MINNESOTA DEPARTMENT OF COMMERCE

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December 1, 2016

Daniel P. Wolf
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, Minnesota 55101-2147

RE: **Comments of the Minnesota Department of Commerce, Division of Energy Resources**
Docket No. ET10/RP-16-509

Dear Mr. Wolf:

Attached are the comments of the Minnesota Department of Commerce, Division of Energy Resources (DOC or the Department) in the following matter:

> The 2017-2031 Resource Plan of Missouri Basin Municipal Power Agency (d/b/a Missouri River Energy Services (MRES)).

The petition was filed on June 30, 2016. The petitioner is:

> Mrg Simon
> Manager, State Government Relations
> Missouri River Energy Services
> 3724 West Avera Drive
> PO Box 88920
> Sioux Falls, SD 57109-8920

The Department recommends that the Commission **accept** MRES's resource plan. The Department's team of Chris Davis, Laura Otis, Susan Peirce, Steve Rakow and Michael Zajicek is available to answer any questions the Commission may have.

Sincerely,

/s/ CHRISTOPHER T. DAVIS
Rates Analyst

CTD/lt
Attachment

MINNESOTA DEPARTMENT OF COMMERCE

BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION

COMMENTS OF THE
MINNESOTA DEPARTMENT OF COMMERCE
DIVISION OF ENERGY RESOURCES

DOCKET NO. ET10/RP-16-509

I. INTRODUCTION

A. OVERVIEW OF THE FILING

Minnesota Rules part 7843 require electric utilities to file proposed integrated resource plans (IRP) every two years. The Missouri Basin Municipal Power Agency d/b/a Missouri River Energy Services' (MRES or the Agency) most recent IRP in Docket No. ET10/RP-10-735, MRES's fifth IRP, was accepted by the Minnesota Public Utilities Commission (Commission) on February 21, 2012. Order Point 8 of the Commission's February 21, 2012 Order stated:

> MRES shall file a status update on its demand-side management and distributed generation efforts, as well as a report updating the Commission on the effect of federal environmental regulations on MRES, by July 1, 2014.

On June 23, 2014, MRES submitted both an IRP Status Update and an Environmental Matrix concerning federal environmental regulations.

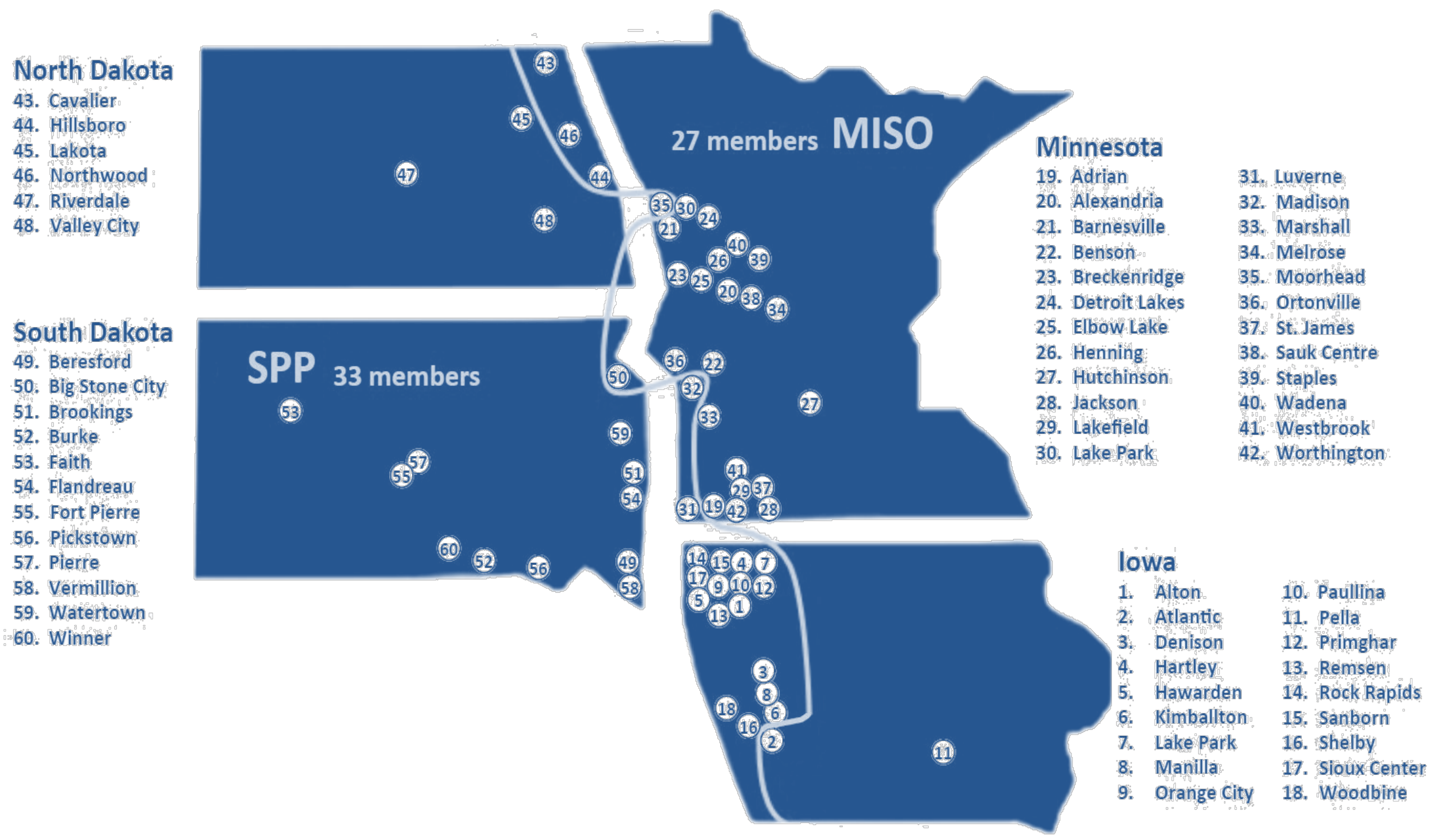
On July 1, 2016, MRES filed its sixth IRP.

B. DESCRIPTION OF MISSOURI RIVER ENERGY SERVICES

MRES is a member-based joint-action agency, headquartered in Sioux Falls, South Dakota. MRES provides power, energy and/or transmission services to its member municipalities in Iowa, Minnesota, North Dakota, and South Dakota. MRES is comprised of 60 municipal utilities, 57 of which are "S-1" customers. All of MRES's 57 "S-1" members purchase power from the Western Area Power Administration (WAPA) and receive hydroelectric preference power from WAPA. For these municipalities MRES provides power requirements over and above their WAPA allocations. MRES has long-term power sales agreements with 57 of its members to provide their total supplemental power requirements and load growth through the year 2030. The three remaining Members each have individual long-term power supply agreements with MRES (Atlantic, Iowa and Pella, Iowa, and Hutchinson, Minnesota). MRES has no retail loads and all of its sales are wholesale sales to its municipal utility Members and other wholesale members.

Beginning in 2015 MRES's Member load was split between two Regional Transmission Organizations[1]. Twenty seven Members, representing about half of the MRES energy sales, are located within the Midcontinent Independent System Operator (MISO) market area; the remaining 33 Members are located within the Southwest Power Pool, Inc. (SPP). Figure 1 below shows the geographical split of MRES's Members into the two market areas.

Figure 1: MRES Members in SPP and MISO



[1] On October 1, 2015, WAPA merged its transmission system into the SPP market area. Much of the MRES resource supply relies on WAPA transmission for deliveries to Member loads, so this action also brought MRES loads and resources into the SPP footprint, including three Minnesota Members: Luverne, Madison, and Moorhead.

Table 1 below shows MRES's existing resources in the MISO and SPP market areas.

Table 1: MRES's Existing Resources in MISO and SPP

MRES MISO Region Resources (MW)		MRES SPP Region Resources (MW)	
Municipal Capacity	106.3	MRES Share of Laramie River	281.8
Point Beach Nuclear Purchase	32.8	Exira Station	140.0
Red Rock Hydro Project (2018)	55.0	Watertown Peaking Plant	45.9
Wind Capacity	85.7	Municipal Capacity	28.1

C. MRES'S PLANNING APPROACH

MRES used the following separate planning processes for its SPP and MISO areas:

1) MRES conducted a DSM Potential study and the results were allocated between the SPP and MISO regions.
2) MRES updated short-term and long-term load forecasts for both the SPP and MISO Members.
3) MRES assessed the net existing resources for both SPP and MISO members, including adding purchases and subtracting contract sales that can individually serve the SPP and MISO Members.
4) MRES identified potential supply-side resource options[2].
5) MRES determined for each region the amount of wind resources needed to meet the:
    - Minnesota Renewable Energy Standard;
    - North Dakota and South Dakota voluntary renewable energy goals, and
    - A hypothetical 10 percent renewable energy standard for Iowa.
6) MRES individually calculated the resource needs for SPP and MISO by subtracting the combination of Steps 3 and Step 5 from Step 2.
7) For each of the two market regions, MRES developed a base case that:
    - Assumed MRES members in Minnesota achieve energy savings of 1.5 percent of retail sales and members in other states achieve the full economic potential amounts of conservation determined in MRES's DSM Potential Study (Step 1); and
    - Assumed a CO_2 cost of approximately \$21.50 starting in 2020 and escalating annually.
8) MRES conducted sensitivity analysis for the base case of each region, including the following scenarios:
    - Zero, \$21.50 and \$34 CO_2 emission costs.
    - High electricity market and natural gas prices.
    - Low and high load forecasts.
    - Laramie River Station reduction for SPP.
    - 50 percent and 75 percent renewable capacity scenario (MISO only).

[2] Given that MRES has a significant surplus of capacity in the SPP region and the cost of firm transmission makes it uneconomical to transfer capacity rights to the MISO market, where MRES has a deficit, MRES only evaluated potential supply-side resource options for its MISO Members, although wind resources were evaluated for both SPP and MISO.

- Achieving only the full economic potential amount of conservation in Minnesota.
- Low and high electricity market and natural gas prices.

D. RESOURCE NEEDS IDENTIFIED BY MRES

Table 2 below shows the summer peak capacity need identified by MRES for both its MISO and SPP Members.

Table 2: MRES Capacity Needs for Both MRES and SPP

Year	MRES MISO Resource Needs (Deficit) (MW)	MRES SPP Resource Needs/(Deficit) (MW)
2017	(59)	211
2018	(57)	56
2019	(69)	90
2020	(65)	91
2021	(63)	87
2022	(160)	88
2023	(158)	88
2024	(157)	237
2025	(154)	236
2026	(153)	237
2027	(150)	237
2028	(148)	234
2029	(146)	230
2030	(160)	228
2031	(159)	223

As can be seen in Table 2, MRES's MISO members have a capacity deficit throughout the planning period while its SPP Members have a surplus throughout the planning period.

E. MRES'S PROPOSED EXPANSION PLAN

Table 3 below shows the supply-side and demand-side additions that MRES proposes to meet the needs of its members over the 2017-2031 planning period for the Company's base case scenario.

Table 3: MRES's Proposed Cumulative Resources for MISO and SPP
Under Base Case, Which Includes Minnesota Members
Achieving 1.5% Energy Savings

	MISO				SPP		
	DSM (MW)	Purchase (MW)	Combustion Turbine (MW)	Total MISO Cumulative Additions (MW)	Wind (MW)	DSM (MW)	Total SPP Cumulative Additions (MW)
2017	5.5	59		64.5		4.8	4.8
2018	11.2	58		69.2		9.7	9.7
2019	17.1	69		86.1		14.8	14.8
2020	23.3	66		89.3	1.5	19.9	21.4
2021	29.4	64		93.4	1.5	24.9	26.4
2022	35.5		167.6	203.1	1.5	30	31.5
2023	41.5		167.6	209.1	1.5	35	36.5
2024	47.5		167.6	215.1	1.5	40	41.5
2025	53.5		167.6	221.1	1.5	45	46.5
2026	59.5		167.6	227.1	1.5	49.9	51.4
2027	65.4		167.6	233	1.5	54.8	56.3
2028	71.2		167.6	238.8	1.5	57.5	59
2029	77.1		167.6	244.7	1.5	60.2	61.7
2030	82.9		167.6	250.5	1.5	62.9	64.4
2031	88.6		167.6	256.2	1.5	65.6	67.1

Table 4 below shows MRES's expansion plans for both the MISO and SPP regions in the event that the Agency is unable to achieve the higher energy savings required for MRES's Minnesota members to reach the State's 1.5 percent energy savings goals.

Table 4: MRES's Cumulative Resource Procurement for MISO and SPP
Under Expected Conservation Case,
Which Includes All Members Achieving Program Conservation Amounts

	MISO					SPP		
	DSM (MW)	Purchase (MW)	Combustion Turbine (MW)	Wind (MW)	Total MISO Cumulative Additions (MW)	Wind (MW)	DSM (MW)	Total SPP Cumulative Additions (MW)
2017	3.3	67			70.3		4	4
2018	6.6	68			74.6		8	8
2019	9.9	82			91.9		12	12
2020	13.1	82			95.1	1.5	15.9	17.4
2021	16.3	82			98.3	1.5	19.8	21.3
2022	19.5		251.4		270.9	1.5	23.7	25.2
2023	22.6		251.4		274	1.5	27.5	29
2024	25.7		251.4		277.1	1.5	31.3	32.8
2025	28.8		251.4		280.2	1.5	35	36.5
2026	31.8		251.4		283.2	1.5	38.8	40.3
2027	34.9		251.4		286.3	1.5	42.5	44
2028	35.5		251.4	1.5	288.4	1.5	43.3	44.8
2029	36.1		251.4	1.5	289	1.5	44	45.5
2030	36.7		251.4	1.5	289.6	1.5	44.8	46.3
2031	37.3		251.4	1.5	290.2	1.5	45.5	47

II. DEPARTMENT'S ANALYSIS

A. THE DEPARTMENT'S ANALYTICAL APPROACH

Minnesota Statutes §216B.2422, subd. 2 states that, in the resource plan proceedings of a generation and transmission Agency such as MRES,

> … the commission's order shall be advisory and the order's findings and conclusions shall constitute prima facie evidence which may be rebutted by substantial evidence in all other proceedings.

Subdivision 4 of the same statute states:

> The commission shall not approve a new or refurbished nonrenewable energy facility in an integrated resource plan or a certificate of need, pursuant to section 216B.243 … unless the utility has demonstrated that a renewable energy facility is not in the public interest.

The Department conducted its review of MRES's IRP with the understanding that the Commission's role was advisory in this proceeding, but that the analysis in the IRP would have significant bearing on MRES's future regulatory proceedings.

Similar to our review of other utilities' resource plans, the Department reviewed MRES's:

- energy and demand forecast;
- resource needs;
- demand-side resources; and
- environmental issues, including compliance with the Clean Power Plan and Minnesota's Greenhouse Gas Reduction Goals; and
- compliance with the Renewable Energy Standard.

In addition, the Department reviewed MRES's capacity expansion modeling using the Strategist model and conducted our own Strategist modeling.

B. ENERGY AND DEMAND FORECASTING

1. Introduction

MRES is responsible for providing all power supply (supplemental to WAPA allocations) required by the Agency's 57 members taking power under the S-1 agreement. The three non S-1 members are provided specifically defined power amounts under their unique long term power sale agreements with MRES.

MRES's structure as a power wholesaler requires a unique forecasting approach. MRES itself serves no retail loads, which makes it difficult to construct one forecast for energy or demand. MRES has instead built individual forecasts for each of its Minnesota members and then aggregated them to arrive at one forecast for its entire Minnesota load.

MRES has 23 members in Minnesota: Adrian, Alexandria, Barnesville, Benson, Breckenridge, Detroit Lakes, Elbow Lake, Henning, Jackson, Lakefield, Lake Park, Luverne, Madison, Marshall, Melrose, Moorhead, Ortonville, Sauk Centre, Staples, St. James, Wadena, Westbrook, and Worthington.

Most MRES members (and all S-1 members) fulfill some portion of their power requirements through WAPA contracts. This fact means that MRES is not responsible for meeting all of those members' power requirements. However, MRES still forecasts the entire power requirement for each of these members because it is important for planning purposes to understand the amount of load that will be served by WAPA and the amount served by MRES.[3] The only exception is Hutchinson, MN which takes a fixed amount (25 MW) from MRES, regardless of its overall energy and demand requirements. Division of the power requirement between WAPA and MRES is not addressed in this section.

[3] Filing at 45.

2. *Short Term Forecast—Energy*

a. *MRES forecasting variables*

MRES constructed individual energy forecasts for each of its members. For each member, the company considered a wide range of variables, which are shown in Table 5 below.

Table 5: Variables Considered for Each Member Forecast, Including Whether it Is a Lag or Logarithmic Variable

VARIABLE	TYPE	LAG	LOGARITHMIC	VARIABLE	TYPE	LAG	LOGARITHMIC
year	Date			d10	Dummy		
month	Date			d11	Dummy		
demand	Energy			trend	Trend		
energy	Energy			lageng1	Energy	YES	
ln_eng	Energy		YES	lageng_12	Energy	YES	
d1	Dummy			cdd	Weather		
d2	Dummy			hdd	Weather		
d3	Dummy			tdd	Weather		
d4	Dummy			ln_trend	Trend		YES
d5	Dummy			ln_lageng1	Energy	YES	YES
d6	Dummy			ln_lageng12	Energy	YES	YES
d7	Dummy			ln_cdd	Weather		YES
d8	Dummy			ln_hdd	Weather		YES
d9	Dummy			ln_tdd	Weather		YES

(i) *Lag variables*

Table 5 above shows that four of the variables are lag variables, which contain data from a time period prior to the present period. MRES considered lag variables with both single period (one month) and twelve period (twelve month) lags for inclusion in its models. Use of a single period lag indicates that the lagged variable (energy in this case) in one month affects the value of that variable in the next month. Use of a twelve month lag suggests a relationship between what happens in a given month from year to year.

(ii) *Logarithmic variables*

Table 5 also shows that MRES considered seven logarithmic variables, which are created by taking the log of the variable in question. Statistically, this data transformation can make sense as an attempt to normalize regression residuals or when the relationship between the dependent and independent variable appears to be exponential. For purposes of model interpretation logarithmic variables can be used when it is desirable to interpret the regression variables in terms of percentage changes.

(iii) Trend variables

Other variables considered for the short term forecast models included trend variables, which simply start at one and then increase by one in each subsequent period. This type of variable is often used to capture a trend beginning at some point in the data set.

(iv) Dummy variables

Dummy variables are often used in utility forecasting to represent each month of the year (January is dummy 1, February dummy 2, and so on). Only 11 dummy variables can be included to represent months of the year, to avoid model over specification.

(v) Energy variables

Energy variables considered include both demand and energy use. Finally, MRES included weather variables for consideration in the model, including heating degree days (HDD), cooling degree days (CDD) and total degree days (TDD). These variables are calculated using historical temperature data and a set baseline for heating and cooling. The HDD/CDD base used by MRES is 65 degrees. TDDs for a month are calculated by adding together HDDs and CDDs for that month. It is standard practice to use HDDs in utility energy and demand forecast models, while use of CDDs and TDDs is less common. Temperature has a significant impact on energy and demand and therefore should be included in models attempting to forecast energy or demand.

b. Constructing the forecast

Energy data was obtained from MRES system records. MRES obtained weather data (HDD/CDD/TDD) from NOAA.[4] MRES did not independently calculate the HDD/CDD/TDD values.

MRES used regression analysis in Microsoft Excel to construct its short term energy forecasts. As discussed above, MRES constructed its forecast from a base set of variables, shown in Table 5. MRES used either energy use or the natural log of energy use (ln_energy) as the dependent variable for each member's model and each model included an intercept and the monthly dummy variables (d1-d11). For the remaining variables, every possible variable combination was tested through regression analysis. This analysis resulted in 550 models being constructed for each member city, which then doubles to over 1,100 once the company added tests to determine whether energy or ln_energy should be the dependent variable. Once those regressions had been run and model statistics such as adjusted R^2 and Durbin-Watson had been obtained, MRES input the results into one spreadsheet that assigned each model a pass/fail grade based on statistical parameters assigned for various statistical tests. See DOC Attachment 1. MRES also included conditions, such as requiring that a model must contain at least one weather variable in order to receive a passing grade.

[4] MRES obtained weather data for 5 weather stations in the forecast area. Each MRES member city was assigned to the nearest weather station and data from that particular weather station was used in the forecast models for the cities assigned to it.

Once MRES obtained a list of passing models for the member city it was modeling, it sorted the models by adjusted R^2 and selected the model from that list with the highest adjusted R^2 value. This process was done for each of the MRES S-1 member cities.

(i) Adjustments needed for some of the models, including spot loads

MRES discussed why several Minnesota member cities required additional analysis for individual loads on pages E-6 and E-7 in Appendix E. Briefly, the reasons for and amounts of each spot load are as follows:

- **Alexandria**: business expansions in 2016 for 800 kW at a 60% load factor (LF), 500 kW at a 60% LF, and 500 kW at a 50% LF;
- **Detroit Lakes**: one business expansion in 2016 for 750 kW at a 60% LF;
- **Luverne**: recent (2012) changes to production at an ethanol plant distorts the load shape so its load was subtracted from historical data for forecasting purposes and then added back in separately. Demand for that load ranges between 2660 and 6592 kW;
- **Marshall**: a large company that is not expected to grow was subtracted from the city's historical data for forecasting and added back in after the regression;
- **Moorhead**: one business expansion of 1,200 kW at a 65% LF was added in 2015;
- **Staples**: acquiring additional service territory, consisting primarily of a hospital, from another utility in late 2016. Demand ranges from 656 to 1,003 kW with a 70% LF.

MRES combined spot load data with forecast data to obtain the final short term forecast for each MRES member city.

3. Short Term Forecast—Demand

MRES did not conduct a demand forecast based on linear regression. Rather, MRES treated demand as a function of energy, using the forecasted energy values from the short term forecast as an input in the equation used to estimate demand. Demand is calculated as follows:

$$Demand = {}^{Energy}\!/_{(Historical\ Load\ Factor \times Hours\ in\ Month)}\ [+Spot\ Load]^{5}$$

See Exhibit E, page E-7.

4. Long Term Forecast—Energy

MRES followed a similar methodology for the long term forecast as the one used in constructing the short term forecast. For each member city, Total Energy, a variable containing historical energy use for that city between 1970[6] and 2012, was used as the dependent variable.

[5] Spot Loads are only added for member cities with spot loads identified above.
[6] Several cities became members at later dates, and thus historical data in these instances were available starting in years later than 1970.

Table 6 below shows the variables that MRES considered for inclusion in the regression models for each member city:

Table 6: Variables Considered for MRES's Long-Term Energy Forecast

Variable	Type	Logarithmic	Source
pop	County Census Data	NO	Woods & Poole
emp	County Census Data	NO	Woods & Poole
wage	County Census Data	NO	Woods & Poole
thh	County Census Data	NO	Woods & Poole
grp	County Census Data	NO	Woods & Poole
inc	County Census Data	NO	Woods & Poole
ipc	County Census Data	NO	Woods & Poole
avg_inc	County Census Data	NO	Woods & Poole
avg_ipc	County Census Data	NO	Woods & Poole
In_pop	County Census Data	YES	Woods & Poole
In_emp	County Census Data	YES	Woods & Poole
In_wage	County Census Data	YES	Woods & Poole
In_thh	County Census Data	YES	Woods & Poole
In_grp	County Census Data	YES	Woods & Poole
In_inc	County Census Data	YES	Woods & Poole
In_ipc	County Census Data	YES	Woods & Poole
In_avg_inc	County Census Data	YES	Woods & Poole
In_avg_ipc	County Census Data	YES	Woods & Poole
cdd	Weather Data	NO	NOAA[1]
hdd	Weather Data	NO	NOAA
tdd	Weather Data	NO	NOAA
In_cdd	Weather Data	YES	NOAA
In_hdd	Weather Data	YES	NOAA
In_tdd	Weather Data	YES	NOAA
MN	Economic Data	NO	Woods & Poole

IA	Economic Data	NO	Woods & Poole
SD	Economic Data	NO	Woods & Poole
ND	Economic Data	NO	Woods & Poole
grp	National Economic Data	NO	Woods & Poole
ln_grp	National Economic Data	YES	Woods & Poole
res_natgas	Alternate Fuel Prices	NO	EIA[2]
com_natgas	Alternate Fuel Prices	NO	EIA
res_prop	Alternate Fuel Prices	NO	EIA
res_oil	Alternate Fuel Prices	NO	EIA
com_oil	Alternate Fuel Prices	NO	EIA
ln_res_natgas	Alternate Fuel Prices	YES	EIA
ln_com_natgas	Alternate Fuel Prices	YES	EIA
ln_res_prop	Alternate Fuel Prices	YES	EIA
ln_res_oil	Alternate Fuel Prices	YES	EIA
ln_com_oil	Alternate Fuel Prices	YES	EIA

(The impacts and reasons for using logarithmic variables are discussed above, along with the construction of and reasons for including the weather variables shown in Table 5.)

The county census data and national economic data variables represent various economic and population measures, including population, employment, average wage, total households, income, income per capita, average income, average income per capita, and gross regional product. Some of these variables were smoothed by using a three-year moving average to correct for large annual fluctuations in some counties. Since the MRES member cities are located in various counties throughout the state, MRES assigned each member a county code based in its county and county census data for only the corresponding county was used for each member's forecast.

MRES considered the prices of alternative fuels for both residential and commercial consumers for inclusion in its forecasts. For cities with natural gas service, natural gas variables were examined, while propane or fuel oil[7] were considered for other cities. All historical pricing data was converted to 2012 dollars.

Finally, MRES included binary variables in several member city forecasts to explain a significant change in load growth that was not explained by any other variable. All binary variables included in the final models were statistically significant. Minnesota cities that contain a binary variable include Elbow Lake, Henning, Lake Park, Jackson, Madison, St. James, Staples, Melrose, Westbrook, and Worthington.

[7] Both could not be included due to multicollinearity issues. See Exhibit F, page F-7.

MRES considered inclusion of all the variables listed in Table 6, in many different combinations by constructing multiple regression models in the statistical program MetrixND. Once these models had been run for each member, MRES evaluated several regression statistics to select the best overall model. MRES chose a best fit model for each member by maximizing the R^2 value as much as possible, while also keeping other test statistics[8] within desirable ranges.

As discussed in the previous section, if a city's historical dataset contains spot load data, then it is subtracted from the forecast data, the forecast is estimated via regression, and then it is added back into the final forecast. Minnesota member spot loads include:

- **Marshall**: the load of a major industrial customer accounts for half of the city's load and is not expected to grow. This customer's load was not included in the forecast data and was added back in post regression;
- **Elbow Lake**: a new hospital came online in 2014 and if left in the historical dataset would distort long term growth rate estimates. Spot load of 1,000 kW with a 43% average load factor was subtracted from the regression data;
- **Jackson**: a business expansion in 2004 with a spot load of 1,000 kW with a 43% average load factor would, if left in the historical dataset, distort long term growth rate estimates. This was subtracted from the regression data;
- **Madison**: a business expansion in 2014 with a spot load of 490-972 kW with a 43% average load factor would, if left in the historical dataset, distort long term growth rate estimates. This was subtracted from the regression data;
- **Melrose**: two expansions requiring spot load treatment are present in the Melrose data. The first is a spot load of 1,000 kW with a 70% load factor in 2015 and the second is a 500 kW spot load with a load factor of 50% starting in 2014.

5. Department Analysis

a. Short Term Forecast—Energy

In its analysis of MRES's short term energy forecast, the Department reviewed both the data and the methodology employed by MRES, which is described above. DOC also reviewed MRES's decision to remove spot loads from some member forecasts.

DOC's review of the forecast data provided by MRES indicated that the data sets used do not have any problems that would make them ill-suited for producing accurate energy forecasts. DOC also reviewed the data tested for inclusion in each of the MRES member models to determine whether each variable type made sense from a theoretical approach.

- **Energy Variables:** Inclusion of energy variables in the model makes sense from a theory standpoint since historical energy use has a strong effect on future energy use.
- **Weather Variables:** Energy use is highly dependent on weather, as a large portion of energy is used for heating and cooling.

[8] Other statistics evaluated include the Mean Average Percent Error, the Durbin-Watson statistic, and T-statistics for each model's independent variables.

- **Dummy Variables:** Dummy variables are appropriate, as they capture changes in energy consumption tied to the month that are consistent year after year.
- **Trend Variables:** MRES appears to include trend variables for largely statistical reasons.

DOC's review of the MRES short-term energy forecast methodology concludes that MRES's methods, while complex, were generally acceptable. However, DOC chose to perform additional analysis regarding the use of different model specifications for each member city as an additional check.

Additionally, DOC reviewed the designation of spot loads for various members.

DOC reviewed the use of varying model specifications for each of the MRES members due to the complexity this format introduces into the construction of the forecast and its interpretation. Use of one model for each of the Minnesota member cities would be less cumbersome. DOC constructed one generic model format using the variables most commonly used in MRES's member forecasts:

$$\begin{aligned} Energy = {} & \beta_0 + \beta_1 \times Dummy1 + \beta_2 \times Dummy2 + \beta_3 \times Dummy3 + \beta_4 \times Dummy4 + \beta_5 \\ & \times Dummy5 + \beta_6 \times Dummy6 + \beta_7 \times Dummy7 + \beta_8 \times Dummy8 + \beta_9 \\ & \times Dummy9 + \beta_{10} \times Dummy10 + \beta_{11} \times Dummy11 + \beta_{12} \times Trend + \beta_{13} \\ & \times lnLagEnergy1 + \beta_{14} \times CDD + \beta_{15} \times HDD + \varepsilon \end{aligned}$$

DOC constructed this forecast by determining which variables occurred most often in the MRES forecasts.

Once this model was constructed, DOC compared its forecasted energy values to those forecasted by MRES with its model specifications. This comparison showed that the difference between the forecasts was vanishingly small. See DOC Attachment 2. Therefore, there is no reason to adjust the forecast provided by MRES. However, MRES may wish to consider simplifying its forecast methodology going forward, as it does not appear to result in a more accurate forecast.

DOC also analyzed the spot loads subtracted from the forecast for several Minnesota member cities. Spot loads in Alexandria, Detroit Lakes, Moorhead, and Staples represent new businesses, business expansions, or service territory expansions in 2015 or 2016. It is appropriate to omit these spot loads from the forecast dataset because they represent one-time load additions that would distort the forecast results if left in the forecast. Additionally, some of the anticipated load additions have not yet come on to the system and could not be accounted for by regression analysis alone, as they are not represented in the historical dataset.

The Luverne spot load data is a bit older (2012) and is not caused by a business expansion, but by a change to production at an ethanol plant. DOC evaluated the necessity of treating this load as spot data by plotting it against the rest of Luverne's energy use and by comparing descriptive statistics between the two data streams. DOC's analysis verified increased variance in the ethanol plant data beginning in the month indicated by MRES both visually and statistically.

The Department recommends that the Commission accept the MRES short term energy forecast as filed.

b. Short Term Forecast—Demand

As stated above, MRES calculated demand algebraically based on energy and historical load factors. It is unusual for a utility to calculate demand in this way, as opposed to using linear regression. Linear regression is a much more powerful predictive tool than algebraic transformation, since linear regression analysis allows the forecaster to predict demand based on its relationship to multiple variables. Linear regression also provides the opportunity to generate test statistics such as the F, R-squared, t-statistics, Durbin-Watson, and many more diagnostic tests. These statistics allow the forecaster to evaluate the overall predictive power of a given regression model and to determine whether the variables included in the model do have an effect on the dependent variable (demand in this case).

Due to these concerns, the Department constructed a demand forecasts for the MRES member cities in Minnesota based on regression analysis using the data that MRES provided in its short term energy model. The results of these models were not significantly different from the results MRES obtained using its algebraic model. See DOC Attachment 3. Therefore, the Department concludes that the MRES short term demand forecasts are acceptable for planning purposes. However, the Department observes that MRES could improve its methodology to obtain these results.

The Department recommends that the Commission accept the forecast results for planning purposes, but advises MRES to construct and file a regression model of demand for its Minnesota members. If MRES would find it helpful to see the demand forecasts constructed by the Department, the Department will provide them. Since the forecast provided is acceptable for planning purposes, the Department is flexible on the timing of the filing of additional modeling, but suggests that the new forecast be filed within six months of the Commission's Order.

c. Long Term Forecast—Energy

The long term forecast provided by MRES in its resource plan filing is similar in its methodology to the short term forecast. As with the short term forecast, DOC reviewed both the data and methodology used by MRES to obtain its long term forecast. DOC also reviewed the spot loads identified by MRES for removal from the long term forecast regressions for several Minnesota member cities.

The Department's analysis of the historical and forecast datasets tested for inclusion as independent variables indicated that the data was appropriate for use in the long term forecast models. As with the short term forecast, DOC reviewed the data tested for inclusion in each of the MRES member models to determine whether each variable type made sense from a theoretical approach.

- **Economic Variables:** Inclusion of economic variables in the model makes sense from a theory standpoint since population, income, and economic output (Gross Regional Product, GRP) can all affect long term energy use for a geographic region.

- **Weather Variables:** Energy use is highly dependent on weather, as a large portion of energy is used for heating and cooling.
- **Alternate Fuel Prices:** Alternate fuels compete with electricity for several customer needs, most significantly fuel. In the long term, customers are incented to choose the fuel that is cheaper; therefore, alternative fuel prices could affect long term energy consumption.

Finally, DOC reviewed the energy data MRES used as the dependent variable for its member forecasts. Generally, this data appears reasonable. However, for ten Minnesota members (Elbow Lake, Henning, Lake Park, Jackson, Madison, St. James, Staples, Melrose, Westbrook, and Worthington) MRES included city specific binary variables to account for "a significant change in load growth which could not be explained with any existing explanatory variable and also would have a significant impact on the overall forecast if left unaccounted for".[9]

The Department reviewed the models that incorporate these city specific binary variables and agrees with MRES's assessment. It is evident that the historical datasets for these members do contain specific changes in load size or growth. MRES does not indicate in the filing whether or not it investigated whether the causes of these changes are due to changes such as adding new businesses or other loads or if they are due to data issues. For example, data problems can arise when there is a billing system changeover.

MRES's solution of adding city-specific binary variables to correct for this problem in its forecasts appears to provide an adequate statistical solution. However, in future IRP dockets MRES should investigate these data sets to determine the cause of the changes in load growth.

The statistical methods MRES used to construct its long term member forecasts are very similar to those used to construct the short term forecasts. The Department had the same observations regarding use of this methodology in the long term forecast as it did in the short term forecast. Additionally, the Department noted that, unlike the short term forecast, the long term forecast does not require that every member's model include a weather variable; cities whose model lack a weather variable include Jackson, Luverne, Madison, and St. James. It is very unusual to see an energy forecast that does not include a weather variable, as it is widely accepted that energy usage is highly correlated with temperature. The Department analyzed the MRES forecasts to determine whether a simpler, uniform model that includes a weather variable would produce similar results to those obtained by MRES.

DOC constructed one generic model format using the variables most commonly used in MRES's member forecasts:

$$Energy = \beta_0 + \beta_1 \times \ln(GRP) + \beta_2 \times \ln(COM\_NatGas) + \beta_3 \times \ln(TDD) + \varepsilon$$ [10]

[9] Appendix F, page F-13.

[10] For member models that MRES included a binary variable, DOC added that variable into its generic model as well.

Once this model was constructed, DOC compared its forecasted energy values to those forecasted by MRES. For all but two member cities[11], the Department's forecast fell within the MRES forecast's 95 percent confidence interval, and nearly all of those forecasts mirrored the MRES forecast very closely. See DOC Attachment 4. Therefore, the Department does not recommend a change to the long term forecasts. However, MRES should include a weather variable in all energy forecasts filed in future dockets.

DOC analyzed the spot loads identified by MRES. MRES identified spot loads in the Minnesota cities of Marshall, Elbow Lake, Jackson, Madison, and Melrose. For all of these cities except Marshall, the spot loads identified by MRES represent new or expanded businesses that result in large, one time increases in the city's load. It is reasonable to omit these loads from the cities' forecasts to prevent distortion of the model and its forecast results.

The Marshall spot load is identified for omission from the forecast because it represents a large business (half of the city's load) that is not anticipated to grow. Omission of this load from the forecast allows MRES to produce a forecast that more accurately captures changes in load from the rest of the city, which may grow even as demand from the large business is unchanged.

The Department concludes that the spot loads identified by MRES in the long term forecast are reasonable.

6. Energy and Demand Forecast Recommendations

The Department analyzed the data and methodology used by MRES in developing its short term energy forecast, short term demand forecast, and long term energy forecast. The Department's review found that the short term energy forecast is acceptable, but could be simplified in future filings. The Department concluded that the long term energy forecast was acceptable for resource planning purposes, despite the omission of a weather variable in several member forecasts. The Department's analysis of the demand forecast concludes that the forecast is acceptable for planning purposes, with suggestions for improvement regarding the forecasting methodology employed.

The Department recommends that the Commission approve the energy and demand forecasts provided by MRES, but advise that MRES work develop a demand forecast based on a regression model and require inclusion of a weather variable in all energy forecasts in future IRP filings.

B. MODELING AND SUPPLY-SIDE RESOURCES

1. Introduction

The Department used Strategist to briefly review MRES's modeling efforts. The general process followed by the Department when reviewing Strategist modeling is as follows:

[11] Barnesville and Sauk Centre. DOC noted that the MRES forecasts for these members included THH (total households).

1. obtain from the applicant a base case file, and the commands necessary to re-create the various scenarios explored by the Company;
2. re-run the applicant's base case file to make sure the outputs match and that the Department is working with the correct file;
3. review the base case's inputs and outputs for reasonableness;
4. create a new base case, which includes any changes deemed necessary to the Company's base case;
5. run scenarios of interest on the new base case to explore various risks and alternative futures;
6. assess the results of the scenarios and establish a new preferred case; and
7. run scenarios of interest on the new preferred case to test the robustness of the preferred case.

The Department's overall goal in reviewing utility modeling efforts is to determine if the proposed plan results in a reliable, low cost, low impact system that manages risk, and to recommend modifications if needed.

2. Prior Resource Plan

On April 28, 2011, the Department submitted initial comments on MRES's 2010 Integrated Resource Plan (IRP) (Docket No. ET10/RP-10-735). Regarding modeling, the Department's recommendations included the Commission advising MRES to:

- acquire intermediate capacity in the 2015-2016 time-frame instead of relying on market purchases;
- consider additions of wind resources before 2015 if lower cost wind is available; and
- consider adjustments to the load shapes used in Strategist to correspond better to demand and energy forecasts; and
- continue to investigate potential base-load purchases while considering the potential impact of CO_2 emission charges.

On February 21, 2012, the Commission issued its *Order Accepting Resource Plan, Requiring Further Filings, and Setting Date for Next Resource Plan* (Order). Regarding modeling, the Order recommended that MRES:

- include CO_2 and externality values in its base case in its next IRP;
- consider adding additional resources to reduce reliance on market purchases;
- consider additions of wind resources before 2015, if lower cost wind is available; and
- consider adjustments to the load shape profiles used in its resource planning model to better correspond to demand and energy forecasts.

These order points are discussed in the Petition.

3. Verifying MRES's Strategist Results

The first step in the Department's modeling was to obtain from MRES the Agency's base case and the commands necessary to re-create certain contingencies and scenarios explored by the Agency in the Petition.[12] MRES provided two base case files, one for the portion of MRES's system that is in SPP market area and one for the portion of MRES's system that is in the MISO market area.

The Department re-ran the base cases provided by MRES through Strategist; the Department's outputs matched the results included in the files provided by MRES. This result confirmed that the inputs in the files provided to the Department created the outputs in those files.

The Department briefly reviewed MRES's overall load and capability reports (one for SPP and one for MISO) provided in the Petition and determined that MRES was reporting a substantial surplus of capacity in the SPP region. Note that the Petition states:

> The cost of firm transmission makes it uneconomical to transfer capacity rights to the MISO market, where MRES has a capacity deficit. Given this excess SPP capacity that cannot be utilized by MISO load, MRES has made several short-term capacity sales.

Therefore, the SPP region's surplus cannot be used by the MISO region and the Department decided to focus solely on MRES's model for the MISO region.

For the second step, the Department attempted to match MRES's MISO results by re-running MRES's Strategist base case and contingency files and comparing the costs to those shown in the Petition's Part VI. The costs from the Department's exercise matched the costs reported by MRES in Part VI of the Petition. This result confirmed that:

- no post-processing of results was performed by MRES;
- the Department was working with the files that created MRES's base case and contingencies, and
- the Department understood how MRES created the various outputs reported in the Petition.

4. Advice on Modeling Technique

For the third step, the Department reviewed MRES's base case model. Given the advisory nature of MRES' IRP, the Department decided to suggest steps that may improve the Agency's modeling rather than on developing a specific alternative expansion plan; however, implementing the Department's recommendation could result in a different plan. One improvement the Department recommends that MRES consider is studying multiple levels of conservation under a variety of contingencies, similar to how supply units are studied. This evaluation can be performed by making different levels of conservation an option available to the model. However, this approach frequently presents Strategist with too many options. Thus, the more common approach is to assume different levels of conservation in different Strategist runs across a variety of contingencies. This approach would enable MRES to determine the least cost level of additional conservation resources and the stability of the resulting expansion plan and costs across a variety of futures. This technique also would

[12] This Strategist data was provided in response to Department Information Request Nos. 1 to 2.

allow MRES to treat supply and demand resources in a similar manner. For clarity, this approach is illustrated in Table 7 below.

Table 7: Conservation Modeling Example

Contingency	-5 GWh Annually	+5 GWh Annually	+10 GWh Annually
Base Case			
High Natural Gas Prices			
Low Natural Gas Prices			
High Forecast			
Low Forecast			
High Wind Prices			
Low Wind Prices			

An additional improvement the Department recommends MRES consider is to model a greater number of contingencies.[13] One goal of an IRP is to determine the best overall expansion plan. Achieving this goal requires exploring the price levels at which various potential resources become cost effective additions. In this Petition MRES did not explore various prices for wind and solar resources, neither of which was selected in the base case. Therefore, the Department recommends that MRES model price contingencies for all resources options that are presented to the Agency's IRP model.

A third potential improvement is in how MRES presents wind and solar generic units to Strategist. In essence, MRES's base case has one wind unit available in all years. However, a single stream of wind prices, for example, cannot represent the price of wind in the future that would be expected as the federal production tax credit (PTC) gradually ramps down. As a solution, MRES could make one wind generic unit available in years 2018 and 2019, a second wind generic unit available in years 2020 to 2022, and so forth. The Department often uses this modeling approach in IRPs to vary the price and size of the generic units to better address the utility's resource needs and other factors such as the PTC. For example, a utility such as Otter Tail Power Company (OTP) might have a large need for energy and capacity in the early years of an IRP due to the retirement of existing units.[14] This situation indicates a need for large generic units in the early years of the IRP (to address the initial deficits). But, once the initial deficits are addressed, OTP's relatively small size (in terms of system demand) indicates that smaller generic units would be advisable to address growth-related needs that occur after the initial deficit is addressed. In this case the starting point for MRES's current IRP resembles the starting point for OTP's IRP. Another example of the value of this approach is the ramp down of the PTC mentioned above. The PTC ramp down means it is reasonable to expect significantly different pricing for wind based upon which year a wind unit is added.[15] Therefore, the Department recommends that MRES consider making generic units with varying characteristics available in different years.

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[13] For the MISO region modeling the Petition presents contingences for:

- high and zero CO_2 costs;
- high natural gas and market prices;
- high and low load forecasts;
- 50 percent and 75 percent renewables; and
- expected conservation.

[14] See OTP's petition in Docket No. E017/RP-16-386.

[15] For example, a wind unit added in 2016 might be expected to cost $30 per MWh for energy generated in 2025, but a wind unit added in 2022 might be expected to cost $50 per MWh for energy generated in 2025.

A fourth potential improvement concerns how MRES prices wind and solar generic units in Strategist. In its current IRP MRES provides both a capital cost and a variable cost.[16] While such modeling of fixed and variable costs accurately portrays how actual costs are incurred by a utility for a utility-owned power plant, including both types of costs makes it more difficult to determine an overall price at which additions of a particular resource become cost effective. It also makes it significantly more difficult when reviewing actual projects during the resource acquisition process to determine at what price level the IRP concluded that a resource was least cost.

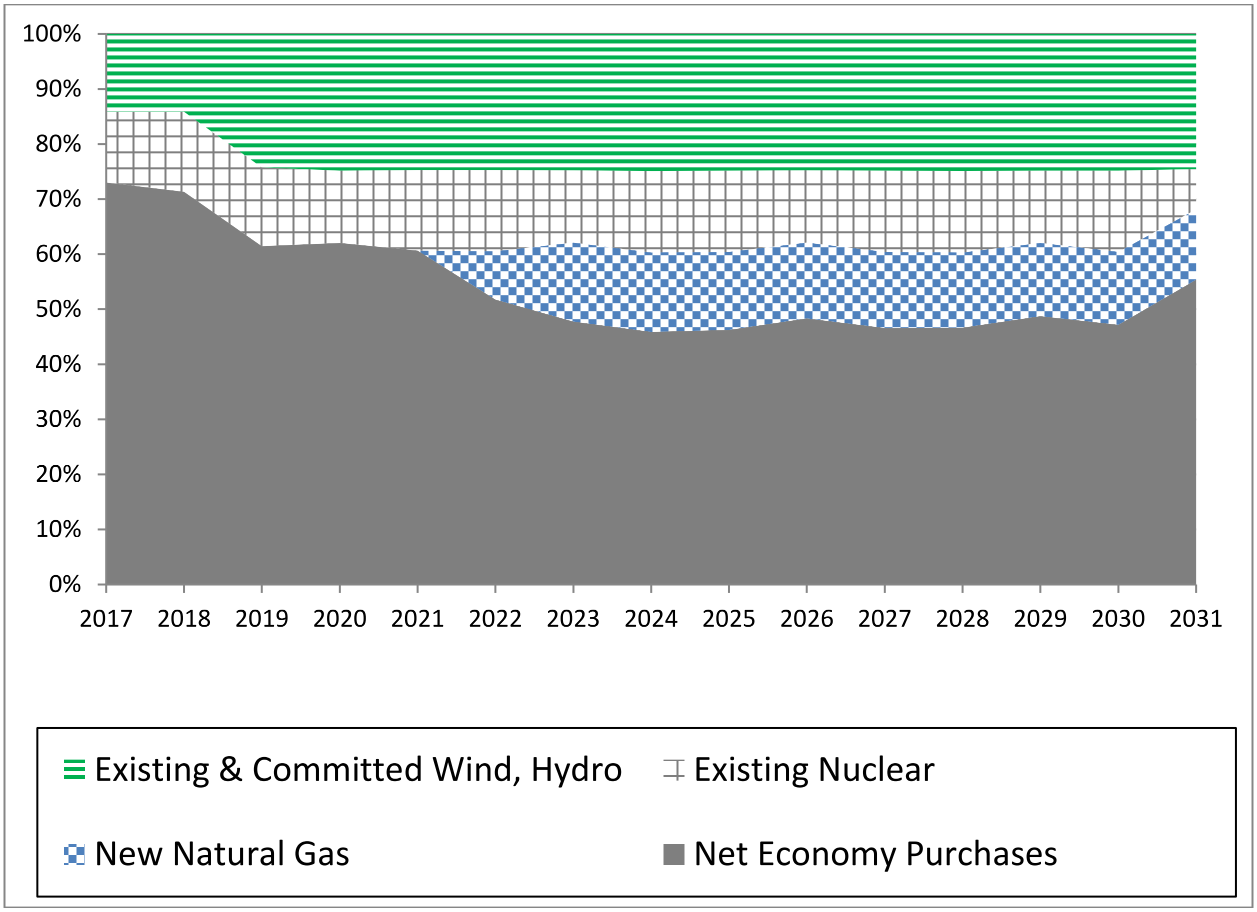
Dispatchable units, such as combustion turbines (CT) and combined cycle units (CC), produce different quantities of energy in every year. Thus, the fixed costs of CT and CC units cannot be turned into a per MWh charge (since the MWh amount is not known). However, in Strategist wind and solar units produce a fixed quantity of energy. With the quantity of energy to be produced each year known it is possible to convert the fixed costs to a single, per MWh charge. The single price can easily be varied during the contingency analysis to provide Strategist a spectrum of prices to identify the price at which a resource type is least cost. This approach also makes it easier, in a subsequent proceeding potentially years later, to determine the price level at which the IRP concluded that a resource was least cost. This is particularly the case if a levelized cost was used as the input during the IRP. Therefore, the Department recommends that MRES consider modeling all costs for generic wind and solar units as a single, per MWh charge.

5. Advice on Preferred Plan

The Department begins by noting that MRES's MISO region has a significant shortage of capacity and energy resources. MRES's preferred plan proposes to address the capacity deficit through the addition of peaking and conservation/load management resources. By default, since MRES adds sufficient capacity MRES's exposure to market prices is capped at the cost of MRES's new CT units. However, MRES's modeling projects the Agency's MISO region to be reliant upon the spot market for 45 percent or more of the Agency's energy for the duration of the IRP. This projection is illustrated in Figure 2 below.

[16] Technically the capital cost appears in Strategist's Proview module in the alternative data section as "Base Year Revenue Requirements" while the variable cost is in Strategist's Generation and Fuel module in the transaction data section as "Transaction Energy Costs."

Figure 2: MRES-MISO Region Energy Production Under MRES's Plan



In the near term, the Agency's MISO region's heavy reliance on energy purchases from the spot market is unlikely to be an economic issue. Overall day-ahead Locational Marginal Prices (LMPs) for MISO's Minnesota Hub have averaged about $20 per MWh for 2016, with monthly average prices varying between $15 per MWh and $30 per MWh. Prices have been low for a number of reasons, including low natural gas prices and transmission limits that prevent energy from exiting Minnesota to regions further east.

The MISO Zone 1 export limit in the 2016-17 auction was 590 MW. The Zone 3 export limit in the 2016-17 auction was 258 MW[17]. Recently MISO reported that these values are expected to increase substantially for 2020 (the Zone 1 limit increasing to 2,432 MW and the Zone 3 limit increasing to 3,897 MW).[18] Increases in the export limit will tend to increase spot market prices in Minnesota. The question is whether additions of must run capacity in Zones 1 and 3 will keep up with the increase in the export limit; if so, spot market prices would tend to be lower than in the rest of MISO. However, the future of spot market

[17] Note that MISO Zone 1 consists of Montana, North Dakota, South Dakota, most of Minnesota, and western Wisconsin; Zone 3 consists of a small portion of southern Minnesota and all of Iowa.
[18] See slide 9 of MISO's *Preliminary Transfer Analysis Results* presentation at the October 5, 2016 meeting of the Loss of Load Expectation Working Group. It is possible that additions of must run generation will keep pace with the increases in export limit, resulting in a continuation of the current separation between spot market prices in Minnesota and the rest of MISO.

energy prices is uncertain. Therefore, the Department recommends that MRES consider ways to further limit the Agency's exposure to spot market prices.

One way to limit exposure to spot market prices would be for MRES to reconsider its analysis of the addition of new wind and solar units. As noted above MRES included both a fixed and variable cost for wind units. Either cost string, on its own, would be reasonable. However, it appears that when MRES combined the two, the Agency may have double counted the costs of wind; alternatively, it may be that the small size of MRES's wind units creates significant diseconomies of scale, driving up the cost. In any event, the Department briefly experimented with the Agency's base case by making optional wind units available, with a price similar to that used for the recent Xcel IRP (Docket No. E002/RP-15-21).[19][20] The result was that 50 MW of new wind units were added in the early years of MRES's IRP. To account for a small-sized addition, the Department repeated the experiment, but with a cost increase of $10 per MWh. The result in both runs was that, once again five units (10 MW each) were added in the early years of the Agency's IRP.

The Department also experimented by separately making generic solar units available, again with prices similar to those used for the recent Xcel IRP. The result was that, in MRES's base case, six solar units (10 MW each) were added in the early years of MRES's IRP. Finally, the Department experimented by making both the wind and the solar units available to MRES's model. The result was that both wind (5 units) and solar (6 units) were added in MRES's base case. Based upon the results of these experiments, the Department recommends that MRES reconsider its analysis of wind and solar additions. The overall goal of MRES's analysis should be to determine the price per MWh at which additions of wind and solar capacity are least cost for MRES's system. This information will enable MRES to determine if it is reasonable to initiate a resource acquisition for new wind and/or solar resources.

6. *Modeling and Supply-side Recommendations*

The Department recommends the Commission advise MRES to consider:

- additional conservation achievement under a variety of contingencies, similar to how supply units are studied;

[19] Wind and solar prices used by Department for modeling in MRES IRP:

Year	Wind ($/MWh)	Solar ($/MWh)	Year	Wind ($/MWh)	Solar ($/MWh)
2018	34		2025	95	
2019		85	2026		61
2020	48		2027	95	
2021		89	2028		
2022	59		2029		95
2023		92	2030		67
2024	59		2031		

- modeling a greater number of contingencies, including modeling price contingencies for all resources options that are presented to the Agency's IRP model;
- making generic units with varying characteristics available in different years if it would aid in the Agency's modeling;
- modeling all costs for generic wind and solar units as a single, per MWh charge;
- consider ways to further limit the Agency's exposure to spot market prices; and
- reconsider the Agency's analysis of wind and solar additions with a goal of determining the price per MWh at which additions of wind and solar capacity are least cost for MRES's system.

C. DEMAND-SIDE RESOURCES

1. Background

One purpose of resource planning is to estimate the optimal amount of demand-side resources for meeting the Company's customer future needs. In the past, another factor used to assess the amount of DSM in a resource plan was whether it at least included the amount of energy and demand savings that would result from meeting the statutory spending requirements of the Conservation Improvement Program (CIP).

In 2007, the passage of the Next Generation Energy Act (NGEA) established energy savings goals of 1.5 percent of gross annual retail sales starting in 2010 for all electric and natural gas utilities operating in Minnesota, unless adjusted by the Commissioner of the Department of Commerce. The greatest impact of the 2007 NGEA was the shift from an annual CIP spending requirement to an annual energy savings goal.

In addition, Minn. Stat. 216B.2401 states:

> The legislature finds that energy savings are an energy resource, and that cost-effective energy savings are preferred over all other energy resources. The legislature further finds that cost-effective energy savings should be procured systematically and aggressively in order to reduce utility costs for businesses and residents, improve the competitiveness and profitability of businesses, create more energy-related jobs, reduce the economic burden of fuel imports, and reduce pollution and emissions that cause climate change.
>
> Therefore, it is the energy policy of the state of Minnesota to achieve annual energy savings equal to at least 1.5 percent of annual retail energy sales of electricity and natural gas through cost-effective energy conservation improvement programs and rate design, energy efficiency achieved by energy consumers without direct utility involvement, energy codes and appliance standards, programs designed to transform the market or change consumer behavior, energy savings resulting from efficiency improvements to the utility infrastructure and system, and other efforts to promote energy efficiency and energy conservation.

In MRES's 2010 IRP, the Department recommended that MRES strive to meet the 1.5 percent energy saving goal for its Minnesota Members, but that the Agency should adopt an action plan that recognizes that MRES was unlikely to meet the 1.5 percent energy savings goal in the short term.

Pages 32-39 of MRES's present IRP describe the Company's efforts to make energy and demand savings one of its priories. Some highlights include:

1. Continuation of its DSM task force;
2. Updating its wholesale rate structure;
3. Continued development of a portfolio of energy efficiency incentive programs;
4. Marketing and promotion to members;
5. Providing member assistance and program administration;[21] and
6. Implementation of a coordinated demand response program.

Additionally MRES had a new DSM potential study created in 2014 that covers 2015 through 2039.

The Agency's historical energy and demand savings are shown in Table 8 below.

Table 8: MRES Historical Energy and Demand Savings, 2008-2014[22]

Year	Energy Savings (million kWh)	Demand Savings (MW)	Energy Savings MN Only (million kWh)	Demand Savings MN Only (MW)
2008	6.2	1.6	4.1	1.0
2009	16.5	3.7	9.8	2.3
2010	26.5	5.3	18.0	3.3
2011	29.8	6.1	18.8	3.7
2012	24.3	5.2	15.2	3.0
2013	28.2	6.1	14.3	2.9
2014	32.9	6.2	21.7	3.7

MRES achieved 14.3 million kWh in energy (0.54 percent of retail sales) and 2.9 kW of demand in 2013 in Minnesota. In 2014 MRES achieved an additional 21.7 million kWh of energy savings (0.82 percent of retail sales) and 3.7 kW of demand savings.

For Reply Comments, the Department requests that the Agency present its historical energy savings (incremental energy savings, not cumulative) in two ways:

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[21] MRES states that it has dedicated 11 full-time employees to energy services work, along with an administrative assistant who works part time on energy efficiency issues.

[22] The Department notes that the annual energy savings reported in MRES's IRP are significantly lower than the energy savings reported online in the Department's Energy Savings Platform (ESP). For example, in the Agency's IRP, 2014 incremental energy savings were reported to be 4.1 million kWh, but the ESP reported 2014 incremental energy savings of xx million kWh. Although the Department discussed this issue briefly with MRES before filing comments, the Department recommends that the Agency provide an explanation in Reply Comments.

- First, showing only its Minnesota Members' annual energy savings as a percent of the Agency's Minnesota sales; and
- Second, showing its system-wide annual energy savings as a percent of its system wide sales.

Additionally the Department requests that the Agency explain why both total cumulative and incremental DSM savings fell from 2011 through 2013 both in MRES system-wide and in Minnesota only.

2. MRES Modeling of Energy and Demand Savings

MRES's 2014 potential study is discussed beginning on page 39 of the IRP and is included in Appendix H of the Petition. The potential study identified the Agency's:

- Technical potential;
- Economic potential;
- Achievable potential; and
- Program potential.

MRES used the potential study results to create two different DSM scenarios. The first one included the level of energy savings resulting from all MRES members achieving the Program potential level of energy savings. MRES also referred to this scenario as the Expected DSM Case. The results of the Expected DSM case are shown in Table 9 below both for Minnesota-only members and for all its members (Minnesota, Iowa, North Dakota and South Dakota for years 2017-2031.

Table 9: Minnesota and MRES-Wide Energy and Demand Savings[23]

	Expected DSM Case MN Only				Expected DSM Case MRES Wide			
Year	Cumulative Energy Savings (GWh)	Incremental Energy Savings (GWh)	Cum. Demand Savings (MW)	Incremental Coincident Demand Savings (MW)	Cumulative Energy Savings (GWh)	Incremental Energy Savings (GWh)	Cumulative Demand Savings (MW)	Incremental Demand Savings (MW)
2017	45.9		13.5		90.4		21	
2018	61.5	15.6	18.2	4.7	121	30.6	28.3	7.3
2019	76.7	15.2	22.9	4.7	151.1	30.1	35.6	7.3
2020	90.7	14	27.5	4.6	178.5	27.4	42.8	7.2
2021	104.4	13.7	32	4.5	205.6	27.1	49.8	7
2022	118	13.6	36.5	4.5	232.5	26.9	56.8	7
2023	131.5	13.5	40.9	4.4	259.2	26.7	63.8	7
2024	144.9	13.4	45.3	4.4	285.8	26.6	70.6	6.8
2025	158.2	13.3	49.7	4.4	312.2	26.4	77.5	6.9
2026	171.5	13.3	54	4.3	338.6	26.4	84.3	6.8
2027	184.7	13.2	58.3	4.3	364.8	26.2	91.1	6.8
2028	186.5	1.8	59.1	0.8	368.5	3.7	92.5	1.4
2029	188.2	1.7	60	0.9	372.1	3.6	93.9	1.4
2030	189.8	1.6	60.8	0.8	375.7	3.6	95.2	1.3
2031	191.5	1.7	61.6	0.8	379.2	3.5	96.5	1.3

MRES found that under the Expected DSM scenario the Minnesota members would not meet Minnesota's 1.5 percent energy savings goal, and thus MRES created an alternative scenario, referred to as the Total Base Case, which added the additional energy savings needed for each of the Agency's Minnesota members to meet their Minnesota 1.5 percent energy savings goals.

Table 10 below shows the additional savings necessary for MRES's Minnesota members to meet Minnesota's 1.5 percent energy savings goal. These additional savings plus the energy savings in the Expected DSM case result in the Total DSM Base Case, also shown in Table 10 below.

[23] MRES assumed additional energy savings after 2027 would be minimal, based on existing technology. Demand savings are coincident.

Table 10: Additional Energy Savings Required to Meet the 1.5 Percent Energy Savings Goal for MRES's Minnesota Members and the Total Base Case Amount of Energy Savings for Each Year of Plan

	Additional DSM Amounts to Meet 1.5% CIP				Total Base Case			
Year	Cumulative Energy Savings (GWh)	Incremental Energy Savings	Cumulative Coincident Demand Savings (MW)	Incremental Coincident Demand Savings	Cumulative Energy Savings (GWh)	Incremental Energy Savings	Cumulative Coincident Demand Savings (MW)	Incremental Coincident Demand Savings
2017	43.9		10.2		134.3		31.1	
2018	58.3	14.4	13.6	3.4	179.3	45	41.9	10.8
2019	73	14.7	17.2	3.6	224.1	44.8	52.8	10.9
2020	89	16	21.3	4.1	267.5	43.4	64.1	11.3
2021	104.8	15.8	25.4	4.1	310.4	42.9	75.2	11.1
2022	120.8	16	29.5	4.1	353.3	42.9	86.3	11.1
2023	136.9	16.1	33.7	4.2	396.1	42.8	97.4	11.1
2024	152.9	16	37.8	4.1	438.7	42.6	108.4	11
2025	168.8	15.9	41.9	4.1	481	42.3	119.4	11
2026	184.8	16	46	4.1	523.4	42.4	130.3	10.9
2027	200.6	15.8	50.1	4.1	565.4	42	141.2	10.9
2028	227.9	27.3	57.2	7.1	596.4	31	149.7	8.5
2029	255.1	27.2	64.4	7.2	627.3	30.9	158.2	8.5
2030	282.2	27.1	71.5	7.1	657.9	30.6	166.7	8.5
2031	309.2	27	78.7	7.2	688.4	30.5	175.2	8.5

3. Department's Analysis of MRES's Energy and Demand Savings

When analyzing the appropriateness of a utility's energy savings plan within an IRP, the Department considers, along with other factors:

- Previous Commission Orders;
- Minnesota's clear preference for energy savings as a resource;
- The Company's historical energy savings achievements;
- The Company's costs of different energy savings levels; and
- The impact of different amounts of energy savings on the Company's total system costs.

a. Commission Order in Docket No. ET10/RP-10-735

In the Commission's Order accepting MRES's 2010 IRP, the Commission encouraged MRES to meet Minnesota's 1.5 percent CIP energy savings goal in a cost-effective manner. As discussed above, MRES proposed a level of energy savings (and associated demand savings) that would enable MRES's Minnesota members to meet the 1.5 percent energy savings goal while its other Members achieved the lower level of Program Potential estimated in the Agency's 2014 potential study.

b. Costs of Energy Savings over Time

Table 11 below provides MRES's projected annual DSM expenditures and energy savings and the resulting annual first year cost.

Table 11: MRES Incremental DSM Expenditures and Energy Savings

Year	Incremental DSM Expenditures	Incremental DSM Energy Savings (kWh)	First Year ($/kWh)[24]
2015	$4,001,305	28,089,481	$0.14
2016	$5,334,421	31,316,320	$0.17
2017	$6,113,649	31,016,366	$0.20
2018	$6,849,600	30,569,260	$0.22
2019	$7,418,087	30,095,342	$0.25
2020	$8,469,253	27,444,131	$0.31
2021	$8,749,012	27,072,583	$0.32
2022	$9,048,206	26,890,556	$0.34
2023	$9,366,465	26,734,092	$0.35
2024	$9,696,135	26,576,770	$0.36
2025	$10,040,372	26,426,015	$0.38
2026	$10,057,211	26,334,256	$0.38
2027	$10,442,921	26,232,559	$0.40
2028	$6,170,705	3,709,177	$1.66
2029	$6,417,519	3,619,580	$1.77
2030	$6,679,712	3,546,728	$1.88
2031	$6,961,603	3,500,021	$1.99

The DSM potential study concluded that, under current technology assumptions, DSM savings would greatly decrease by 2028, hence the dramatic increase in the cost of first-year kWh saved in the later years. It is likely, however that improvements in technology will increase the amounts of cost-effective DSM projects by 2028. Table 11 includes neither the projected lifetime energy savings that will result from each year's achievements nor the projected lifetime $/kWh saved. The Department requests that MRES include the projected lifetime energy savings and lifetime $/kWh for each year of MRES's IRP.

c. MRES's modeling results compared to historical DSM Savings

MRES used Strategist to model two potential levels of DSM achievement, the Total Base Case and the Expected Base Case. Under the Expected Base Case scenario MRES would have to procure an additional 1.5 MW of renewable resources beginning in 2028. MRES estimates that the Expected Base Case scenario would cost $130 million less than the Total Base Case scenario.

The Department's policy is to recommend that the Commission approve the amount of DSM that results in the lowest present value of societal costs over the planning period, so long as achievement of the energy savings appears possible. The Department may recommend lower energy savings than indicated by modeling if the level of energy savings appears unachievable when compared to the utility's historical savings. As with recommendations for supply-side resources, the Department's DSM recommendations change from IRP to IRP if information such as the amount of resource already procured, forecasts, and costs changes.

Evaluating the last 5 years, 2010 through 2014, of data from Table 7 indicates that MRES has averaged about 28.3 million kWh incremental energy savings per year. Assuming a

[24] Nominal dollars.

similar rate of growth in the future, we can compare that average incremental energy savings necessary to the necessary incremental energy savings for MRES's scenarios, shown in Table 12 below. At the current MRES-wide incremental energy savings rate, the Expected DSM Case is achievable in most of the years of the IRP; however it would take a large increase in the incremental energy savings rate to achieve the Total Base Case.

Table 12: Incremental Energy Savings Necessary for MRES's Proposed Scenarios

Year	Average Incremental Energy Savings (GWh)	Expected DSM Case Incremental Energy Savings (GWh)	Additional Savings to Achieve Expected DSM Case (GWh)	Total Base Case Incremental Energy Savings (GWh)	Additional Savings to Achieve Total Base Case (GWh)
2018	28.3	30.6	2.3	45.0	16.7
2019	28.3	30.1	1.8	44.8	16.5
2020	28.3	27.4	-0.9	43.4	15.1
2021	28.3	27.1	-1.2	42.9	14.6
2022	28.3	26.9	-1.4	42.9	14.6
2023	28.3	26.7	-1.6	42.8	14.5
2024	28.3	26.6	-1.7	42.6	14.3
2025	28.3	26.4	-1.9	42.3	14.0
2026	28.3	26.4	-1.9	42.4	14.1
2027	28.3	26.2	-2.1	42.0	13.7
2028	28.3	3.7	-24.6	31.0	2.7
2029	28.3	3.6	-24.7	30.9	2.6
2030	28.3	3.6	-24.7	30.6	2.3
2031	28.3	3.5	-24.8	30.5	2.2

MRES will need increase its DSM expansion rate to meet the 1.5 percent CIP requirement. A comparison of Tables 3 and 4 above indicates that by 2022 the Agency would need 84 MW more of peaking capacity than proposed by MRES in its base case. Given the uncertainty of the Agency's ability to meet the Total Base Case levels of DSM, the Department recommends that MRES discuss in reply comments its contingent plans in the event that the larger levels of DSM achievement are not attained.

4. *Department's Recommendations Concerning MRES's Energy and Demand Saving*

   a. *For Reply Comments*

The Department requests that MRES provide the following information in its Reply Comments.

(i) Please explain why the historical energy savings shown in Table 3-2 of the Petition differ from the MRES energy savings shown in the Department's Electric Savings Program.

(ii) Please include the projected lifetime energy savings and lifetime $/kWh for each year of MRES's IRP

(iii) Please present the Agency's historical incremental energy savings as a percent of wholesale sales, both for Minnesota only sales and for total system-wide sales.

(iv) Please describe the Agency's contingency in the event that MRES is unable to achieve the larger level of energy savings specified in its Total Base Case scenario.

b. Overall Recommendation

The Department recommends that the Commission advise MRES to continue to strive to meet the energy savings of the Total Savings Base case.

D. LEAST COST PLAN FOR USING RENEWABLES AND CONSERVATION FOR MEETING 50% AND 75% OF NEW CAPACITY

Minnesota Statutes 216B.2422, Subd. 2 states, in part,

> As a part of its resource plan filing, a utility shall include the least cost plan for meeting 50 and 75 percent of all new and refurbished capacity needs through a combination of conservation and renewable energy resources.

The Department notes that in the past most utilities complied with the spirit of this statutory requirement by including the least cost plan for meeting 50 and 75 percent of all new *energy* through a combination of conservation and renewable energy resources. MRES, however, conducted its analysis assuming nameplate capacity of the resources added. (The statute is unclear as to whether the percentage of capacity must be based on nameplate or accredited capacity.)

1. 50% Renewables DSM Scenario

For MRES's 50 percent Renewables/DSM sensitivity case, MRES assumed that by 2031 the Company would have added:

- 67.5 MW wind[25];
- 100 MW of conservation; and
- 168 MW combustion turbines.

Thus, MRES's 50% scenario included approximately 50% of new renewables and DSM capacity: 167.5 MW/335.5 MW =50 percent. MRES stated that the 50% Renewables/DSM scenario would cost approximately $125 million greater than its base case. However, as mentioned above, the Department concludes that MRES can improve its modeling of photovoltaic and wind resources. The Department's limited analysis indicated that adding some wind and solar resources may be more cost-effective than MRES's proposed plan. The Department would be willing to talk about this analysis further if MRES requests.

2. 75% Renewables/DSM Scenario

For MRES's 75 percent Renewables/DSM sensitivity case, MRES assumed that by 2031 the Company would have procured:

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[25] At a MISO accredited capacity factor of 15.6 percent, the 67.5 MW of wind would equal 10.5 MW of accredited capacity.

- 152 MW wind[26];
- 100 MW conservation; and
- 83.8 MW combustion turbine.

Thus MRES's 75% scenario included 75% of new renewables and DSM capacity: 83.8 MW/335.8 MW = 75%. MRES stated that the 75% renewables/DSM capacity scenario would result in a cost increase of about $105 million, approximately $20 million less than the 50% renewables/DSM scenario. However, the Department's limited analysis indicated that adding some wind in the early years may be more cost-effective than MRES's proposed plan, thus the 75% renewables/DSM scenario may be much less expensive than indicated.

E. COMPLIANCE WITH THE RENEWABLE ENERGY OBJECTIVE

1. Background

Prior to the 2007 Legislative Session, Minn. Stat. §216B.1691 required utilities to make a good faith effort to obtain 10 percent of their Minnesota retail sales from eligible energy technologies by 2015, and to obtain 0.5 percent renewable energy from biomass technologies. The 2007 Minnesota Legislature amended Minn. Stat. §216B.1691 to include a Renewable Energy Standard (RES) beginning in 2010. As amended, Minn. Stat. §216B.1691, Subd. 2 sets forth the Renewable Energy Objective in place through 2010 and requires that:

> Each electric utility shall make a good faith effort to generate or procure sufficient electricity generated by an eligible energy technology to provide its retail customers or the retail customers of a distribution utility to which the electric utility provides wholesale electric service so that commencing in 2005, at least one percent of the electric utility's total retail electric sales to retail customers in Minnesota is generated by eligible energy technologies, and seven percent of the electric utility's total retail electric sales to retail customers in Minnesota by 2010 is generated by eligible energy technologies.

Minn. Stat. §216B.1691, Subd 2a establishes the RES utilities must meet through 2025 and specifically requires that:

> each electric utility shall generate or procure sufficient electricity generated by an eligible energy technology to provide its retail customers in Minnesota, or the retail customers of a distribution utility to which the electric utility provides wholesale electric service, so that at least the following standard percentages of the electric utility's total retail electric sales to retail customers in Minnesota is generated by eligible energy technologies by the end of the year indicated:

[26] At a MISO accredited capacity factor of 15.6 percent, the 152 MW of wind would equal 23.7 MW of avoided capacity.

- 2012 12 percent
- 2016 17 percent
- 2020 20 percent
- 2025 25 percent

The statute no longer requires that a portion of the renewable energy generation come from biomass technologies. An eligible energy technology is defined by Minn. Stat. §216B.1691, Subd. 1 as an energy technology that:

> Generates electricity from the following energy sources: (1) solar; (2) wind; (3) hydroelectric with a capacity of less than 100 megawatts; (4) hydrogen, provided that after January 1, 2010, the hydrogen must be generated from the resources listed in this clause; or (5) biomass, which includes without limitation, landfill gas, an anaerobic digester system, and an energy recovery facility used to capture the heat value of mixed municipal solid waste or refuse-derived fuel from mixed municipal solid waste as a primary fuel.

Minn. Stat. §216B.1691, subd. 2(d) directs the Commission to "issue necessary orders detailing the criteria and standards by which it will measure an electric utility's efforts to meet the renewable energy objectives of subdivision 2 to determine whether the utility is making the required good faith effort."

The Commission set forth the criteria for determining compliance with the RES Statute after taking comments from effected parties in a number of Orders.[27] Among the resources the Commission has determined ineligible for meeting the RES are resources used for green pricing, resources that do not meet the statutory definition of eligibility, and generation assigned to compliance for other regulatory purposes such as another state's Renewable Portfolio Standard Requirements (RPS)

The 2007 amendment to Minn. Stat. §216B.1691, Subd. 4 required the Minnesota Public Utilities Commission to establish a program for tradable Renewable Energy Credits (RECs) by January 2008, and to require all electric utilities to participate in a Commission-approved REC tracking system once such a system was in operation.

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[27] *In the Matter of Detailing Criteria and Standards for Measuring an Electric Utility's Good Faith Efforts in Meeting the Renewable Energy Objectives Under Minn. Stat. §216B.1691,* Docket No. E999/CI-03-869, Initial Order Detailing Criteria and Standards for Determining Compliance with Minn. Stat. §216B.1691 and Requiring Customer Notification by Certain Cooperative, Municipal, and Investor-Owned Distribution Utilities. (June 1, 2004)
In the Matter of Detailing Criteria and Standards for Measuring an Electric Utility's Good Faith Efforts in Meeting the Renewable Energy Objectives Under Minn. Stat. §216B.1691, Docket No. E999/CI-03-869; *In the Matter of a Commission Investigation into a Multi-State Tracking and Trading System for Renewable Energy Credits,* Docket No. E999/CI-04-1616, Second Order Implementing Minn. Stat. §216B.1691, Opening Docket to Investigate Multi-State Program for Tracking and Trading Renewable Credits and Requesting Periodic Updates from Stakeholder Group; (October 19, 2004)
In the Matter of Detailing Criteria and Standards for Measuring an Electric Utility's Good Faith Efforts in Meeting the Renewable Energy Objectives Under Minn. Stat. §216B.1691, Docket No. E999/CI-03-869, Order After Reconsideration (August 13, 2004)

The Commission subsequently adopted the use of the Midwest Renewable Energy Tracking System (M-RETS), a multi-state REC tracking system, as the REC tracking system under Minn. Stat. §216B.1691, Subd. 4(d), and required Minnesota utilities to participate.[28] Specifically, the Commission required utilities to complete the online registration process and sign the Terms of Use agreement with the M-RETS system administrator APX, Inc, and receive account approval from APX by January 1, 2008. In addition, the Commission directed utilities to make a substantial and good faith effort to create a system account and sub-accounts for its organization, and to register its generation units/facilities in the M-RETS system by March 1, 2008.

In its December 18, 2007 *Order Establishing Initial Protocols for Trading Renewable Energy Credits,* the Commission adopted a four-year shelf life for all renewable energy credits to be used for compliance with the Minnesota RES. A four-year shelf life allows a REC to be retired towards MN RES compliance in the year of generation and during the four years following the year of generation.

Finally, in its December 3, 2008 *Third Order Detailing Criteria and Standards for Determining Compliance under Minn. Stat. §216B.1691 and Setting Procedures for Retiring Renewable Energy Credits*, the Commission directed utilities to begin retiring RECs equivalent to one percent of their Minnesota annual retail sales for the 2008 and 2009 compliance year by May 1st of the following year. Upon retirement, RECs are transferred into a specific Minnesota RES retirement account and, once retired, are not available to meet other state or program requirements, thus addressing the statutory prohibition against double counting the RECs and promoting the environmental benefits of renewable energy. The Commission further directed the utilities to submit a compliance filing demonstrating their compliance with the RES by June 1.

In addition to amending the RES Statute, Minn. Stat. §216B.241, Subd. 1c(b) was added to establish an energy-savings goal as part of a utility's conservation improvement plan (CIP), and states:

> Each individual utility and association shall have an annual energy-savings goal equivalent to 1.5 percent of gross annual retail energy sales unless modified by the commissioner under paragraph (d). The savings goals must be calculated based on the most recent three-year weather normalized average.

Attaining the 1.5 percent energy savings goal would reduce a utility's forecasted retail sales, and consequently lower the amount of renewable generation required to meet RES obligations.

2. MRES's Renewable Standard

Table 13, below, summarizes MRES's RES requirement in MWhs over the forecast period. Many of the cities served by MRES receive a direct allocation of electricity from the Western

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[28] *In the Matter of a Commission Investigation into a Multi-State Tracking and Trading System for Renewable Energy Credits,* Docket No. E999/CI-04-1616, Order Approving Midwest Renewable Energy Tracking System (M-RETS) Under Minn. Stat. §216B.1691, Subd. 4(d), and Requiring Utilities to Participate in M-RETS (October 9, 2007)

Area Power Association (WAPA). The energy forecast reported by MRES includes energy provided by WAPA. MRES is not subject to RES requirements on the energy provided by WAPA. According to MRES, the energy it provides its Minnesota members represents approximately 64 percent of the total energy forecast.

Table 13: MRES' Renewable Energy Standard

Year	MN Energy Sales (excluding WAPA)	REO/RES Percentage	RES Requirement (MWhs)
2015	800,418	12%	96,050
2016	809,338	17%	137,587
2017	819,711	17%	139,351
2018	830,283	17%	141,148
2019	839,747	17%	142,757
2020	848,423	20%	169,685
2021	857,848	20%	171,570
2022	866,866	20%	173,373
2023	876,029	20%	175,206
2024	885,357	20%	177,071
2025	894,366	25%	223,591
2026	903,222	25%	225,806
2027	912,050	25%	228,012
2028	920,842	25%	230,210
2029	930,031	25%	232,508
2030	939,304	25%	234,826
2031	948,260	25%	237,054

Over the forecast period, MRES's RES requirement increases from 137,587 MWh in 2016 to 237,054 MWh in 2031. To the extent that the Company has additional energy savings, its RES requirement would decrease.

i. Meeting Minnesota's RES

In 2015, MRES had total annual renewable generation of 247,232 MWhs of which approximately 50 percent or 123,616 MWhs reflects Minnesota's share of the Company's total system. In addition, MRES had unretired RECs totally 773,122 of which 386,561 represent Minnesota's share. Table 14, below estimates MRES ability to meet its RES requirement based on the existing annual generation and its unretired REC balance.

Table 14: Minnesota RES Compliance with Existing Resources

Year	MN REO/RES Requirement MWh	Annual Renew. Generation (MWh)	Cumulative Balance (MWh) (Beg. Balance + Annual Gen – RES Req.) Surplus/(Deficit)
			Beg. Balance: 386,561
2015	96,050	123,616	414,127
2016	137,587	123,616	400,155
2017	139,351	123,616	384,420
2018	141,148	123,616	366,888
2019	142,757	123,616	347,747
2020	169,685	123,616	301,679
2021	171,570	123,616	253,725
2022	173,373	123,616	206,968
2023	175,206	123,616	152,378
2024	177,071	123,616	98,923
2025	223,591	123,616	(1,053)
2026	225,806	123,616	(103,242)
2027	228,012	123,616	(207,639)
2028	230,210	123,616	(314,233)
2029	232,508	123,616	(423,125)
2030	234,826	123,616	(534,335)
2031	237,054	123,616	(647,784)

The combination of existing annual renewable generation plus unretired REC balances gives MRES sufficient renewable generation to meet its Minnesota RES requirement through 2025. As noted earlier, additional energy savings would reduce the RES requirement and further extend MRES's ability to meet its RES requirement. In addition, the other states in which MRES operates (Iowa, South Dakota, and North Dakota) all have lower RES obligations which may allow MRES to allocate some additional RECs towards its Minnesota requirements.

In its filing, MRES proposed the addition of a total of 10 MW of wind generation assuming 1.5 MW per year are added beginning in 2020. Assuming 50 percent of the additional wind generation is available for Minnesota RES compliance, MRES's ability to comply with its Minnesota RES requirement extends from 2025 to 2026.

The Department concludes that MRES is on track to meet its RES requirement until at least 2025.

F. ENVIRONMENTAL ISSUES

The Department reviews utility resource plans for compliance with pending state and national environmental legislation that impacts the electric utility's operations. MRES provided an update on the environmental regulations most effecting its generation fleet. A summary of those impacts is provided below:

1. *Regional Haze*

The Regional Haze Program is intended to address visibility impairment in Class I wilderness areas, and requires reductions in sulfur dioxide (SO_2) and Nitrous Oxides (NOx). MRES's only coal-fired generation facility, Laramie River Station, is effected by the Regional Haze Rules. In 2014, the EPA disapproved a portion of the Wyoming State Implementation Plan for NOx removal, and imposed more stringent emission limits which will effect operations at LRS. MRES indicates that meeting the more stringent federal emission limits will require installation of Selective Non-Catalytic Reduction technology by 2019 at a cost of more than $500 million for the entire project, and will not provide significant emission reductions beyond those already being achieved by the installation of over-fired air and low NOx burners. Basin Electric, the operating agent of LRS, has appealed the decision. Enforcement has been stayed pending appeal.

Carbon regulations contained in the Clean Power Plan would also be expected to affect operations at LRS. Implementation of the CPP has been stayed by the US Supreme Court pending appeal.

The Department concludes that MRES is adequately tracking environmental regulations that might impact its operations.

G. *MINNESOTA GREENHOUSE GAS EMISSIONS REDUCTION GOAL*

1. *Background*

In 2013, the Minnesota Legislature passed amendments to Minnesota Statutes §216B.2422, subd. 4. The amended legislation now states (new language underlined):

> The commission shall not approve a new or refurbished nonrenewable energy facility in an integrated resource plan or a certificate of need, pursuant to section 216B.243, nor shall the commission allow rate recovery pursuant to section 216B.16 for such a nonrenewable energy facility, unless the utility has demonstrated that a renewable energy facility is not in the public interest. <u>The public interest determination must include whether the resource plan helps the utility achieve the greenhouse gas reduction goals under section 216H.02, the renewable energy standard under section 216B.1691, or the solar energy standard under section 216B.1691, subdivision 2f</u>.

On August 5, 2013, the Commission issued a Notice of Information in Future Resource Plan Filings (Commission's Letter). The Commission Letter states, in part:

> **PLEASE TAKE NOTICE** that the Commission expects utilities to include in their resource plans filed after August 1, 2013 an explanation of how the resource plan helps the utility achieve the greenhouse gas reduction goals, renewable energy standard, and solar energy standard as listed in the above-

referenced legislation. Parties should also be prepared to discuss the matter in comments.

Minnesota Statutes section 216H.03, subdivision 2 states:

> For the purpose of this section, "statewide power sector carbon dioxide emissions" means the total annual emissions of carbon dioxide from the generation of electricity within the state and all emissions of carbon dioxide from the generation of electricity imported from outside the state and consumed in Minnesota. Emissions of carbon dioxide associated with transmission and distribution line losses are included in this definition. Carbon dioxide that is injected into geological formations to prevent its release to the atmosphere in compliance with applicable laws, and emissions of carbon dioxide associated with the combustion of biomass, as defined in section 216B.2411, subdivision 2, paragraph (c), clauses (1) to (4), are not counted as contributing to statewide power sector carbon dioxide emissions.[29]

2. MRES Response to August 5, 2013 Commission Notice

MRES's IRP filing included a few references to the Commission's requirement for utilities to include an explanation of how the resource plan helps the utility achieve Minnesota's greenhouse gas reduction goals. For example, on page 114 of MRES's Petition said the following about why its resource plan is in the public interest:

> It [the Resource Plan] minimizes adverse effects on the environment. Emission externality and allowance costs for any new resources are included as integral elements of the economic analysis, and both DSM and conservation effects are included in the load and resource modeling. The potential effects of various CO_2 emission costs were evaluated in several sensitivity cases. For Minnesota, the resulting increase in renewable resources helps to achieve the state's greenhouse gas reduction goals of Minn. Stat. § 216H.02.

Further, on page 112, MRES stated:

> Likewise, pursuing both the short-term and long-term objectives identified in this IRP also ensures that MRES is doing its part to help the State of Minnesota meet its policy objectives to reduce greenhouse gases embodied in Minn. Stat. § 216H. Notably, the MRES resource plan results demonstrate that future resource

[29] (1) methane or other combustible gases derived from the processing of plant or animal material;
(2) alternative fuels derived from soybean and other agricultural plant oils or animal fats;
(3) combustion of barley hulls, corn, soy-based products, or other agricultural products;
(4) wood residue from the wood products industry in Minnesota or other wood products such as short-rotation woody or fibrous agricultural crops;

> needs will rely heavily on growing DSM and non-emitting generating resources, and the only carbon-based resource additions identified as economical rely on low-emitting natural gas. It is also worthy of note that 21 of the 24 MRES Members in Minnesota are located in the MISO region, and MRES no longer has transmission to serve the majority of its Minnesota load with its base-load coal resource, LRS.

The Department submitted DOC Information Request No. 15 requesting MRES to provide a quantitative analysis of changes in the Agency's greenhouse gas emissions since 2005 and show how MRES's proposed resource plan will help the Agency achieve Minnesota's greenhouse gas reduction goals.

In response, MRES submitted two tables and a narrative providing background and its analysis. In its IR response, MRES stated:

> Significant load additions in the last ten years have caused an increase in the whole tonnage amount of $CO2$ emitted system wide for MRES. However, MRES $CO2$ emission rates have steadily declined since 2005. The MRES energy portfolio has become more diverse over the past decade with the addition of wind generation and a power purchase agreement for nuclear generation. The addition of the Red Rock Hydroelectric Project in 2019 will also add to the MRES renewable energy portfolio. Furthermore, these estimates do not include the Pierre Solar Project, a 1 MW solar project that began commercial operation on September 30, 2016. MRES purchases all of the output of this solar project. While the solar project is small in scope it will help MRES achieve further $CO2$ rate reductions. MRES assumed the $CO2$ output from market energy purchases to be the regional average of 1,547 lbs./MWh (based on the eGRID2010 MRO regional average emissions rate). Market energy sales were not removed from generation even though they were not used to serve MRES members' energy needs.

The Department includes the Agency's entire response as Attachment 5. MRES's analysis indicates that its emission *rate* is projected to decline from a low of 19 percent in 2017 to a high of 41 percent in 2030.

The Department used annual projected CO_2 emissions from the Agency's response to calculate the percentage change in projected CO_2 emissions as compared to 2005 emissions, as shown in Table 15 below.

Table 15: Comparing MRES Base Case CO_2 Emissions
With 2005 Emissions and Minnesota's Greenhouse Gas Reduction Goal

Year	CO2 Tons	Percentage Reduction/(Increase) in CO_2 Emissions Compared to 2005 Emissions (%)[30]	Minnesota Greenhouse Gas Reduction Goal (%)
2005	2,705,994		
2014	3,233,442	(19)	
2015	2,716,699	(0)	15
2016	3,339,865	(23)	15
2017	3,567,068	(32)	15
2018	3,274,104	(21)	15
2019	3,078,138	(14)	15
2020	2,957,676	(9)	15
2021	2,810,813	(4)	15
2022	2,885,352	(7)	15
2023	2,919,043	(8)	15
2024	2,778,819	(3)	15
2025	2,910,760	(8)	30
2026	2,928,648	(8)	30
2027	2,789,251	(3)	30
2028	2,951,512	(9)	30
2029	2,963,643	(10)	30
2030	2,835,412	(5)	30
2031	3,117,391	(15)	30

As can be seen in Table 15 above, the Agency projects no reduction in CO_2 emissions over the planning period. MRES stated that the CO_2 emissions provided did not exclude market energy sales even though they were not used to serve its customers' energy needs.

As mentioned above MRES states that:

> Significant load additions in the last ten years have caused an increase in the whole tonnage amount of CO2 emitted system wide for MRES.

MRES did not provide data detailing its increase in load since 2005. For reply comments the Department requests that MRES describe the additional load added since 2005. In addition, the Department requests that the Agency provide an analysis that compares 2005 statewide power sector carbon dioxide emissions (total annual emissions of carbon dioxide from MRES's generation of electricity within Minnesota and all emissions of carbon dioxide from the generation of electricity imported from outside the state and consumed by MRES's

[30] Negative values indicate that CO_2 emissions increased.

customers in Minnesota) with projected statewide power sector carbon dioxide emissions over the length of the planning period, assuming both Total Base Case and Expected Conservation achievement scenarios [31].

III. RECOMMENDATIONS

A. FOR REPLY COMMENTS

1. Forecasting

The Department requests that MRES update its analysis of wind and solar additions by modeling all costs for generic wind and solar units as a single, per MWh charge; with a goal of determining the price per MWh at which additions of wind and solar capacity are least cost for MRES's system.

2. DSM Resources

The Department requests that MRES provide the following in its Reply Comments:

a. Please explain why the historical energy savings shown in Table 3-2 of the Petition differ from the MRES energy savings shown in the Department's Electric Savings Program.

b. Please include the projected lifetime energy savings and lifetime $/kWh for each year of MRES's IRP.

c. Please present the Agency's historical incremental energy savings as a percent of wholesale sales, both for Minnesota only sales and for total system-wide sales.

d. Please describe the Agency's contingency plan in the event that MRES is unable to achieve the larger level of energy savings specified in its Total Base Case scenario.

3. Greenhouse Gas Reduction Goal

The Department requests that MRES provide the following in its Reply Comments:

a. Please describe (including amounts and locations) of the additional load added to its system since 2005.

b. Please provide an analysis that compares 2005 statewide power sector carbon dioxide emissions (total annual emissions of carbon dioxide from MRES's generation of electricity within Minnesota and all emissions of carbon dioxide from the generation of electricity imported from outside the state and consumed by MRES's customers in Minnesota) with projected statewide power sector carbon dioxide emissions over the length of the planning period,

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[31] The Department notes that MRES's CO_2 emissions would be even lower under the brief analysis the DOC conducted, which indicated that solar and wind resources may be cost-effective for the Agency's MISO region.

assuming both Total Base Case and Expected Conservation achievement scenarios.

B. DEPARTMENT RECOMMENDATIONS

1. Energy and Demand Forecasting

a. Short-Term Energy Forecast

The Department recommends that the Commission accept the MRES short-term energy forecast as filed.

b. Short-Term Demand Forecast

The Department recommends that the Commission accept MRES's short-term demand forecast for planning purposes. Also, the Department recommends that the Commission advise MRES to construct and file a regression model of demand for its Minnesota members within six months of the Commission Order in this proceeding.

2. Modeling and Supply-side Recommendations

The Department recommends the Commission advise MRES to consider:

a. additional conservation achievement under a variety of contingencies, similar to how supply units are studied;
b. modeling a greater number of contingencies, including modeling price contingencies for all resources options that are presented to the Agency's IRP model;
c. making generic units with varying characteristics available in different years if it would aid in the AGENCY's modeling;
d. consider ways to further limit the AGENCYs exposure to spot market prices; and
e. modeling all costs for generic wind and solar units as a single, per MWh charge; and
f. reconsider the AGENCY's analysis of wind and solar additions with a goal of determining the price per MWh at which additions of wind and solar capacity are least cost for MRES's system.

3. DSM Resources

The Department recommends that the Commission advise MRES to continue to strive to meet the energy savings of the Total Savings Base case.

/lt

DESIRED STATS

R^2	> than	0.700
F	> than	0.00
DW	> than	0.00
DW	< than	4.00
G1	> than	-10.0%
G1	< than	10.0%
G2	> than	-5.0%
G2	< than	5.0%
T	all > than	2.00

number of passing cases 26

errors 0

Sort Results

pick case number 329
then run it through FCMaster

Run Forecast(s)

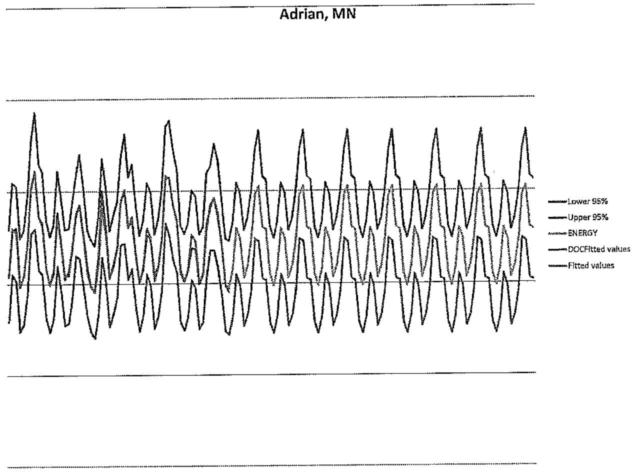
select failing model	R^2	F	DW	G1	G2	T	LAG	TREND	WHTR
341						fail			

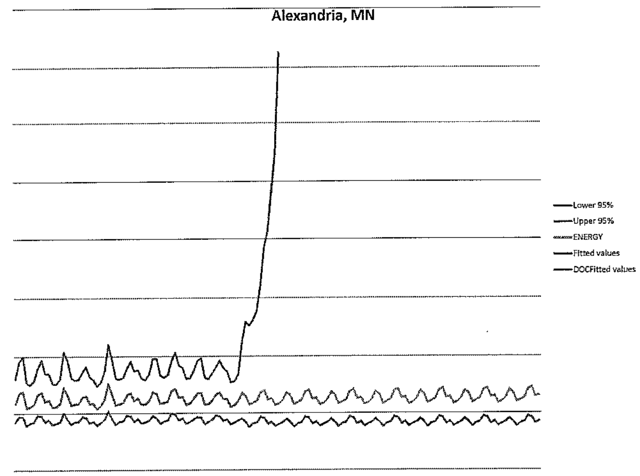
must have at least 1 weather var

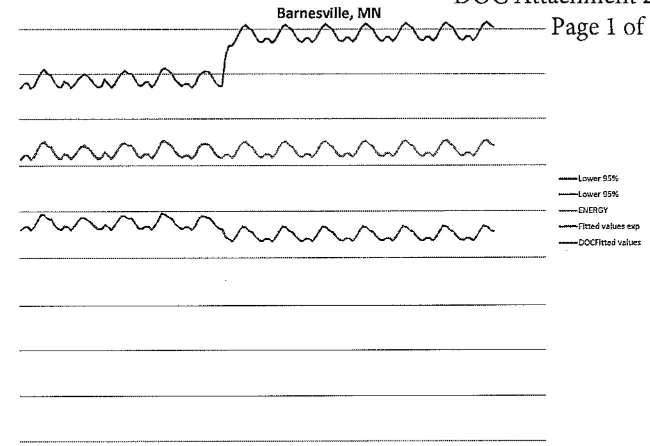
must have 0 or more trnd var

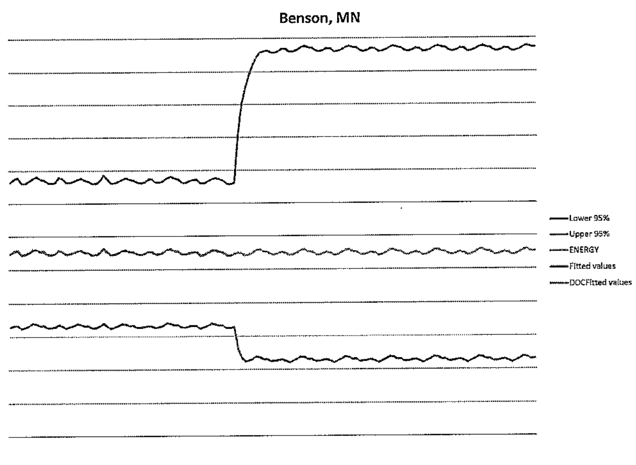
must have 1 or less lag var

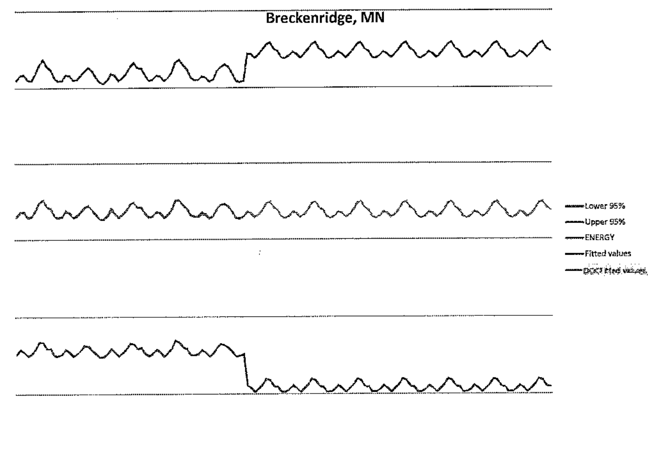
1152	CASE #	energy Y	R^2	F	DW	G1	G2	trend	lageng1	lageng_12	1 cdd	1 hdd	tdd	1 ln_trend	ln_lageng1	ln_lageng12	ln_cdd	ln_hdd	ln_tdd	spot_id	t_check	lag_check	trend_check	wthr_check
pass	325	energy	0.9308	62.0796	1.1218	2.9%	0.0%				8.599	6.9564								0	6.956439	0	0	2
pass	865	energy	0.9308	62.0796	1.1218	2.9%	0.0%				6.04		6.956							0	6.040077	0	0	2
pass	326	ln_eng	0.9294	60.7782	1.1133	2.8%	0.0%				7.589	7.1859								0	7.185884	0	0	2
pass	866	ln_eng	0.9294	60.7782	1.1133	2.8%	0.0%				4.984		7.186							0	4.984041	0	0	2
pass	1027	energy	0.9088	46.246	1.1426	3.4%	0.0%				2.821								5.061	0	2.820573	0	0	2
pass	218	ln_eng	0.903	46.7672	1.317	3.7%	0.0%												7.753	0	7.753011	0	0	1
pass	974	ln_eng	0.903	46.7672	1.317	3.7%	0.0%												7.753	0	7.753011	0	0	1
pass	217	energy	0.8953	43.0638	1.4065	4.0%	0.0%												7.647	0	7.646993	0	0	1
pass	973	energy	0.8953	43.0638	1.4065	4.0%	0.0%												7.647	0	7.646993	0	0	1
pass	164	ln_eng	0.8936	42.3109	1.3775	3.5%	0.0%						7.12							0	7.119805	0	0	1
pass	812	ln_eng	0.8936	42.3109	1.3775	3.5%	0.0%						7.12							0	7.119805	0	0	1
pass	919	energy	0.886	36.2581	1.4304	3.7%	0.0%						7.117				2.006			0	2.006155	0	0	2
pass	67	energy	0.8794	34.0852	1.5006	1.8%	0.3%				5.739				2.849912					0	2.849912	1	0	1
pass	163	energy	0.8786	36.5895	1.4928	3.7%	0.0%						6.629							0	6.628801	0	0	1
pass	811	energy	0.8786	36.5895	1.4928	3.7%	0.0%						6.629							0	6.628801	0	0	1
pass	61	energy	0.8751	32.812	1.424	2.0%	0.2%		2.50808		5.725									0	2.508081	1	0	1
pass	68	ln_eng	0.8738	32.4292	1.4784	1.7%	0.3%				4.888				2.932785					0	2.932785	1	0	1
pass	62	ln_eng	0.8687	31.018	1.3836	1.8%	0.2%		2.54146		4.879									0	2.541462	1	0	1
pass	392	ln_eng	0.8661	28.2495	1.7344	3.6%	0.3%					4.4552			2.260857		2.404			0	2.260857	1	0	2
pass	55	energy	0.8611	31.4788	0.9509	2.5%	0.0%				5.698									0	5.697975	0	0	1
pass	380	ln_eng	0.8541	27.5655	1.3764	3.8%	0.0%					5.0195					2.024			0	2.023728	0	0	2
pass	56	ln_eng	0.8534	29.6238	0.9145	2.4%	0.0%				4.887									0	4.886752	0	0	1
pass	391	energy	0.8466	24.2648	1.8302	3.9%	0.3%					3.9733			2.16027		2.382			0	2.16027	1	0	2
pass	272	ln_eng	0.8445	27.6972	1.4315	3.7%	0.0%					4.4507								0	4.450713	0	0	1
pass	379	energy	0.8344	23.8696	1.4762	4.0%	0.0%					4.5346					2.024			0	2.024437	0	0	2
pass	271	energy	0.8235	23.9391	1.5394	3.9%	0.0%					3.942								0	3.942014	0	0	1
fail	341	energy	0.9371	59.5541	1.3119	1.5%	-0.1%				8.798	6.4689		-2.048	1.214985					0	-2.04828	1	1	2
fail	449	energy	0.9371	59.5541	1.3119	1.5%	-0.1%					-6.363	8.798	-2.048	1.214985					0	-6.36292	1	1	2
fail	881	energy	0.9371	59.5541	1.3119	1.5%	-0.1%				6.363		6.469	-2.048	1.214985					0	-2.04828	1	1	2
fail	329	energy	0.9364	63.0355	1.2177	1.7%	-0.2%				9.064	7.3248		-2.24						0	-2.23951	0	1	2
fail	437	energy	0.9364	63.0355	1.2177	1.7%	-0.2%					-6.374	9.064	-2.24						0	-6.37411	0	1	2
fail	869	energy	0.9364	63.0355	1.2177	1.7%	-0.2%				6.374		7.325	-2.24						0	-2.23951	0	1	2
fail	443	energy	0.9363	58.7809	1.2879	1.5%	-0.2%		0.95577			-6.342	8.83	-2.061						0	-6.34188	1	1	2
fail	335	energy	0.9363	58.7809	1.2879	1.5%	-0.2%		0.95577		8.83	6.6169		-2.061						0	-2.06123	1	1	2
fail	875	energy	0.9363	58.7809	1.2879	1.5%	-0.2%		0.95577		6.342		6.617	-2.061						0	-2.06123	1	1	2
fail	377	energy	0.9357	54.6371	1.305	1.4%	-0.1%				8.608	6.2602		-1.958	1.125252	0.235759				0	-1.95811	2	1	2
fail	485	energy	0.9357	54.6371	1.305	1.4%	-0.1%					-6.108	8.608	-1.958	1.125252	0.235759				0	-6.10847	2	1	2
fail	917	energy	0.9357	54.6371	1.305	1.4%	-0.1%				6.108		6.26	-1.958	1.125252	0.235759				0	-1.95811	2	1	2
fail	359	energy	0.9356	54.585	1.3067	1.4%	-0.1%			0.128331	8.597	6.2541		-1.922	1.141164					0	-1.922	2	1	2
fail	467	energy	0.9356	54.585	1.3067	1.4%	-0.1%			0.128331		-6.115	8.597	-1.922	1.141164					0	-6.11469	2	1	2
fail	899	energy	0.9356	54.585	1.3067	1.4%	-0.1%			0.128331	6.115		6.254	-1.922	1.141164					0	-1.922	2	1	2
fail	339	energy	0.9354	57.9293	1.3119	0.9%	-0.6%	-1.72			8.444	6.3973			1.221703					0	-1.7153	1	1	2
fail	447	energy	0.9354	57.9293	1.3119	0.9%	-0.6%	-1.72				-6.001	8.444		1.221703					0	-6.00076	1	1	2
fail	879	energy	0.9354	57.9293	1.3119	0.9%	-0.6%	-1.72			6.001		6.397		1.221703					0	-1.7153	1	1	2
fail	365	energy	0.9353	57.8452	1.2085	1.4%	-0.1%				8.802	7.2276		-2.245		0.4821697				0	-2.24487	1	1	2
fail	473	energy	0.9353	57.8452	1.2085	1.4%	-0.1%					-6.078	8.802	-2.245		0.4821697				0	-6.07778	1	1	2
fail	905	energy	0.9353	57.8452	1.2085	1.4%	-0.1%				6.078		7.228	-2.245		0.4821697				0	-2.24487	1	1	2
fail	455	energy	0.9352	57.7405	1.2066	1.5%	-0.2%			0.395388		-6.076	8.775	-2.217						0	-6.07563	1	1	2
fail	347	energy	0.9352	57.7405	1.2066	1.5%	-0.2%			0.395388	8.775	7.2263		-2.217						0	-2.21737	1	1	2
fail	887	energy	0.9352	57.7405	1.2066	1.5%	-0.2%			0.395388	6.076		7.226	-2.217						0	-2.21737	1	1	2
fail	479	energy	0.9349	53.9493	1.2793	1.4%	-0.1%		0.85738			-6.079	8.634	-1.98		0.268257				0	-6.07885	2	1	2
fail	371	energy	0.9349	53.9493	1.2793	1.4%	-0.1%		0.85738		8.634	6.4057		-1.98		0.268257				0	-1.97964	2	1	2
fail	911	energy	0.9349	53.9493	1.2793	1.4%	-0.1%		0.85738		6.079		6.406	-1.98		0.268257				0	-1.97964	2	1	2
fail	353	energy	0.9348	53.8896	1.2808	1.5%	-0.1%		0.87427	0.162966	8.621	6.3993		-1.943						0	-1.94297	2	1	2
fail	461	energy	0.9348	53.8896	1.2808	1.5%	-0.1%		0.87427	0.162966		-6.084	8.621	-1.943						0	-6.08352	2	1	2
fail	893	energy	0.9348	53.8896	1.2808	1.5%	-0.1%		0.87427	0.162966	6.084		6.399	-1.943						0	-1.94297	2	1	2
fail	327	energy	0.9347	61.2896	1.2153	1.1%	-0.6%	-1.92			8.655	7.27								0	-1.92285	0	1	2
fail	435	energy	0.9347	61.2896	1.2153	1.1%	-0.6%	-1.92				-5.983	8.655							0	-5.98312	0	1	2
fail	867	energy	0.9347	61.2896	1.2153	1.1%	-0.6%	-1.92			5.983		7.27							0	-1.92285	0	1	2
fail	441	energy	0.9345	57.1609	1.2879	1.0%	-0.6%	-1.73	0.95824			-5.976	8.471							0	-5.97627	1	1	2
fail	333	energy	0.9345	57.1609	1.2879	1.0%	-0.6%	-1.73	0.95824		8.471	6.5447								0	-1.72689	1	1	2
fail	873	energy	0.9345	57.1609	1.2879	1.0%	-0.6%	-1.73	0.95824		5.976		6.545							0	-1.72689	1	1	2
fail	342	ln_eng	0.9345	57.0954	1.2806	1.5%	-0.1%				7.642	6.5717		-1.721	1.33456					0	-1.72116	1	1	2
fail	450	ln_eng	0.9345	57.0954	1.2806	1.5%	-0.1%					-5.19	7.642	-1.721	1.33456					0	-5.18987	1	1	2
fail	882	ln_eng	0.9345	57.0954	1.2806	1.5%	-0.1%				5.19		6.572	-1.721	1.33456					0	-1.72116	1	1	2
fail	357	energy	0.9339	53.1152	1.3207	1.0%	-0.6%	-1.58		-0.1774	8.249	6.128			1.21877					0	-1.5798	2	1	2
fail	465	energy	0.9339	53.1152	1.3207	1.0%	-0.6%	-1.58		-0.1774		-5.791	8.249		1.21877					0	-5.79133	2	1	2
fail	897	energy	0.9339	53.1152	1.3207	1.0%	-0.6%	-1.58		-0.1774	5.791		6.128		1.21877					0	-1.5798	2	1	2
fail	340	ln_eng	0.9339	56.5691	1.2921	0.9%	-0.5%	-1.6			7.397	6.5667			1.324647					0	-1.59706	1	1	2
fail	448	ln_eng	0.9339	56.5691	1.2921	0.9%	-0.5%	-1.6				-4.917	7.397		1.324647					0	-4.91701	1	1	2
fail	880	ln_eng	0.9339	56.5691	1.2921	0.9%	-0.5%	-1.6			4.917		6.567		1.324647					0	-1.59706	1	1	2
fail	375	energy	0.9339	53.08	1.3144	0.9%	-0.6%	-1.6			8.245	6.1243			1.197773	-0.065625				0	-1.60064	2	1	2
fail	915	energy	0.9339	53.08	1.3144	0.9%	-0.6%	-1.6			5.77		6.124		1.197773	-0.065625				0	-1.60064	2	1	2
fail	483	energy	0.9339	53.08	1.3144	0.9%	-0.6%	-1.6				-5.77	8.245		1.197773	-0.065625				0	-5.77016	2	1	2
fail	336	ln_eng	0.9334	56.1172	1.2472	1.6%	-0.1%		1.01735		7.672	6.7283		-1.741						0	-1.74065	1	1	2
fail	444	ln_eng	0.9334	56.1172	1.2472	1.6%	-0.1%		1.01735			-5.168	7.672	-1.741						0	-5.16794	1	1	2
fail	876	ln_eng	0.9334	56.1172	1.2472	1.6%	-0.1%		1.01735		5.168		6.728	-1.741						0	-1.74065	1	1	2
fail	330	ln_eng	0.9333	60.005	1.179	1.7%	-0.2%				7.891	7.4536		-1.922						0	-1.92178	0	1	2
fail	438	ln_eng	0.9333	60.005	1.179	1.7%	-0.2%					-5.193	7.891	-1.922						0	-5.1932	0	1	2
fail	870	ln_eng	0.9333	60.005	1.179	1.7%	-0.2%				5.193		7.454	-1.922						0	-1.92178	0	1	2
fail	363	energy	0.9332	55.9701	1.2104	1.0%	-0.6%	-1.88			8.374	7.1006				0.1677811				0	-1.87791	1	1	2
fail	471	energy	0.9332	55.9701	1.2104	1.0%	-0.6%	-1.88				-5.703	8.374			0.1677811				0	-5.70308	1	1	2
fail	903	energy	0.9332	55.9701	1.2104	1.0%	-0.6%	-1.88			5.703		7.101			0.1677811				0	-1.87791	1	1	2
fail	345	energy	0.9332	55.9401	1.2123	1.0%	-0.6%	-1.86		0.075567	8.365	7.1102								0	-1.8615	1	1	2
fail	453	energy	0.9332	55.9401	1.2123	1.0%	-0.6%	-1.86		0.075567		-5.716	8.365							0	-5.71558	1	1	2
fail	885	energy	0.9332	55.9401	1.2123	1.0%	-0.6%	-1.86		0.075567	5.716		7.11							0	-1.8615	1	1	2
fail	351	energy	0.9331	52.3981	1.2957	1.0%	-0.6%	-1.59	0.95587	-0.14694	8.265	6.2681								0	-1.59437	2	1	2
fail	891	energy	0.9331	52.3981	1.2957	1.0%	-0.6%	-1.59	0.95587	-0.14694	5.755		6.268							0	-1.59437	2	1	2
fail	459	energy	0.9331	52.3981	1.2957	1.0%	-0.6%	-1.59	0.95587	-0.14694		-5.755	8.265							0	-5.75507	2	1	2
fail	369	energy	0.933	52.3722	1.2894	1.0%	-0.6%	-1.62	0.9331		8.262	6.2647				-0.036918				0	-1.6163	2	1	2
fail	477	energy	0.933	52.3722	1.2894	1.0%	-0.6%	-1.62	0.9331			-5.735	8.262			-0.036918				0	-5.73522	2	1	2
fail	909	energy	0.933	52.3722	1.2894	1.0%	-0.6%	-1.62	0.9331		5.735		6.265			-0.036918				0	-1.6163	2	1	2
fail	378	ln_eng	0.933	52.3344	1.2773	1.5%	-0.1%				7.481	6.3317		-1.621	1.261176	0.1367931				0	-1.62084	2	1	2
fail	486	ln_eng	0.933	52.3344	1.2773	1.5%	-0.1%					-4.992	7.481	-1.621	1.261176	0.1367931				0	-4.99169	2	1	2
fail	918	ln_eng	0.933	52.3344	1.2773	1.5%	-0.1%				4.992		6.332	-1.621	1.261176	0.1367931				0	-1.62084	2	1	2
fail	360	ln_eng	0.933	52.3121	1.2793	1.5%	-0.1%			0.036172	7.476	6.3306		-1.588	1.27695					0	-1.58752	2	1	2
fail	468	ln_eng	0.933	52.3121	1.2793	1.5%	-0.1%			0.036172		-5.001	7.476	-1.588	1.27695					0	-5.00134	2	1	2
fail	900	ln_eng	0.933	52.3121	1.2793	1.5%	-0.1%			0.036172	5.001		6.331	-1.588	1.27695					0	-1.58752	2	1	2
fail	874	ln_eng	0.9328	55.5882	1.2585	1.0%	-0.5%	-1.62	1.00021		4.891		6.724							0	-1.6151	1	1	2
fail	334	ln_eng	0.9328	55.5882	1.2585	1.0%	-0.5%	-1.62	1.00021		7.423	6.7239								0	-1.6151	1	1	2
fail	442	ln_eng	0.9328	55.5882	1.2585	1.0%	-0.5%	-1.62	1.00021			-4.891	7.423							0	-4.89088	1	1	2

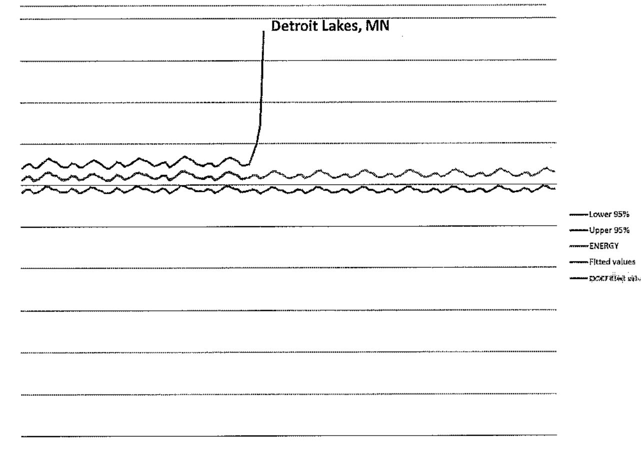

Adrian, MN
Lower 95%
Upper 95%
ENERGY
DOCFitted values
Fitted values

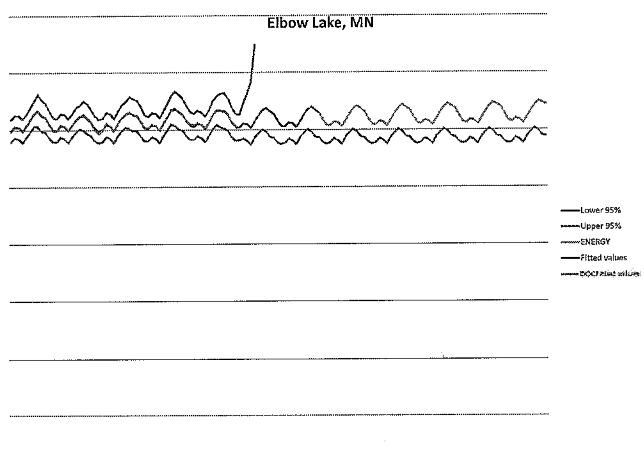

Alexandria, MN
Lower 95%
Upper 95%
ENERGY
Fitted values
DOCFitted values

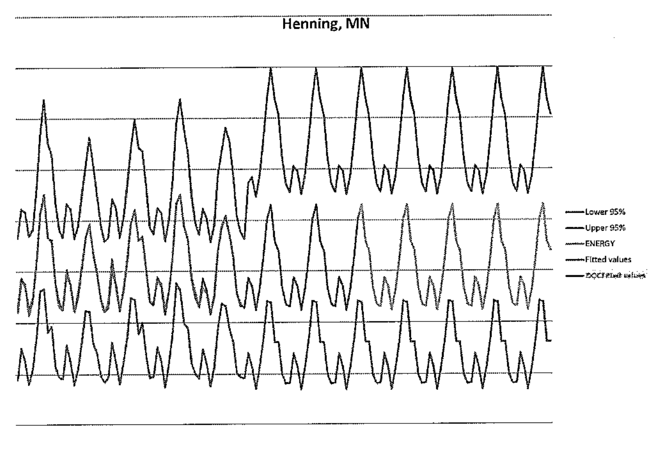

Barnesville, MN
Lower 95%
Lower 95%
ENERGY
Fitted values exp
DOCFitted values

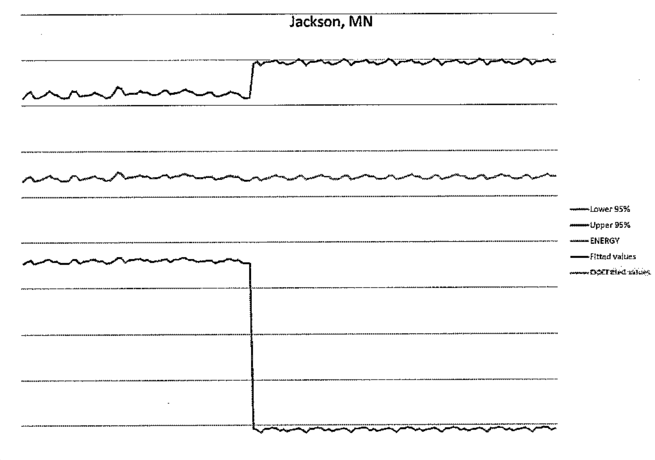

Benson, MN
Lower 95%
Upper 95%
ENERGY
Fitted values
DOCFitted values

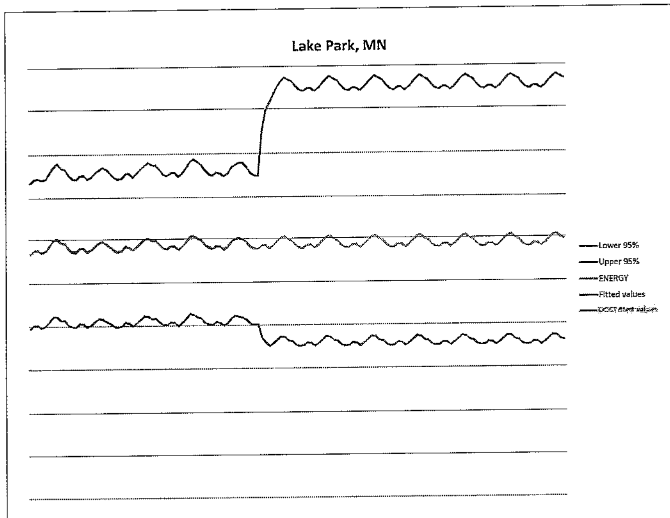

Breckenridge, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

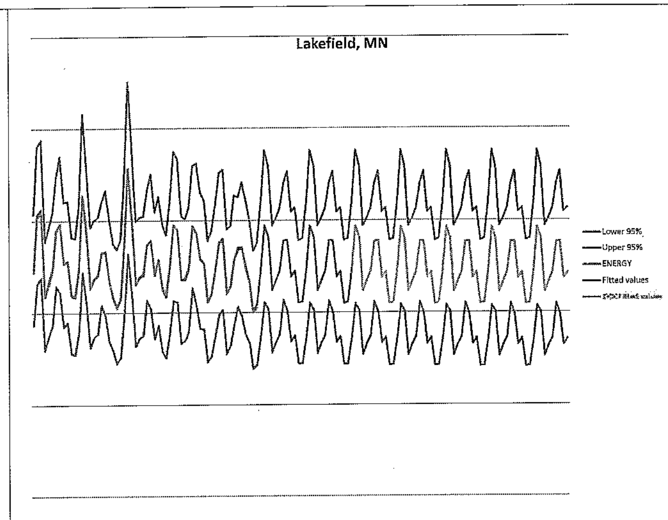

Detroit Lakes, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

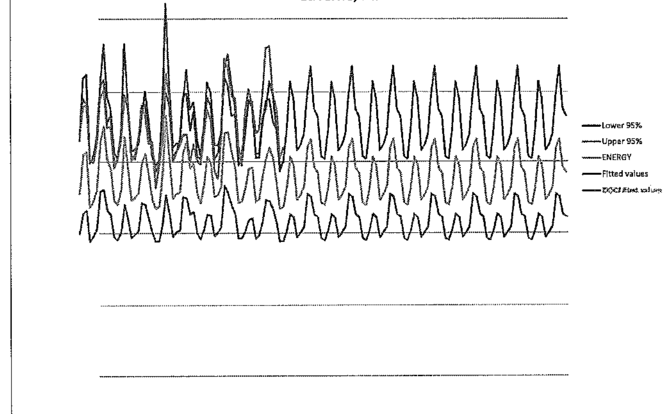

Elbow Lake, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

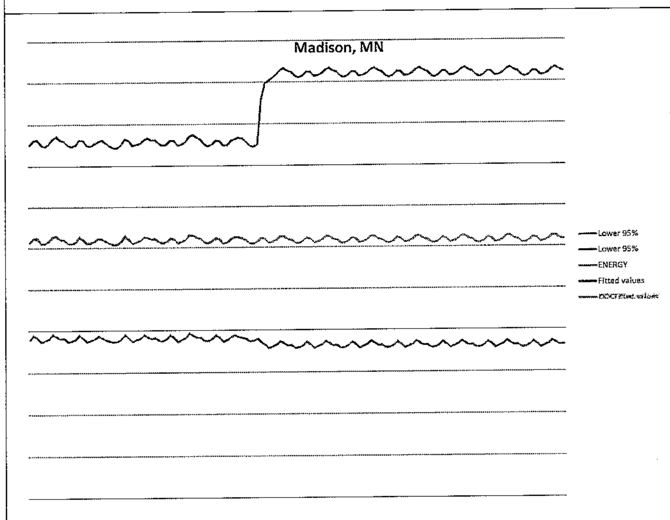

Henning, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

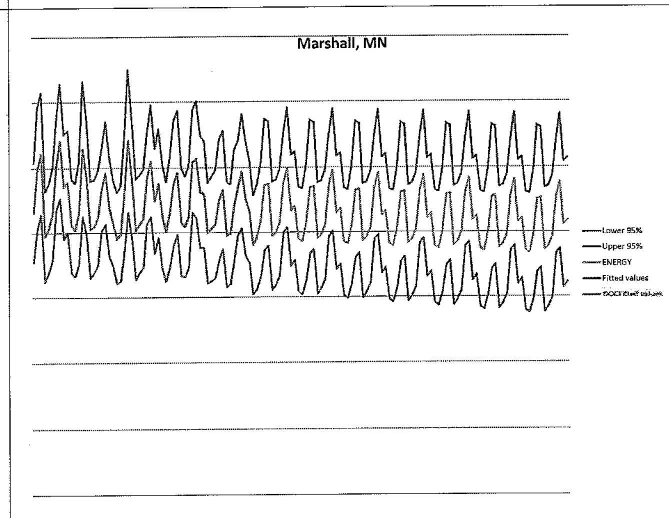

Jackson, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

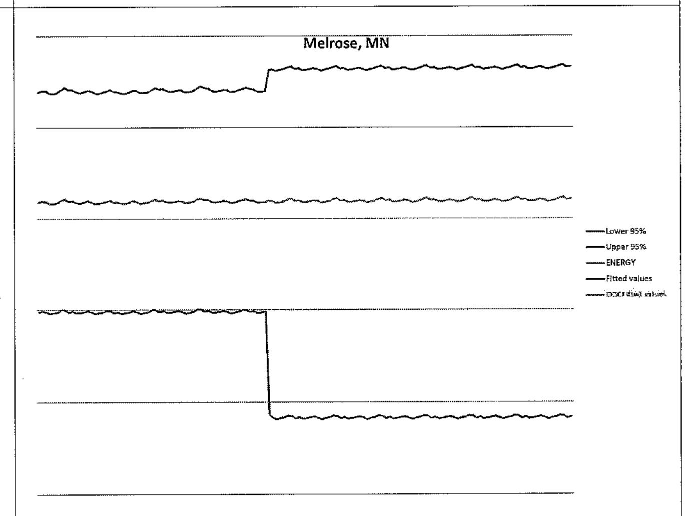

Lake Park, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

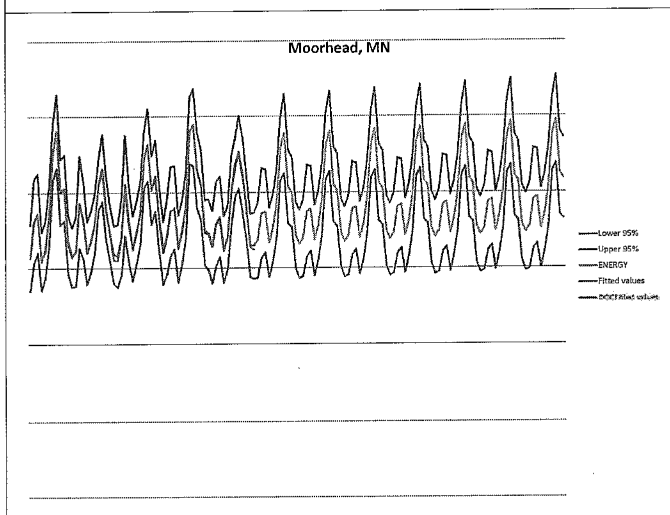

Lakefield, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

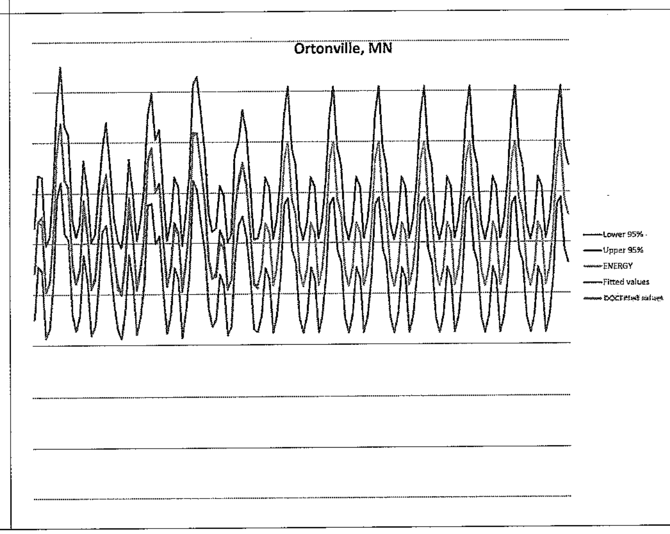

Luverne, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

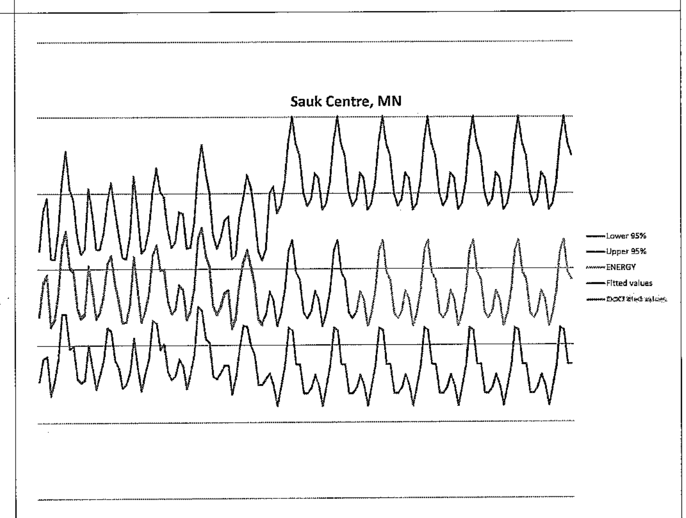

Madison, MN
Lower 95%
Lower 95%
ENERGY
Fitted values

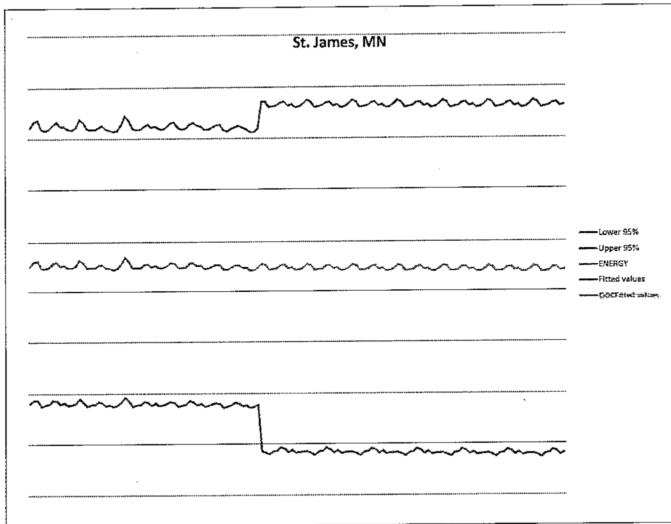

Marshall, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

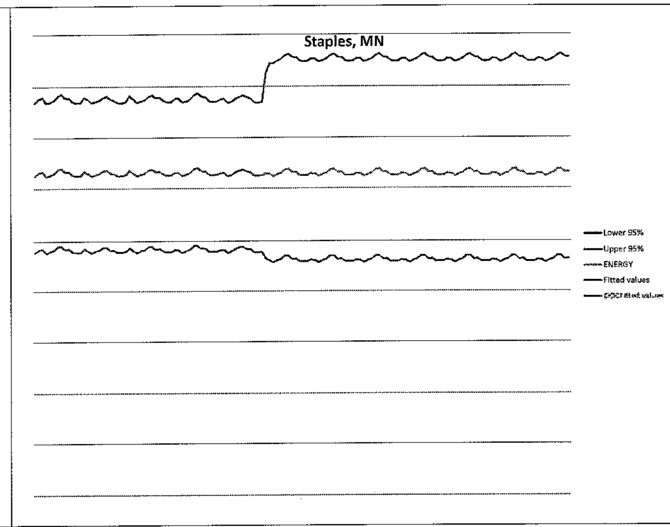

Melrose, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

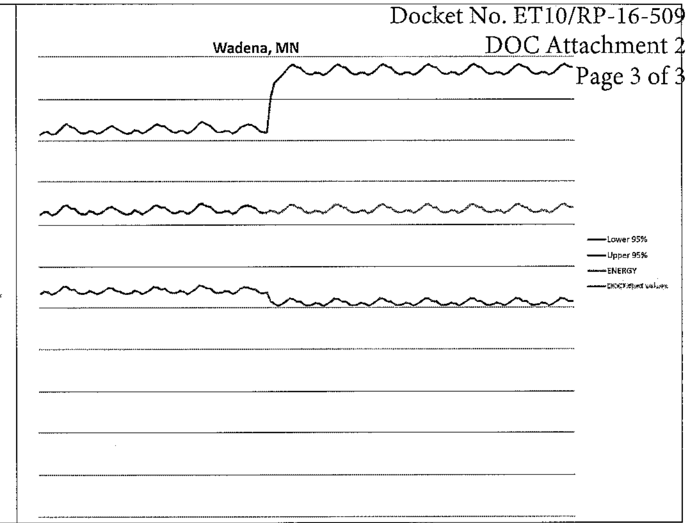

Moorhead, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

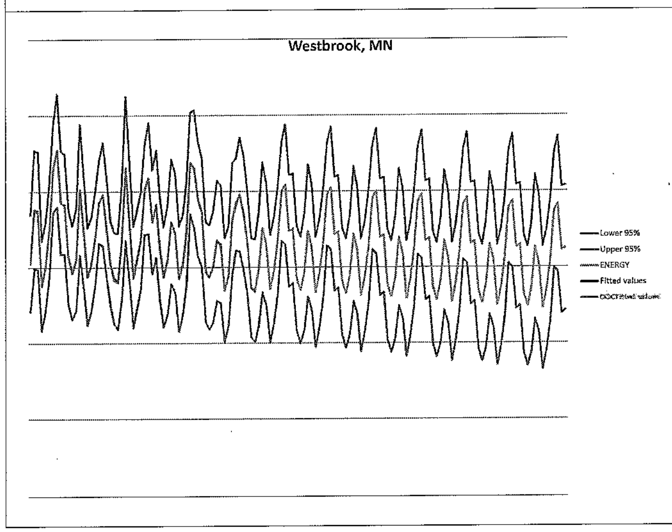

Ortonville, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

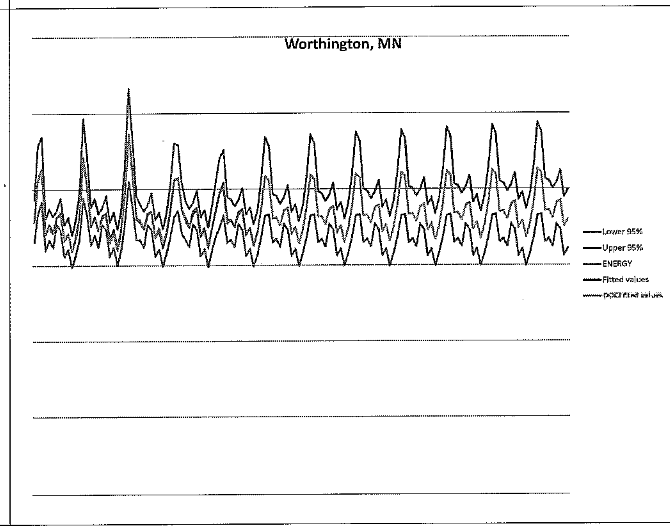

Sauk Centre, MN
Lower 95%
Upper 95%
ENERGY
Fitted values

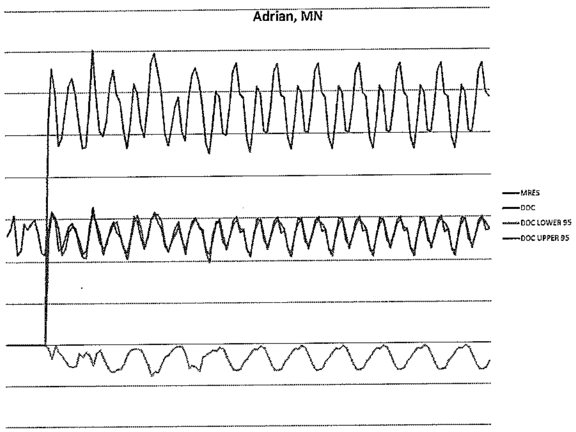

St. James, MN
Lower 95%
Upper 95%
ENERGY
Fitted values
DOC Fitted values

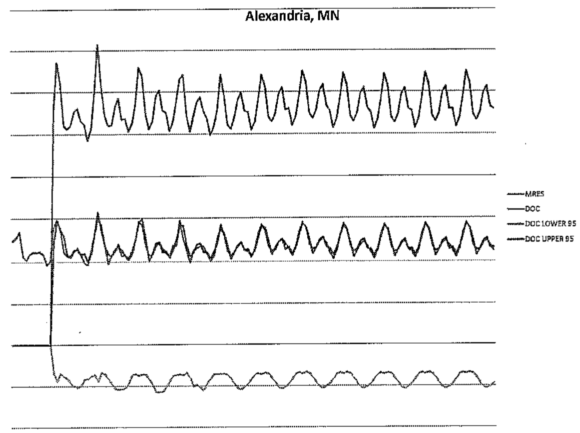

Staples, MN
Lower 95%
Upper 95%
ENERGY
Fitted values
DOC Fitted values

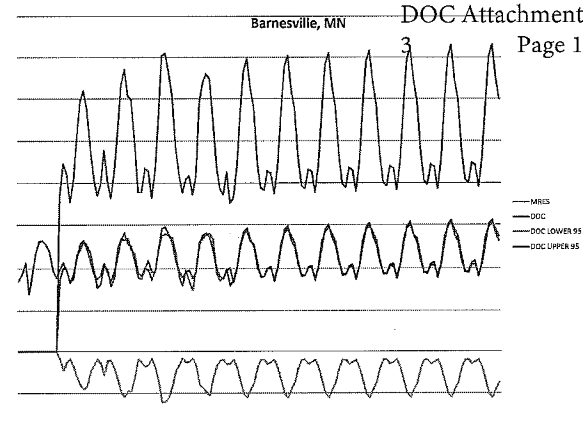

Wadena, MN
Lower 95%
Upper 95%
ENERGY
DOC Fitted values

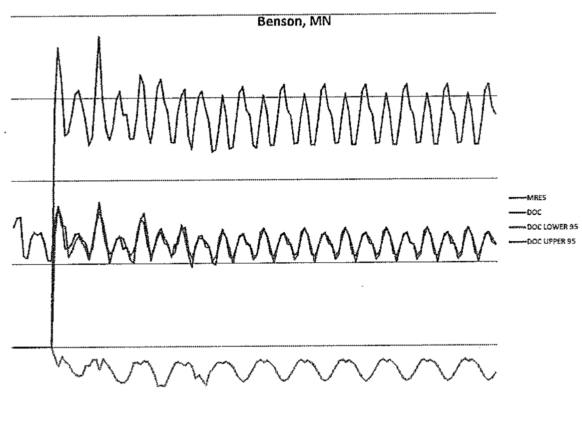

Westbrook, MN
Lower 95%
Upper 95%
ENERGY
Fitted values
DOC Fitted values

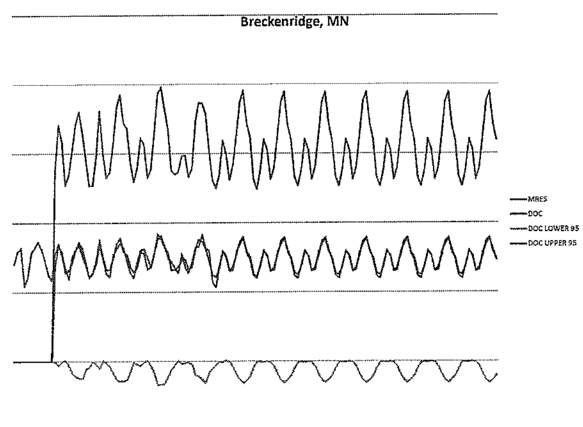

Worthington, MN
Lower 95%
Upper 95%
ENERGY
Fitted values
DOC Fitted values


Adrian, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95


Alexandria, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95


Barnesville, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95


Benson, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95


Breckenridge, MN
MRES
DOC
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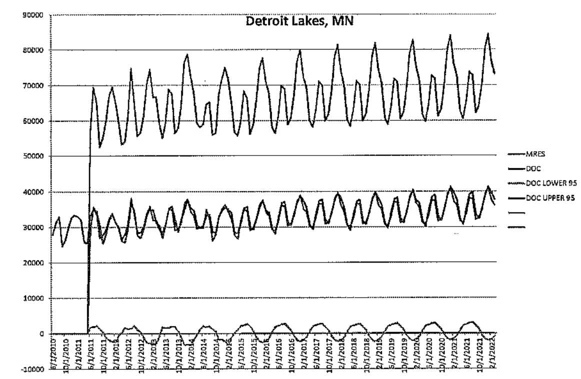
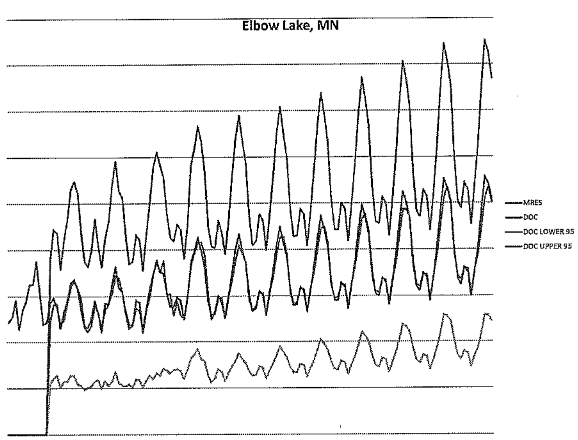
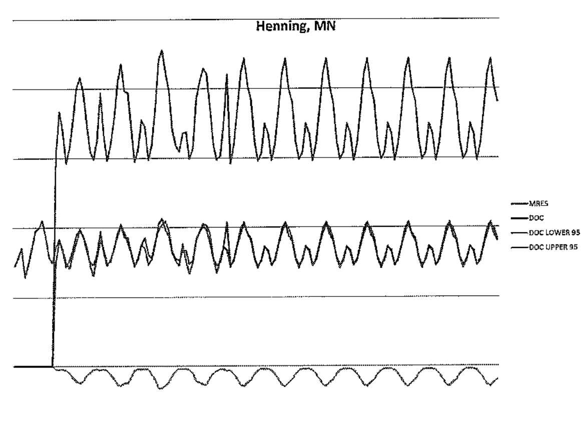

Detroit Lakes, MN
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
MRES
DOC
DOC LOWER 95
DOC UPPER 95


Elbow Lake, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95


Henning, MN
MRES
DOC
DOC LOWER 95
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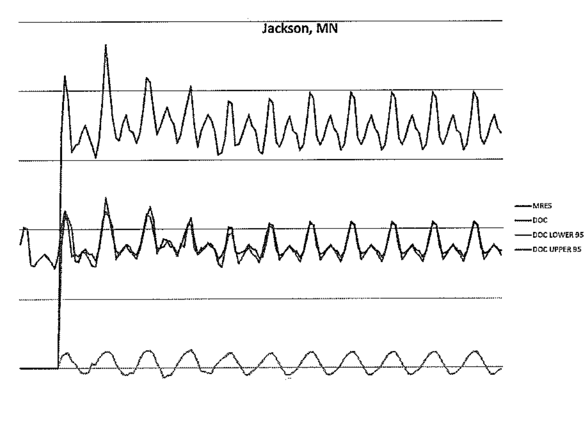
Jackson, MN
MRES
DOC
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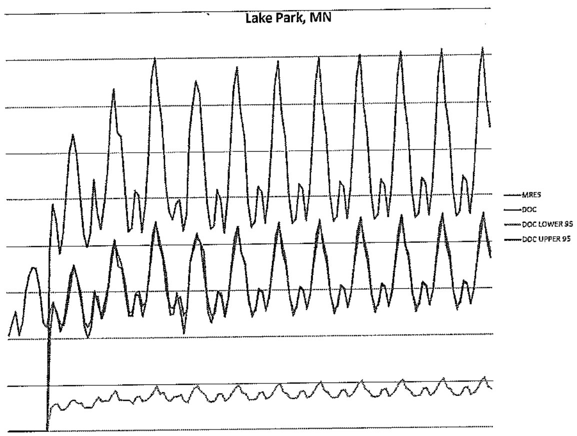
Lake Park, MN
MRES
DOC
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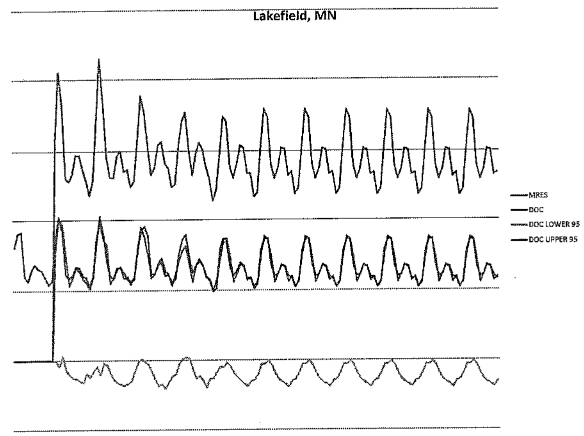
Lakefield, MN
MRES
DOC
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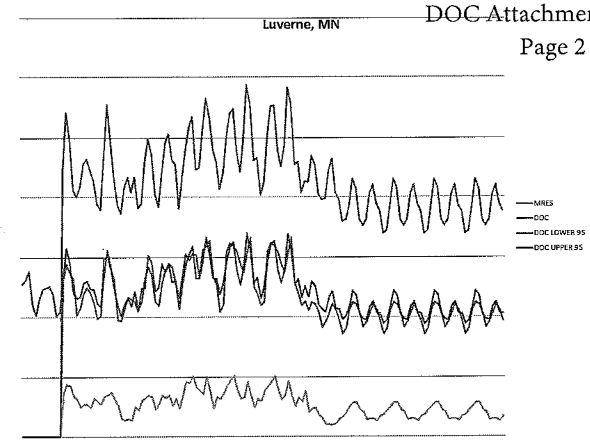
Luverne, MN
MRES
DOC
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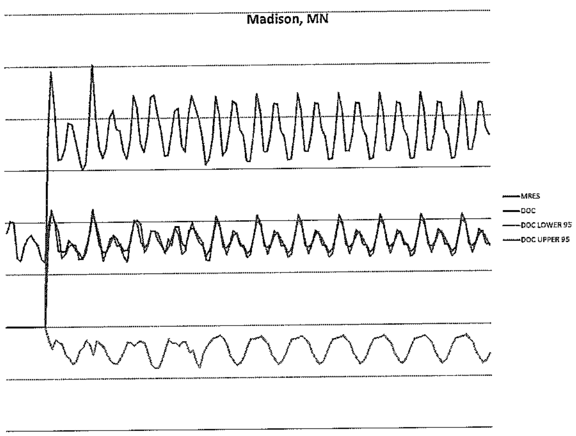
Madison, MN
MRES
DOC
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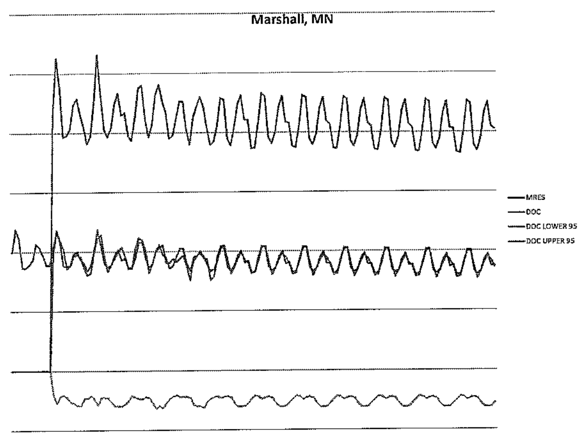
Marshall, MN
MRES
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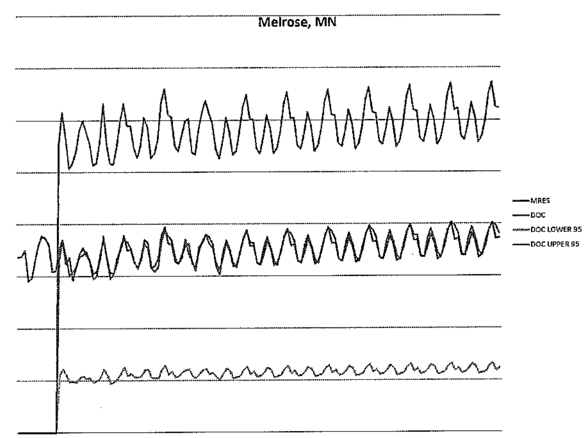
Melrose, MN
MRES
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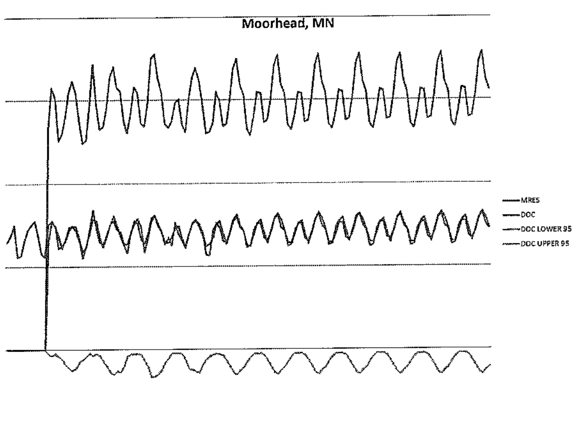
Moorhead, MN
MRES
DOC
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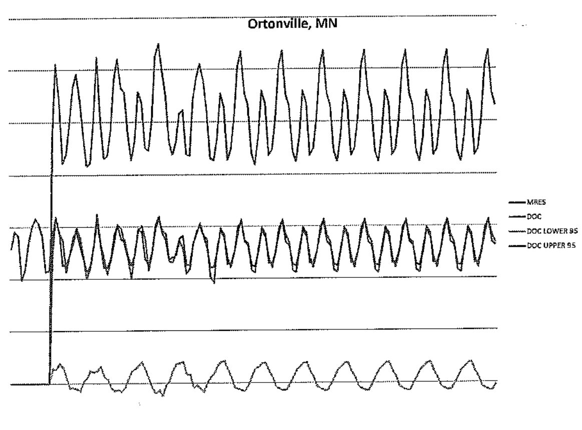
Ortonville, MN
MRES
DOC
DOC LOWER 95
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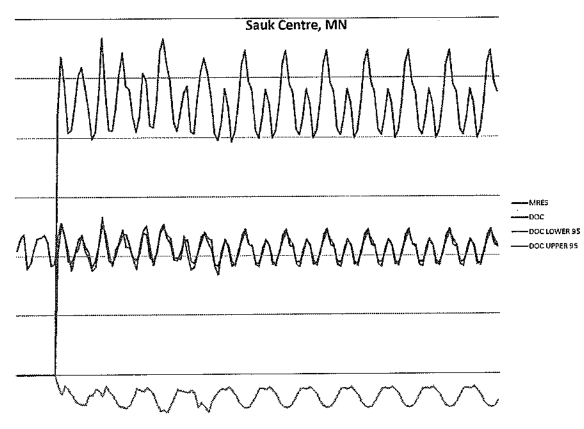
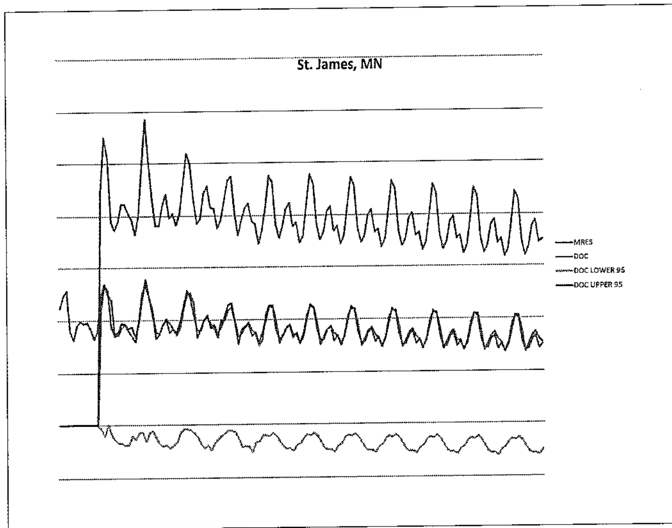
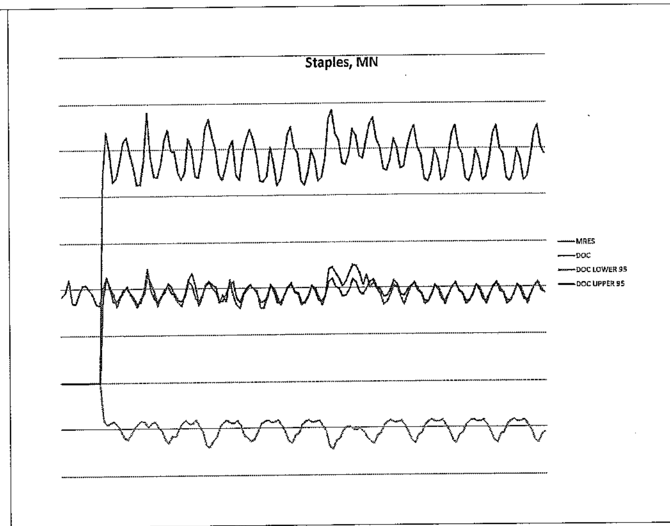
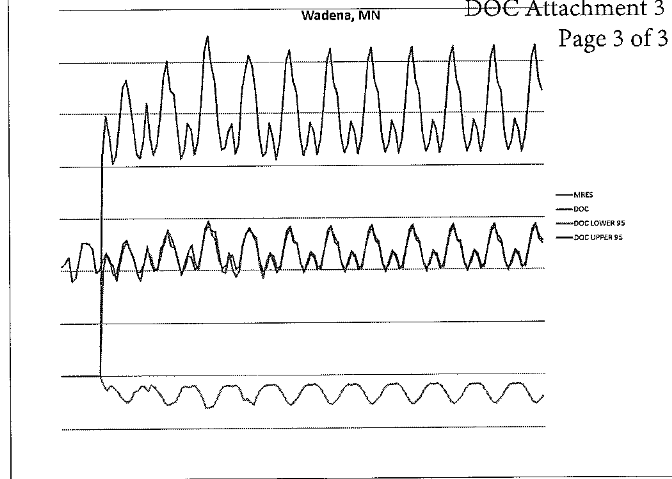
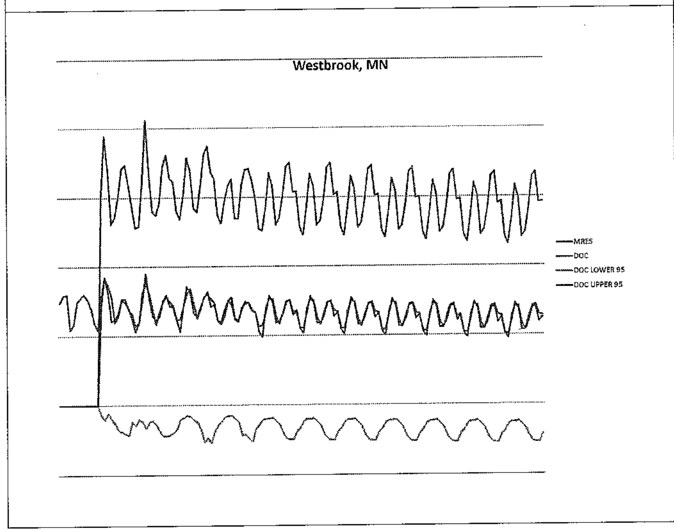
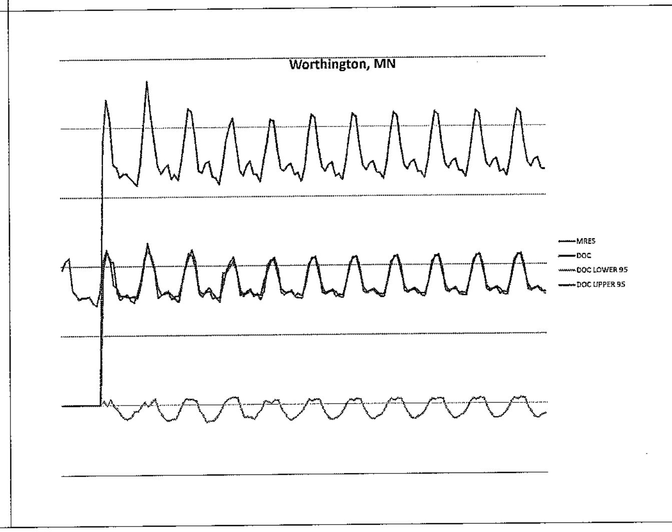

Sauk Centre, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95

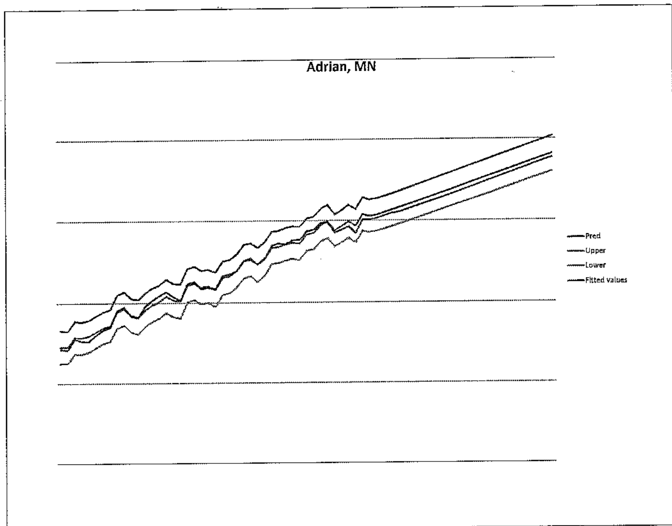

St. James, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95

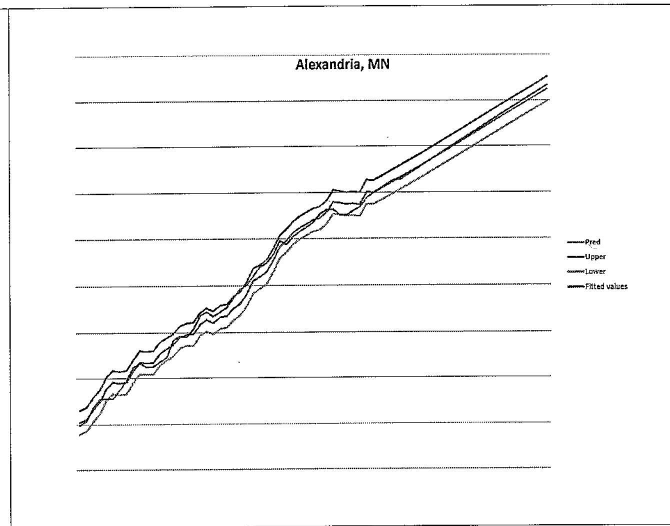

Staples, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95

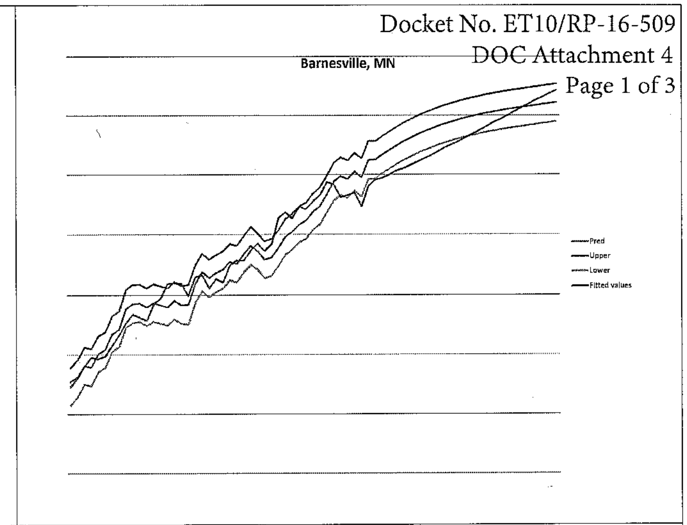

Wadena, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95

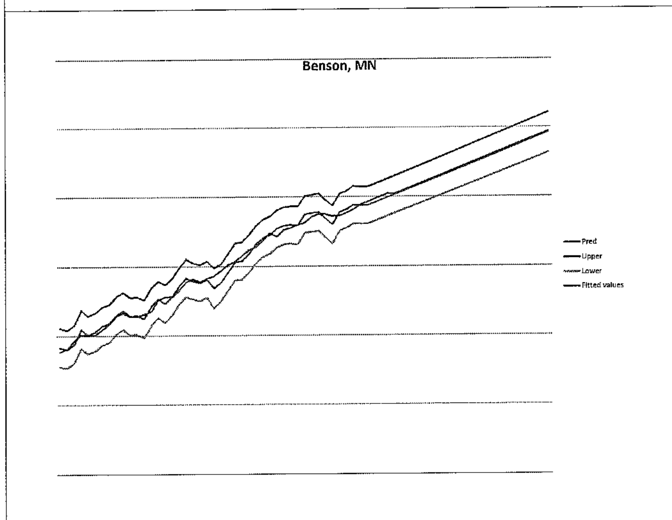

Westbrook, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95

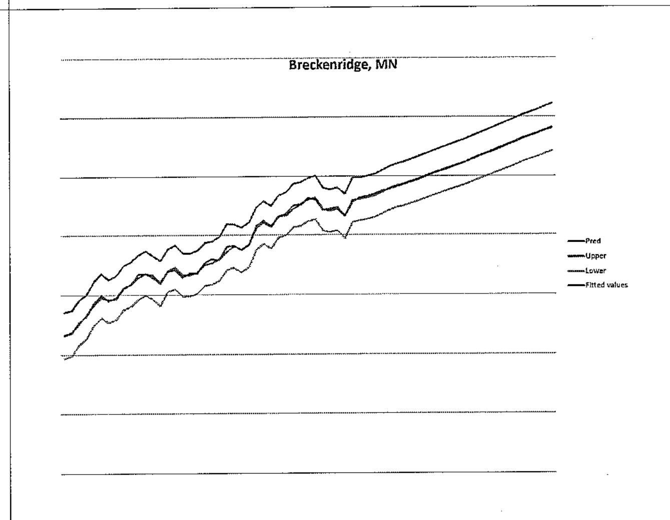

Worthington, MN
MRES
DOC
DOC LOWER 95
DOC UPPER 95

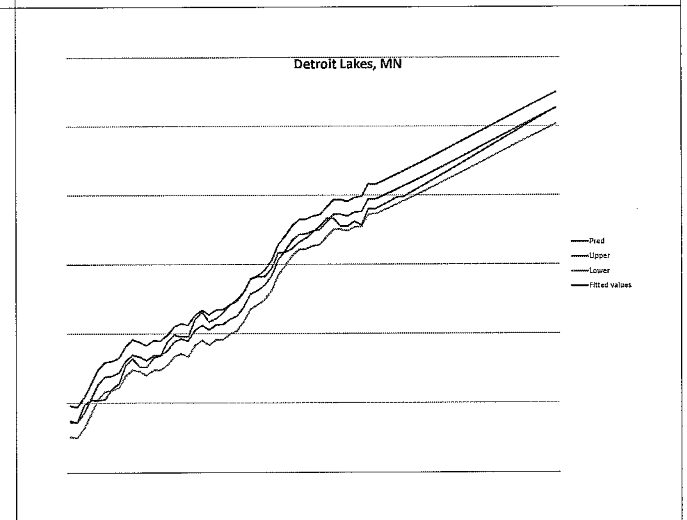

Adrian, MN
Pred
Upper
Lower
Fitted values

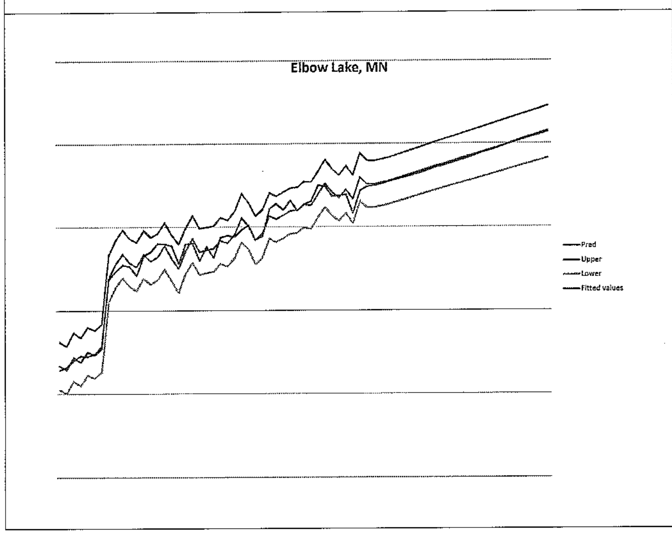

Alexandria, MN
Pred
Upper
Lower
Fitted values

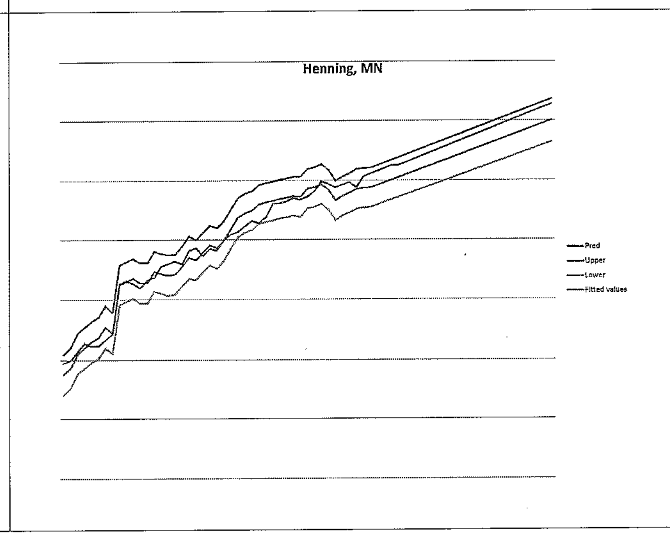

Barnesville, MN
Pred
Upper
Lower
Fitted values

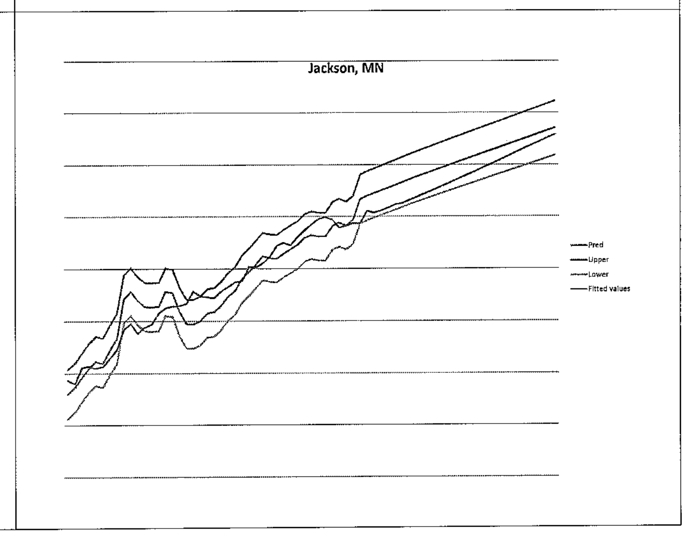

Benson, MN
Pred
Upper
Lower
Fitted values

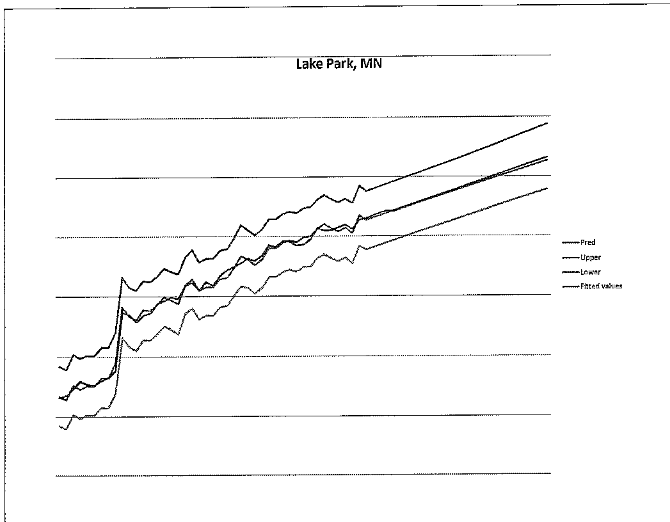

Breckenridge, MN
Pred
Upper
Lower
Fitted values

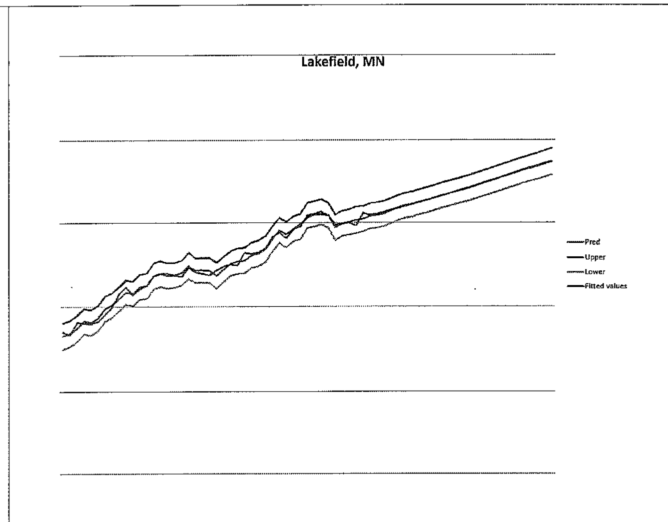

Detroit Lakes, MN
Pred
Upper
Lower
Fitted values

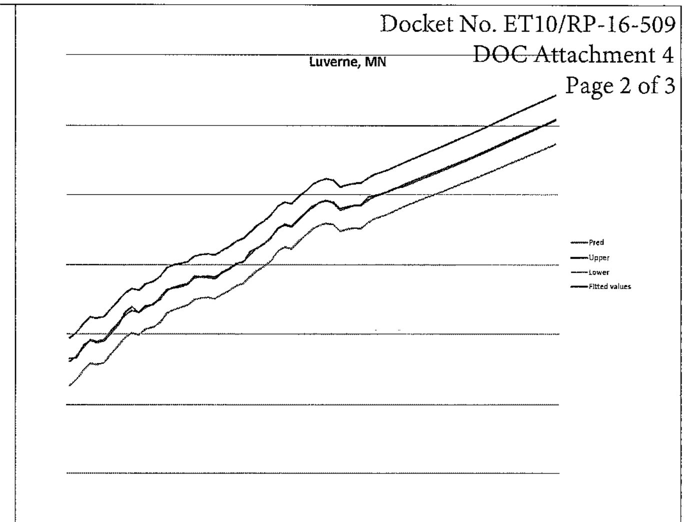

Elbow Lake, MN
Pred
Upper
Lower
Fitted values

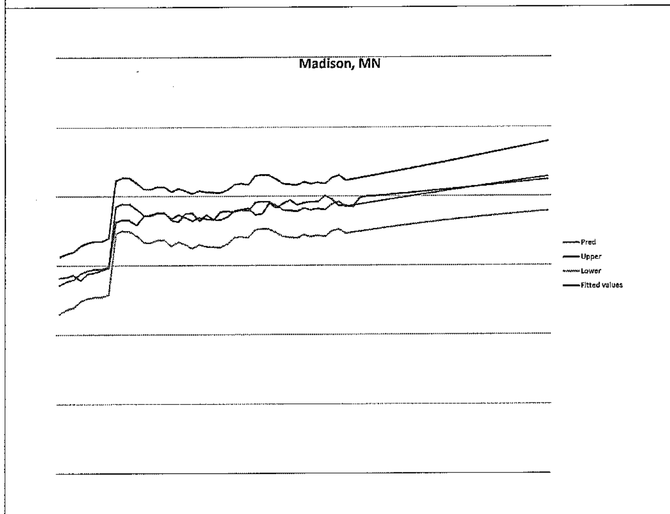

Henning, MN
Pred
Upper
Lower
Fitted values

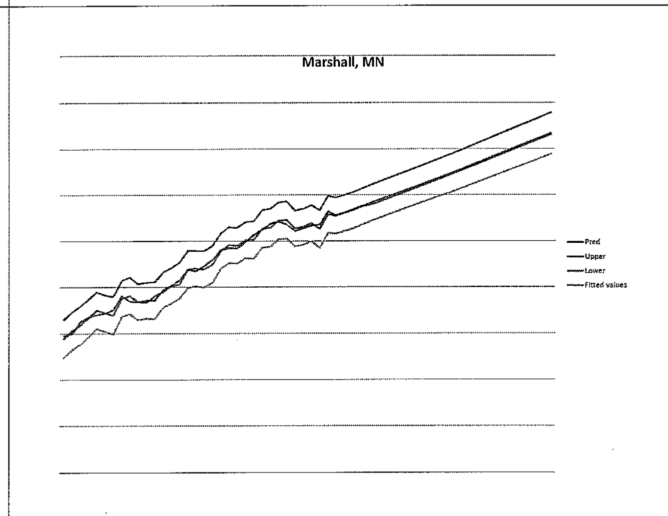

Jackson, MN
Pred
Upper
Lower
Fitted values

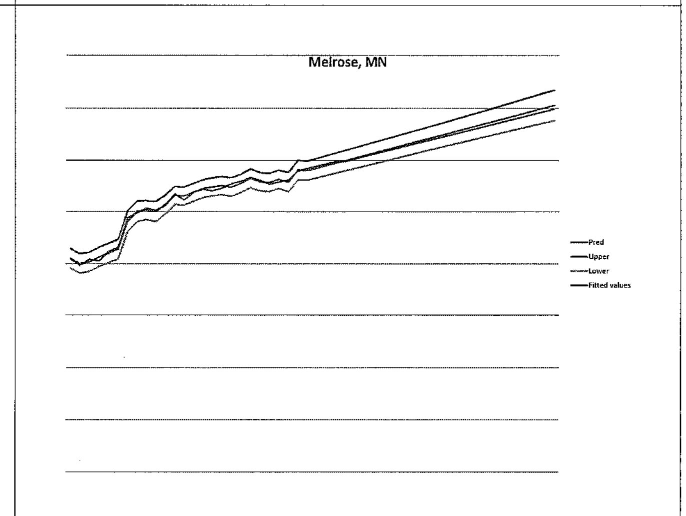

Lake Park, MN
Pred
Upper
Lower
Fitted values

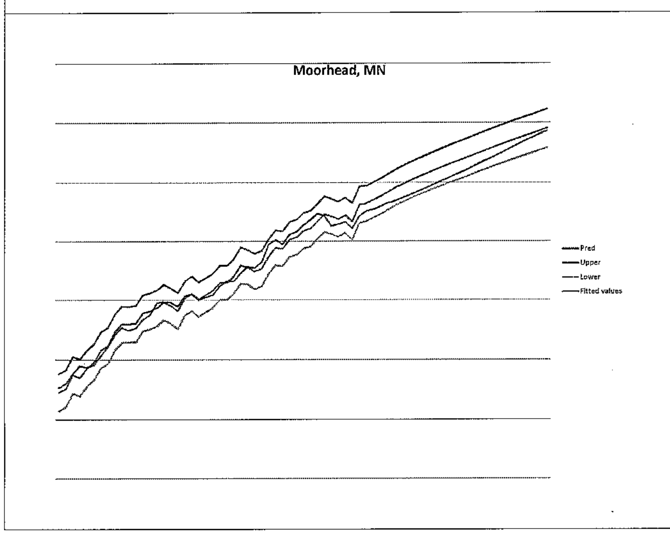

Lakefield, MN
Pred
Upper
Lower
Fitted values

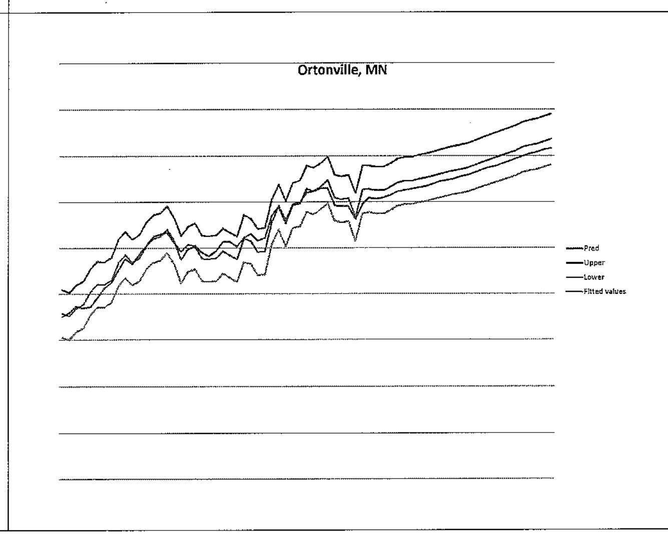

Luverne, MN
Pred
Upper
Lower
Fitted values

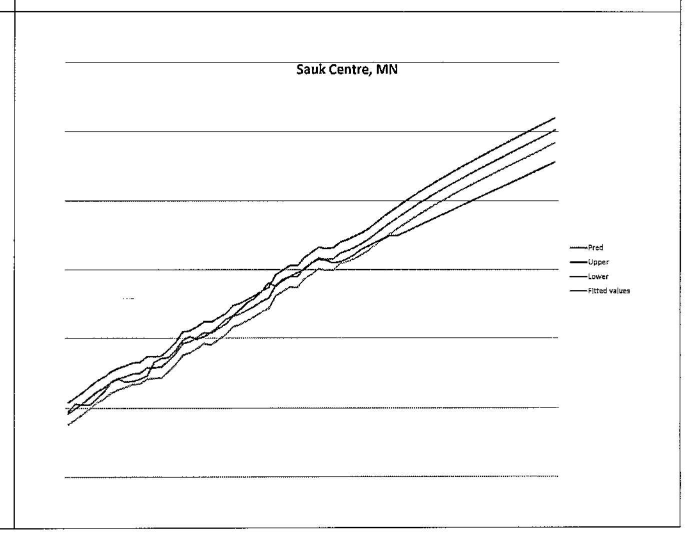

Madison, MN
Pred
Upper
Lower
Fitted values

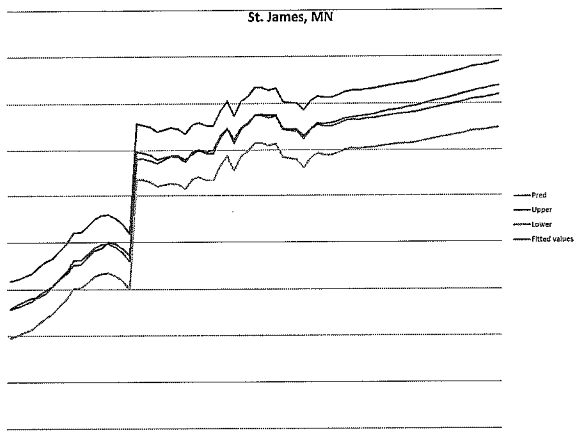

Marshall, MN
Pred
Upper
Lower
Fitted values

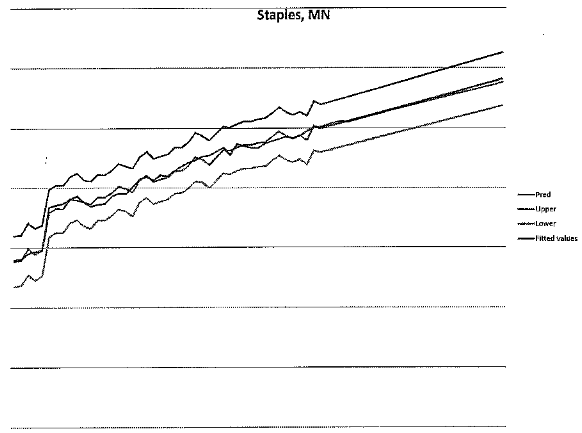

Melrose, MN
Pred
Upper
Lower
Fitted values

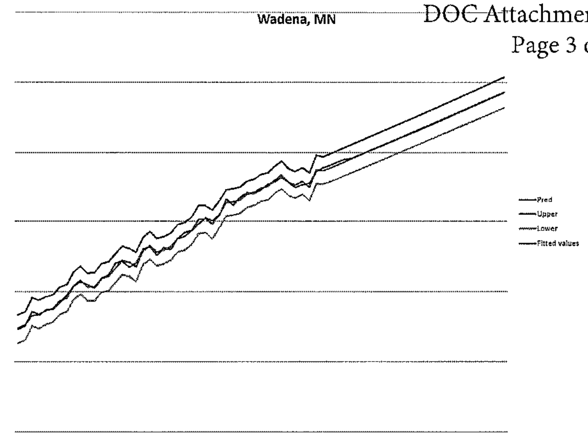

Moorhead, MN
Pred
Upper
Lower
Fitted values

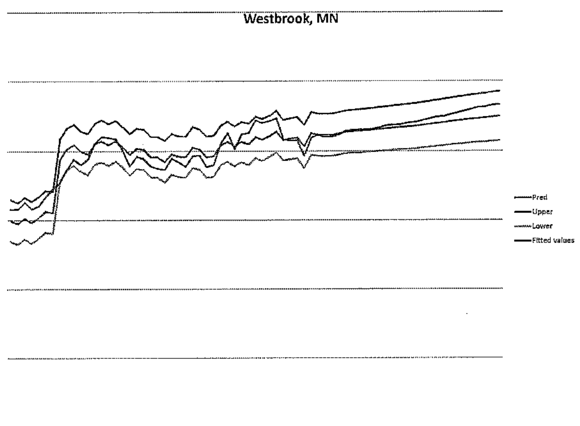

Ortonville, MN
Pred
Upper
Lower
Fitted values

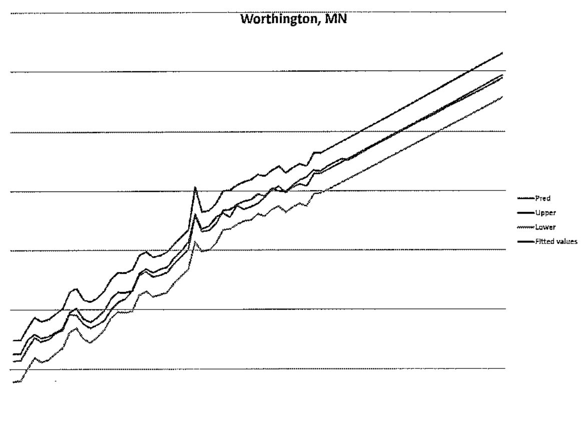

Sauk Centre, MN
Pred
Upper
Lower
Fitted values


St. James, MN
Pred
Upper
Lower
Fitted values


Staples, MN
Pred
Upper
Lower
Fitted values


Wadena, MN
Pred
Upper
Lower
Fitted values


Westbrook, MN
Pred
Upper
Lower
Fitted values


Worthington, MN
Pred
Upper
Lower
Fitted values

Response of Missouri River Energy Services
To
Minnesota Department of Commerce
Division of Energy Resources
Information Request No. 15

Docket Number: ET10/RP-16-509 Date of Request: November 16, 2016

Information requested by: Christopher T. Davis

Author: Eric D. Carl Response Due: November 28, 2016

Author's Title: Resource Planner

Author's Telephone No.: 605-330-4889

Information Request 15

Minnesota Statutes 216H.02, Subdivision 1 states:

> **It is the goal of the state to reduce statewide greenhouse gas emissions across all sectors producing those emissions to a level at least 15 percent below 2005 levels by 2015, to a level at least 30 percent below 2005 levels by 2025, and to a level at least 80 percent below 2005 levels by 2050. The levels shall be reviewed based on the climate change action plan study.**

On August 5, 2013, the Commission issued a Notice of Information in Future Resource Plan Filings (Commission's Letter). The Commission Letter states, in part:

> **PLEASE TAKE NOTICE that the Commission expects utilities to include in their resource plans filed after August 1, 2013 an explanation of how the resource plan helps the utility achieve the greenhouse gas reduction goals, renewable energy standard, and solar energy standard as listed in the above-referenced legislation. Parties should also be prepared to discuss the matter in comments.**

Please provide a quantitative analysis of changes in MRES's greenhouse gas emissions since 2005 and show how MRES's proposed resource plan will help the G&T achieve Minnesota's greenhouse gas reduction goals.

Response to Information Request 15

Tables 1 and 2 below demonstrate the ability of MRES to achieve the greenhouse gas reduction goals for the MRES system under Minnesota Statutes § 216H.02 for both the MRES Base Case and Expected Conservation Case scenarios. Significant load additions in the last ten years have caused an increase in the whole tonnage amount of CO_2 emitted system wide for MRES. However, MRES CO_2 emission rates have steadily declined since 2005. The MRES energy portfolio has become more diverse over the past decade with the addition of wind generation and a power purchase agreement for nuclear generation. The addition of the Red Rock Hydroelectric Project in 2019 will also add to the MRES renewable energy portfolio. Furthermore, these estimates do not include the Pierre Solar Project, a 1 MW solar project that began commercial operation on September 30, 2016. MRES purchases all of the output of this solar project. While the solar project is small in scope it will help MRES achieve further CO_2 rate reductions. MRES assumed the CO_2 output from market energy purchases to be the regional average of 1,547 lbs./MWh (based on the eGRID2010 MRO regional average emissions rate). Market energy sales were not removed from generation even though they were not used to serve MRES members' energy needs.

Table 1
Base Case
CO_2 Emissions and CO_2 Reduction Amounts

Year	CO_2 Tons	CO_2 lbs./MWh	lbs./MWh Reduction Since 2005	Reduction Goal
2005	2,705,994	3,086.2		
2014	3,233,442	2,501.2	19%	
2015	2,716,699	2,146.2	30%	15%
2016	3,339,865	2,440.1	21%	15%
2017	3,567,068	2,399.9	22%	15%
2018	3,274,104	2,194.7	29%	15%
2019	3,078,138	2,060.7	33%	15%
2020	2,957,676	1,983.3	36%	15%
2021	2,810,813	1,866.3	40%	15%
2022	2,885,352	1,913.1	38%	15%
2023	2,919,043	1,931.8	37%	15%
2024	2,778,819	1,837.4	40%	15%
2025	2,910,760	1,917.7	38%	30%
2026	2,928,648	1,920.7	38%	30%
2027	2,789,251	1,826.0	41%	30%
2028	2,951,512	1,924.9	38%	30%
2029	2,963,643	1,917.4	38%	30%
2030	2,835,412	1,822.3	41%	30%
2031	3,117,391	1,974.5	36%	30%

Table 2 Expected Conservation Case CO_2 Emissions and CO_2 Reduction Amounts				
Year	**CO_2 Tons**	**CO_2 lbs./MWh**	**lbs./MWh Reduction Since 2005**	**Reduction Goal**
2005	2,705,994	3,086.2		
2014	3,221,836	2,492.2	19%	
2015	2,716,393	2,132.0	31%	15%
2016	3,348,970	2,419.9	22%	15%
2017	3,584,944	2,376.8	23%	15%
2018	3,300,949	2,170.3	30%	15%
2019	3,119,501	2,038.6	34%	15%
2020	2,992,959	1,948.8	37%	15%
2021	2,854,403	1,831.5	41%	15%
2022	2,950,026	1,880.7	39%	15%
2023	2,999,095	1,898.7	38%	15%
2024	2,871,484	1,807.4	41%	15%
2025	2,995,995	1,869.9	39%	30%
2026	3,013,656	1,863.5	40%	30%
2027	2,886,778	1,773.4	43%	30%
2028	3,040,488	1,845.8	40%	30%
2029	3,055,751	1,826.3	41%	30%
2030	2,946,480	1,736.2	44%	30%
2031	3,232,042	1,864.6	40%	30%

Response of Missouri River Energy Services
To
Minnesota Department of Commerce
Division of Energy Resources
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Information Request 16

Section 6.6 of MRES's IRP includes a narrative describing the G&T's short- and long-term action plans. Please provide a table(s) that shows by year, when MRES plans to procure the resource, including combustion turbines and wind to comply with Renewable Energy Standards. In the table, please indicate whether the resources are for the SPP or MISO region.

Response to Information Request 16

The tables below show projected MRES resource additions by year for the SPP and MISO regions under both the MRES Base Case and Expected Conservation Case scenarios.

Table 1-1
Base Case - MISO

Year	Type	Nameplate (MW)	Accredited (MW)
2017	One Year Capacity Purchase	59.0	59.0
2018	One Year Capacity Purchase	58.0	58.0
2019	One Year Capacity Purchase	69.0	69.0
2020	One Year Capacity Purchase	66.0	66.0
2021	One Year Capacity Purchase	64.0	64.0
2022	Natural Gas Combustion Turbine	167.6	167.6

Table 1-2
Base Case - SPP

Year	Type	Nameplate (MW)	Accredited (MW)
2020	Wind	10.0	1.5

Table 2-1 **Expected Conservation Case - MISO**			
Year	Type	Nameplate (MW)	Accredited (MW)
2017	One Year Capacity Purchase	67.0	67.0
2018	One Year Capacity Purchase	68.0	68.0
2019	One Year Capacity Purchase	82.0	82.0
2020	One Year Capacity Purchase	82.0	82.0
2021	One Year Capacity Purchase	82.0	82.0
2022	Natural Gas Combustion Turbine	251.4	251.4
2025	Wind	10.0	1.5
2028	Wind	10.0	1.5

Table 2-2 **Expected Conservation Case - SPP**			
Year	Type	Nameplate (MW)	Accredited (MW)
2020	Wind	10.0	1.5
2028	Wind	10.0	1.5

CERTIFICATE OF SERVICE

I, Sharon Ferguson, hereby certify that I have this day, served copies of the following document on the attached list of persons by electronic filing, certified mail, e-mail, or by depositing a true and correct copy thereof properly enveloped with postage paid in the United States Mail at St. Paul, Minnesota.

Minnesota Department of Commerce
Comments

Docket No. ET10/Rp-16-509

Dated this 1st day of December 2016

/s/Sharon Ferguson

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