NorthWestern Energy
Delivering a Bright Future

April 20, 2016

Mr. Will Rosquist
Administrator, Regulatory Division
Montana Public Service Commission
1701 Prospect Ave.
P. O. Box 202601
Helena MT 59620-2601

RE: Docket D2015.8.64 – Greycliff Petition
PSC Set 5 Data Requests (047-055)

Dear Mr. Rosquist:

Enclosed for filing is one copy of NorthWestern Energy's responses to the PSC Set 5 Data Requests (047-055).

The responses will be hand delivered to the PSC and MCC, e-filed with the PSC, emailed to counsel of record and mailed to the service list.

If you have any questions, please call Joe Schwartzenberger at (406) 497-3362.

Sincerely,

Tracy Lowney Killoy

Tracy Lowney Killoy
Administrative Assistant
Regulatory Affairs

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of NorthWestern Energy's responses to PSC Set 5 Data Requests (047-055) in Docket No. D2015.8.64 has been hand delivered to the Montana Public Service Commission and the Montana Consumer Counsel this date. It has also been e-filed on the PSC website, emailed to counsel of record, and mailed to the remainder of the service list as follows:

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Date: April 20, 2016

Tracy Lowney Killoy

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NorthWestern Energy
Docket No. D2015.8.64
Greycliff's Petition to Set Terms and Conditions

Public Service Commission (PSC)
Set 5 (047-055)

Data Requests received April 8, 2016

PSC-047 RE: Electronic Files
Witnesses: LaFave, Hansen

To the extent not already provided in the update to PSC-012(a), please provide Excel-readable files of all exhibits, supporting files, and inputs to PowerSimm.

RESPONSE:

See the "PSC-047" folder on the attached CD. The file labeled "PSC-047" is an updated revised version of page 1 of Exhibit__(LPH-1)_rev. NorthWestern corrected the formula that calculated the energy price for Greycliff's production without carbon. When the portfolio is long energy and the variable cost of CU4 is less than the market price, the excess sales are valued at the variable cost of CU4, and when the variable cost of CU4 is greater than the market price, the excess energy sales are valued at the market price. The original version of Exhibit__(LPH-1)_rev inadvertently valued excess energy sales at zero when the portfolio was long energy and the variable cost of CU4 was greater than the market price.

Please note that the files labeled "PSC-047 Forward Curves" and "PSC-047 PowerSimm Output" contain copyright-protected information. NorthWestern is relying on the "fair use" exemption of federal copyright law to provide this information for purposes of this docket only. No copies should be made, nor should the parties receiving this information use the copyrighted material for any purposes other than for this docket.

NorthWestern Energy
Docket No. D2015.8.64
Greycliff's Petition to Set Terms and Conditions

Public Service Commission (PSC)
Set 5 (047-055)

Data Requests received April 8, 2016

PSC-048 RE: Interconnection Network Upgrades
Witness: LaFave

Please explain the effect of assuming a 5% contribution of capacity value on the cost of Interconnection Network Upgrades in Exhibit__(BJL-1).

RESPONSE:

The assumption of the 5% contribution of capacity value is not in any way tied to or connected with the cost of Interconnection Network Upgrades. My Prefiled Supplemental Response Testimony and my Prefiled Revised Supplemental Response Testimony pages BJL-4 and 5 detail the customer expense of the reimbursed network upgrades and the additional value for capacity, respectively. The details and supporting calculations are identified in Exhibit__(BJL-1) on their respective tabs.

NorthWestern Energy
Docket No. D2015.8.64
Greycliff's Petition to Set Terms and Conditions

Public Service Commission (PSC)
Set 5 (047-055)

Data Requests received April 8, 2016

PSC-049 RE: Thermal Asset Variable O&M and Fuel Prices
Witness: Hansen, parts a, b, d, e / LaFave, part c

At 3:7-10 you describe changes to levelized variable O&M and fuel prices at CU4.

a. Please provide Excel readable files of all price strips used to verify these conclusions.

b. Please describe and explain the methods used to forecast these price strips, and reference all other sources that you relied upon.

c. If not addressed previously, please explain the cause of these changes in detail.

d. Please describe the method used to estimate emissions costs for CU4 under carbon cost assumptions.

e. Please describe the method used to estimate emissions costs for natural gas generators modeled in NorthWestern's 2015 Electricity Supply Resource Procurement Plan (2015 Plan).

RESPONSE:

a. See the "PSC-049" folder on the CD attached to Data Request PSC-047.

b. The natural gas and electric forecasts are a combination of current market prices and long-term price escalation factors. The near-term prices are obtained from Intercontinental Exchange ("ICE") and Natural Gas Exchange ("NGX"). These sources are used to compose forward price curves from January 2018 until July 2020 and then escalated through the remainder of the forecast at the average escalation rate from the Energy Information Administration ("EIA") 2015 Annual Energy Outlook nominal Henry Hub gas price projection.

The Colstrip price forecast uses estimated prices from 2018 through 2021. After 2021, the coal price is escalated throughout the remainder of the planning horizon using the 20-year average inflation escalation for Gross Domestic Product ("GDP") as provided by the U.S. Bureau of Economic Analysis ("BEA").

c. Please see the Prefiled Revised Supplemental Response Testimony of Bleau J. LaFave.

PSC-049 cont'd

d. NorthWestern input Colstrip's estimated carbon emissions rate into PowerSimm. During simulation, Colstrip is economically dispatched to the market price and the resulting carbon emissions are determined. The carbon emissions costs are the simulated carbon emissions multiplied by the simulated carbon price.

e. NorthWestern input the natural gas-fired generator's estimated carbon emissions rate into PowerSimm. During simulation, the natural gas-fired generators are economically dispatched to the market price and the resulting carbon emissions are determined. The carbon emissions costs are the simulated carbon emissions multiplied by the simulated carbon price.

NorthWestern Energy
Docket No. D2015.8.64
Greycliff's Petition to Set Terms and Conditions

Public Service Commission (PSC)
Set 5 (047-055)

Data Requests received April 8, 2016

PSC-050 RE: Natural Gas and Electricity Price Forecasts
Witness: Hansen

a. Please confirm that the PowerSimm natural gas and electricity price forecasts used to estimate avoided costs in revised supplemental response testimony are identical to the forecasts used in the 2015 Plan. If not, please explain.

b. If not already provided, please provide Excel readable files of natural gas and electricity price forecasts used to estimate avoided costs in this instance.

c. If not already provided, please provide Excel readable files of all natural gas and electricity price forecasts shown in the 2015 Plan, Vol. 1, Ch. 4.

RESPONSE:

a. The natural gas and electricity price forecasts used in the revised supplemental response testimony are not identical to the forecasts used in the 2015 Plan. The forecasts used in the response testimony were taken from the market close on January 15, 2016 and the 2015 Plan forecasts were taken from the market close on December 9, 2015.

b. See the "PSC-047 Forward Curves" file provided in response to Data Request PSC-047.

c. See the "PSC-050" folder on the CD attached to Data Request PSC-047. Please note that this folder contains copyright protected information. NorthWestern is relying on the "fair use" exemption of federal copyright law to provide this information for purposes of this docket only. No copies should be made, nor should the parties receiving this information use the copyrighted material for any purposes other than for this docket.

NorthWestern Energy
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Public Service Commission (PSC)
Set 5 (047-055)

Data Requests received April 8, 2016

PSC-051 RE: Avoided Cost Methodology
Witness: Hansen

a. Please confirm that your method in this case uses the variable cost at CU4 to estimate avoided cost when NorthWestern supply is long and the market price is above CU4 variable cost, and uses the market price to estimate avoided cost when supply is long and market is below CU4 variable cost. If not, please explain.

b. Please calculate avoided cost using CU4 variable cost in all cases to estimate avoided cost when supply is long.

c. Please calculate avoided cost using the market price in all cases to estimate avoided cost when supply is long.

RESPONSE:

a. Confirmed.

b. The avoided cost using CU4 variable cost without carbon is $24.36 and the avoided cost including carbon and environmental attributes is $36.68. The change in the avoided cost is due to the change in the energy rate from my Prefiled Supplemental Response Testimony and the calculation requested for this data request. The table below details the variance.

Scenarios	Energy Rate - Response Testimony	Energy Rate - 51b	Variance
Without Carbon	$ 31.49	$ 31.61	$ 0.12
With Carbon and Environmental Attributes	$ 43.28	$ 43.93	$ 0.65

c. The avoided cost using the market price for all excess sales is $27.85 without carbon and $37.78 including carbon and environmental attributes. The change in the avoided cost is due to the change in the energy rate from my Prefiled Supplemental Response Testimony and the calculation requested for this data request. The table below details the variance.

	Energy Rate - Response Testimony	Energy Rate - 51c	Variance
Without Carbon	$ 31.49	$ 35.10	$ 3.61
With Carbon and Environmental Attributes	$ 43.28	$ 45.03	$ 1.75

NorthWestern Energy
Docket No. D2015.8.64
Greycliff's Petition to Set Terms and Conditions

Public Service Commission (PSC)
Set 5 (047-055)

Data Requests received April 8, 2016

PSC-052 RE: PowerSimm Modeling and Avoidable Resources
Witness: Hansen

a. Please confirm that the PowerSimm model used to estimate avoided costs in this case uses NorthWestern's current portfolio of resources for the base run rather than the "Economically Optimal Portfolio" (EOP) described in the 2015 Plan, Vol. 1, Ch. 12.

b. Please estimate the avoided cost of the Greycliff resource using the EOP as the base case, under each of the following alternative assumption sets:

   i.) The avoidable resource when supply is long is the curtailable resource with highest variable cost,

   ii.) The avoidable resource when supply is long is the market, and

   iii.) The avoidable resource when supply is long and the highest cost curtailable resource is less than market is the curtailable resource, while the avoidable resource when supply is long and the highest cost curtailable resource is greater than market is the market.

RESPONSE:

a. Confirmed. The PowerSimm model used the current portfolio of resources for this analysis rather than the "Economically Optimal Portfolio" (EOP) as described in the 2015 Plan due to the fact that the current portfolio of resources (with the hydroelectric assets) was the preferred portfolio from the 2013 Plan. This was the most current preferred portfolio as the 2015 Plan had not been filed.

b. Per the Notice of Staff Action issued April 18, NorthWestern will respond to this subpart on April 27.

NorthWestern Energy
Docket No. D2015.8.64
Greycliff's Petition to Set Terms and Conditions

Public Service Commission (PSC)
Set 5 (047-055)

Data Requests received April 8, 2016

PSC-053 RE: Blended Market - CCCT Model
Witness: John Bushnell

Please estimate avoided costs using the blended market – CCCT model approved in Docket No. 2012.1.3, Final Order 7199d, under the following assumptions:

a. A 348 MW GE 7FA.05 ACC turbine installed in 2025 as described in the 2015 Plan;

b. Natural gas and electricity price forecasts identical to those used to develop your revised supplemental response testimony; and

c. Two calculations – with and without environmental attributes.

RESPONSE:

The requested estimates of avoided cost using the CCCT model approved in Docket No. D2012.1.3 are provided as Attachments 1 and 2. The estimates are as follows:

- Carbon not included in price forecast:
  - Off-Peak Wind Rate: $0.02999/MWh
  - On-Peak Wind Rate: $0.03807/MWh
  - Annual Average Wind Rate: $0.03187/MWh

- Carbon included in price forecast:
  - Off-Peak Wind Rate: $0.03217/MWh
  - On-Peak Wind Rate: $0.04025/MWh
  - Annual Average Wind Rate: $0.03405/MWh

These estimates of avoided costs do not account for any related ancillary services or network interconnection costs.

Blended Market-Combined Cycle Plant Approach
Carbon Costs Not Included

	Year	Annual Capital ($/Kw-yr)	Fixed O&M 2.0% ($/kW-yr)	Total fixed ($/kW-yr)	Variable O&M 2.0% ($/kWh)	Natural Gas Cost Forecast ($/MMBtu)	Fuel Cost 6.528 ($/kWh)	Market Price ($/kWh)	Total Cost ($/kWh)
1	**2018**							0.02175	0.02175
2	**2019**							0.02314	0.02314
3	**2020**							0.02468	0.02468
4	**2021**							0.02583	0.02583
5	**2022**							0.02703	0.02703
6	**2023**							0.02828	0.02828
7	**2024**							0.02957	0.02957
8	**2025**	172.43	$11.89	184.32	0.00305	3.72	0.02431		0.05074
9	**2026**	172.43	12.12	184.56	0.00311	3.86	0.02518		0.05170
10	**2027**	172.43	12.37	184.80	0.00317	4.00	0.02608		0.05269
11	**2028**	172.43	12.61	185.05	0.00323	4.14	0.02702		0.05373
12	**2029**	172.43	12.86	185.30	0.00330	4.29	0.02800		0.05480
13	**2030**	172.43	13.12	185.56	0.00336	4.45	0.02902		0.05592
14	**2031**	172.43	13.38	185.82	0.00343	4.61	0.03008		0.05708
15	**2032**	172.43	13.65	186.09	0.00350	4.78	0.03119		0.05829
16	**2033**	172.43	13.93	186.36	0.00357	4.95	0.03234		0.05955
17	**2034**	172.43	14.20	186.64	0.00364	5.14	0.03354		0.06086
18	**2035**	172.43	14.49	186.92	0.00371	5.33	0.03479		0.06222
19	**2036**	172.43	14.78	187.21	0.00379	5.53	0.03609		0.06363
20	**2037**	172.43	15.07	187.51	0.00386	5.74	0.03745		0.06510
21	**2038**	172.43	15.37	187.81	0.00394	5.95	0.03886		0.06663
22	**2039**	172.43	15.68	188.12	0.00402	6.18	0.04033		0.06821
23	**2040**	172.43	16.00	188.43	0.00410	6.41	0.04186		0.06987
24	**2041**	172.43	16.32	188.75	0.00418	6.66	0.04346		0.07158
25	**2042**	172.43	16.64	189.08	0.00427	6.91	0.04512		0.07337
								2018-2042 24-year levelized cost:	0.04389

2015 RPP Inflation:	2.0%
2015 RPP ICC:	7.03%
On-Peak hours/year:	2038
Wind capacity value:	5%

Updated D2015.8.64 Avoided costs:

Option 1(a): Long-term non-wind (19 mo. - 25 year contracts)
Off-Peak Rate: $0.02999 $/kWh
On Peak Rate: $0.08975 $/kWh

Option 1(c): Long-term wind (19 mo. - 25 year contracts)
Off-Peak Rate: $0.02999
On Peak Rate: $0.03807

Blended Market-Combined Cycle Plant Approach
Carbon Costs Included

	Year	Annual Capital	Fixed O&M 2.0%	Total fixed	Variable O&M 2.0%	Natural Gas Cost Forecast	Fuel Cost 6.528	Market Price	Total Cost
		($/Kw-yr)	($/kW-yr)	($/kW-yr)	($/kWh)	($/MMBtu)	($/kWh)	($/kWh)	($/kWh)
1	2018							0.02175	0.02175
2	2019							0.02314	0.02314
3	2020							0.02468	0.02468
4	2021							0.02583	0.02583
5	2022							0.03903	0.03903
6	2023							0.04077	0.04077
7	2024							0.04259	0.04259
8	2025	172.43	$11.89	184.32	0.00305	3.72	0.02431		0.05074
9	2026	172.43	12.12	184.56	0.00311	3.86	0.02518		0.05170
10	2027	172.43	12.37	184.80	0.00317	4.00	0.02608		0.05269
11	2028	172.43	12.61	185.05	0.00323	4.14	0.02702		0.05373
12	2029	172.43	12.86	185.30	0.00330	4.29	0.02800		0.05480
13	2030	172.43	13.12	185.56	0.00336	4.45	0.02902		0.05592
14	2031	172.43	13.38	185.82	0.00343	4.61	0.03008		0.05708
15	2032	172.43	13.65	186.09	0.00350	4.78	0.03119		0.05829
16	2033	172.43	13.93	186.36	0.00357	4.95	0.03234		0.05955
17	2034	172.43	14.20	186.64	0.00364	5.14	0.03354		0.06086
18	2035	172.43	14.49	186.92	0.00371	5.33	0.03479		0.06222
19	2036	172.43	14.78	187.21	0.00379	5.53	0.03609		0.06363
20	2037	172.43	15.07	187.51	0.00386	5.74	0.03745		0.06510
21	2038	172.43	15.37	187.81	0.00394	5.95	0.03886		0.06663
22	2039	172.43	15.68	188.12	0.00402	6.18	0.04033		0.06821
23	2040	172.43	16.00	188.43	0.00410	6.41	0.04186		0.06987
24	2041	172.43	16.32	188.75	0.00418	6.66	0.04346		0.07158
25	2042	172.43	16.64	189.08	0.00427	6.91	0.04512		0.07337
								2018-2042 24-year levelized cost:	0.04607

2015 RPP Inflation:	2.0%
2015 RPP ICC:	7.03%
On-Peak hours/year:	2038
Wind capacity value:	5%

Updated D2015.8.64 Avoided costs:

Option 1(a): Long-term non-wind (19 mo. - 25 year contracts)
Off-Peak Rate: $0.03217 $/kWh
On Peak Rate: $0.09193 $/kWh

Option 1(c): Long-term wind (19 mo. - 25 year contracts)
Off-Peak Rate: $0.03217
On Peak Rate: $0.04025

NorthWestern Energy
Docket No. D2015.8.64
Greycliff's Petition to Set Terms and Conditions

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Set 5 (047-055)

Data Requests received April 8, 2016

PSC-054 RE: Valuing Intermittency
Witness: LaFave

a. Your avoided cost includes a deduction of $1.99/MWh that apparently represents the levelized value of real-time market discounts from day-ahead, divided by expected annual Greycliff production. Does this day-ahead premium represent the value that customers receive in securing firm delivery contracts a day prior to expected need? If not, why else would a rational utility buy premium priced day-ahead power?

b. Given that NorthWestern's customers are in general not expected to commit to using a specific volume of power on a day-ahead basis, why should they receive a premium associated with firm, day-ahead contracts?

c. Avoided costs for wind power generally include price deductions related to intermittent production, in the form of higher regulation costs and lower capacity payments relative to thermal units. Please explain the origin of any additional costs that NorthWestern would incur through purchasing intermittent power from Greycliff.

d. In your experience, do either day-ahead or real-time markets differentiate electricity products by source of generation?

RESPONSE:

a. Yes.

b. Customer load is forecasted at different intervals including day-ahead forecast. Service of that load, possibly including day-ahead purchases, is arranged to ensure that power is available. Large amounts of power may not be available or capable to serve load in the real-time market after other parties have settled in the day-ahead market. The "premium" is the capacity and guarantee of delivery of the energy purchased to reliably serve the load. A wind facility is not able to deliver energy and capacity on a similar firm basis and the $1.99/MWh deduction is designed to reflect the lower quality product when compared to market, or any other non-intermittent resource. Also see the response to part c below.

c. As identified in Exhibit__(BJL-1)_rev_2, customers will see an increase in regulation costs. There are also increased costs for ramping up and down dispatchable resources to make up for the shortfalls and over-deliveries. In addition, these dispatchable assets need to be available for this ramping up or down; they are set aside for this service, meaning they are not available for economic dispatch. The day-ahead vs. real-time and the supplemental services charges are an attempt to simulate the charges required to firm the intermediate resource similar to the capacity reductions in the previous dockets.

PSC-054 cont'd

d. Not specifically, but in practice, yes, as described in the response to Data Request PSC-014 and above in the response to part c. These additional costs do not exist or are minimal for dispatchable resources. In many cases, dispatchable resources can create value in these areas.

NorthWestern Energy
Docket No. D2015.8.64
Greycliff's Petition to Set Terms and Conditions

Public Service Commission (PSC)
Set 5 (047-055)

Data Requests received April 8, 2016

PSC-055 RE: Valuing Intermittency
Witness: LaFave

a. In your experience, are utility projections of day-ahead customer loads and utility supply resources, including wind resources, biased to protect the utility from the additional costs mentioned in your response to DR PSC-014(a)? If possible, provide data to support your response.

b. Please describe the additional costs mentioned in DR PSC-014(a). Are these costs sufficient (on average) to exceed the discount associated with real-time purchases?

c. Please consider this model: First assume that NorthWestern sets its schedule in the day-ahead markets based upon unbiased projections of customer load and available supply resources, including Greycliff. Next assume that all projections of customer load and supply resources excepting Greycliff are exactly correct in real-time. Then deviations of Greycliff from projection should net to zero in the long run, implying that real-time purchases and sales to meet load would net to zero in the long run, and therefore that Greycliff would impose no additional "real-time" related costs on the utility relative to its dispatchable resources. Do you confirm or deny this analysis? Please provide sufficient explanation to support your conclusion

RESPONSE:

a. There is no bias by the utility. The utility attempts to forecast for accuracy. The more accurate, the better for NorthWestern customers.

b. See the response to Data Request PSC-054c.

c. Deny. See also the response to part a, above. Because wind is weather dependent, when a plant delivers more energy than its forecast, it is very likely that other regional facilities will also be long. Being long power from the day-ahead plan can put the portfolio in a sell position at low prices. When the plant delivers less energy than forecast, the portfolio will be in a purchase position at higher prices because there is more demand on the market. This repeated sell at low prices and purchase at high prices would impose real-time costs as compared to the ability to deliver the actual day-ahead commitment.