, is a statistical measure of how close the data are to the fitted regression line. The Adjusted R-squared value corrects for inflation of the R-squared value due to the number of variables in the model. It is the percentage of the total variation in the dependent variable explained by the regression model and is measured on a scale of 0 to 1. An Adjusted R-squared value of 1 indicates the dependent variable is entirely determined by the independent variables. As provided in Table A-1, the regression has an Adjusted R-squared of 0.994, indicating that the model is a good predictor of the dependent variable.

- *Durbin-Watson statistic* is used to test for the presence of autocorrelation in residuals and is measured on a scale of 0 to 4. Autocorrelation means the residuals (the actual values of the dependent variable minus the predicted values) from the regression are not mutually independent. If they are correlated, then least-squares regression underestimates the standard error of the coefficients and the predictors could appear significant when they may not be. A low (0) and high (4) Durbin-Watson statistic indicates the presence of autocorrelation; whereas, a Durbin-Watson statistic of 2 specifies that autocorrelation has been removed from the regression. As provided in Table A-1, the regression has a Durbin-Watson statistic of 2.082, indicating that autocorrelation has been corrected within the model.

Regression Results

- The *regression coefficient* represents the slope of the linear regression. If the coefficient is significant (i.e., the *t*-value is significant), the coefficient indicates that for every 1.0-unit change in the independent variable, the prediction of the dependent variable will change by the coefficient's value. For example, as provided in Table A-1, the independent variable (Company) coefficient is 1.036 and statistically significant. Therefore, for each 1.0-unit increase in the independent variable, the predicted value of the dependent variable will increase by 1.036 units, indicating the two sets of data behave similarly.

- *Elasticity* is a measure of how responsive a variable is based on the change in another variable. Specifically, elasticity is the percentage change in the dependent variable due to a percent change in the independent variable. An elasticity of 1.0 indicates that for a 1.0 percent change in the independent variable there is a corresponding 1.0 percent change in the dependent variable. As provided in Table A-1, the coefficient has an elasticity of 0.942, indicating that a 1.0 percent change in the independent variables will result in a 0.942 percent change in the dependent variable, indicating the two sets of data behave similarly.

- *Correlation coefficient* is a measure of the strength of the degree of association between to random variables and ranges in value from -1 to 1. As provided in Table A-1, the correlation coefficient of 0.984 indicates a strong degree of association between the independent and dependent variable and that the data behave similarly.

Table A-1 Regression Results

Variable	Coefficient	Standard Error	T-Stat	P-Value
CONST	0.005	0.005	1.145	25.34%
Company	1.036	0.021	50.283	0.00%
AR(1)	1.252	0.049	25.476	0.00%
AR(2)	-0.419	0.048	-8.659	0.00%
Variable	Coefficient	Mean	Elasticity	
Company	1.036	0.187	0.942	
Model Statistics				
Adjusted Observations	286			
R-Squared	0.994			
Adjusted R-Squared	0.994			
Sum of Squared Errors	0.12			
Mean Squared Error	0			
Std. Error of Regression	0.02			
Durbin-Watson Statistic	2.082			

Correlation Table		
	NREL	Company
NREL	1	0.984
Company	0.984	1