DIRECT TESTIMONY OF

EUGENE L. SHLATZ

ON BEHALF OF NORTHWESTERN ENERGY

TABLE OF CONTENTS

Witness Information

Q. Please identify yourself, your employer, and your job title.

A. My name is Eugene L. Shlatz. I have been employed by Green Mountain Solutions Consulting, Inc. ("GMS") since 2022. My business address is 70 South Winooski Avenue, Burlington, Vermont.

Q. On whose behalf are you testifying?

A. I am appearing on behalf of NorthWestern Corporation d/b/a NorthWestern Energy ("NorthWestern").

Q. Please summarize your education and experience.

A. I have more than 40 years' experience in electric utility operations, engineering, and electric pricing. At GMS, I manage engagements for electric utility system reliability, renewable energy, and advanced energy systems. I have supported filings before federal, state, and Canadian Provincial regulatory commissions on a range of electric utility matters, including renewables integration, net metering, and retail and wholesale rates. Prior to my employment at GMS, I was employed by Guidehouse Inc. (previously Navigant Consulting, Inc.) for 23 years.

I hold Bachelor's and Master's degrees in Electric Power Engineering from Rensselaer Polytechnic Institute and am a registered Professional Engineer in Vermont, specializing in electrical engineering. I am a Life Member of the Institute of Electrical and Electronics Engineers (IEEE) and previously was a Section Chair in the State of Vermont. I have managed technical and economic studies of electric supply and reliability for municipal, cooperative, and investor-owned electric utilities throughout North America.

My experience includes evaluation of conventional and renewable energy sources, and the impact of these sources on electric reliability and cost of supply. I have testified before state utility commissions on electric reliability, renewable energy, and siting of energy delivery facilities on behalf of municipal, cooperative, and investor-owned utilities, including rate cases involving the review of capital projects proposed for inclusion in rates. I also was employed by Green Mountain Power ("Company") in various positions of increasing responsibility, including Director of Engineering and Operations, where I was responsible for the planning, design, and operation of the Company's generation, transmission, and distribution systems. My qualifications and previous appearances before regulatory agencies appear in more detail in Exhibit ELS-1.

As a matter of practice, GMS is committed to maintaining an independent and unbiased approach to its engagements.

Q. Have you previously testified before the Montana Public Service Commission ("MPSC")?

A. Yes, I testified as an expert witness on behalf of NorthWestern before the MPSC in its 2018 electric general rate review under Docket No. 2018.02.012. My testimony supported NorthWestern's proposed net metering tariff and rates.

Q. Have you previously testified before the Federal Energy Regulatory Commission ("FERC") on Transmission Open Access?

A. Yes, I prepared direct testimony and appeared as an expert witness in support of NorthWestern's 2019 Open Access Transmission Tariff ("OATT") filing before FERC in ER19-1756-000. I have also testified on behalf of Duke Energy Florida, El Paso Electric, Public Service of New Mexico, and Northern Indiana Public Service in their OATT filings before FERC.

Purpose and Summary of Testimony

Q. What is the purpose and scope of your testimony?

A. My testimony presents the results of the updated analysis I performed to determine generation reserve requirements under NorthWestern's OATT Schedules 3, 3A, and 11 for the period January 1 through December 31, 2023. The analysis I present here is an update consistent with the study presented in NorthWestern's 2019 FERC filing in ER19-1756-000 ("2019 Study"). To support the updated analysis, I also updated the Load Variability

("LV") study completed by Navigant Consulting, Inc. in 2019 that NorthWestern relied upon to support generating reserve requirements associated with these three schedules at that time. I applied the results contained in the updated LV study conducted by GMS in June 2024 to support the updated reserve requirements calculations for these three schedules. The updated LV study was prepared under my direction for NorthWestern and is provided as Exhibit ELS-2. This analysis documents the amount of generation capacity that NorthWestern must reserve for customers receiving Regulation and Frequency Response Service under Schedules 3 and 3A of NorthWestern's OATT and Flex Reserves Service under Schedule 11. Regulation and Frequency Response Service includes two ancillary rate components: (1) Fast-Moving and (2) Load Following reserves.

My testimony also describes how GMS allocated generating capacity that NorthWestern reserves for Regulation and Frequency Response Service to four wholesale customer classes, which includes Variable Energy Resource ("VER") and non-VER resources. The VER resources include wind and solar generation; hereafter referred to as Wind and Solar. The four wholesale customer classes that generation reserves are assigned include: (1) Load, (2) Wind, (3) Solar, and (4) Non-VER Generators. GMS used a test year of January 2023 through December 2023 to quantify and allocate generating capacity reserves to wholesale customer classes receiving Regulation and Frequency Response Service. The generating units assigned to provide regulating services are supported in the Direct Testimony of Joseph M. Stimatz.

NorthWestern is also updating the analysis of reserve requirements for Flex Reserves Service under Schedule 11 of its OATT that applies to wind generators receiving wholesale service within its Montana service territory. Flex Reserves is the additional generating capacity NorthWestern reserves to respond to downward ramps in wind generator output for units located within its Balancing Authority Area ("BAA"). Because NorthWestern requires Flex Reserves to meet downward ramps in output from wind generators, this service applies only to the wind generators.[1]

Q. What has changed between the time NorthWestern submitted its 2019 OATT filing before FERC and your updated analysis using 2023 data?

A. The primary change is the addition of a fourth customer class, Solar, which NorthWestern now includes in Schedules 3 and 3A to account for the large amount of solar generation installed in its BAA following NorthWestern's 2019 OATT filing. Approximately 160 megawatts ("MW") of large solar generating plants have been installed over the past two years; one is the 80-MW MTSUN generation plant that became operational in January 2023, and the second is the 80-MW Apex solar plant that became operational in August 2023. An

[1] NorthWestern also uses its OATT ancillary services rates to determine avoided costs for ancillary services for wind Qualifying Facilities on its Montana system.

additional 17 MW of smaller solar generating plants raises the total installed solar capacity in service in 2023 to 177 MW.

The second material difference is the installation of approximately 200 MW of wind generation in NorthWestern's BAA, which raises the total installed wind generation to 440 MW.

Q. How is your testimony organized?

A. My testimony provides as follows:

- First, I summarize the results of GMS's analysis regarding LV and Flex Reserves and explain how I used these results to determine the amount of generating capacity NorthWestern must reserve for customers that receive Regulation and Frequency Response and Flex Reserves Services.
- Next, I describe the methods GMS applied to determine the amount of Regulation and Frequency Response Service that NorthWestern must provide to comply with NERC's current reliability standard. The Regulation and Frequency Response Service includes two delivery components: (1) Fast-Moving and (2) Load Following reserves.
- Next, I present the allocation of Fast-Moving and Load Following reserves to four customer classes: (1) Load; (2) Wind, (3) Solar, and (4) Non-VER Generators. GMS applied the Fair Allocation methodology consistent with the 2019 Study and that FERC has accepted in prior wholesale

applications to allocate Fast-Moving and Load Following reserves to each customer class.

- Lastly, I present the results of the Flex Reserves segment of our analysis and the amount of generating capacity that NorthWestern must reserve to respond to downward ramps of wind generators located within its Montana BAA.

Overview of Regulation and Frequency Response Service

Q. What is Regulation and Frequency Response Service?

A. Regulation and Frequency Response Service is an ancillary service required for transmission service under the NorthWestern OATT and is reflected in Schedules 3 and 3A of the OATT. This service is necessary to provide for the continuous balancing of resources (generation and interchange) with load and for maintaining scheduled interconnection frequency at sixty cycles per second (60 Hz). In discussing Regulation and Frequency Response Service in Order No. 888, where FERC first made provision of this service mandatory for public utilities, FERC explained that "someone must supply extra generating capacity, called regulating margin, and provide a controlled dispatch of that capacity to balance the moment-to-moment variations in the load located in a control area."[2] In addition to meeting the moment-to-

[2] *Promoting Wholesale Competition Through Open Access Nondiscriminatory Transmission Services by Public Utilities and Recovery of Stranded Costs by Public Utilities and Transmitting Utilities*, 61 Fed. Reg. 21,540 (1996), FERC Stats. & Regs. ¶ 31,036 at 31,960 (1996) (Order No. 888), *order on reh'g*, Order No. 888-A, 62 Fed. Reg. 12,274 (1997), FERC Stats. & Regs. ¶ 31,048 (1997), *order on reh'g*, Order No. 888-B, 62 Fed. Reg.

moment fluctuations in load, FERC has explained that Regulation and Frequency Response Service provides the capacity necessary for balancing within-the-hour variations in load.[3]

Analysis Results

Q. What findings and conclusions did GMS reach regarding its analysis in this case?

A. A summary of GMS's findings and conclusions follows:

- NorthWestern maintains data and records that I relied upon to accurately determine the amount of generating capacity it must reserve for transmission customers receiving Regulation and Frequency Response Service under NorthWestern's OATT. Consistent with the 2019 Study, GMS used one-minute interval data to determine the amount of generating capacity that NorthWestern must have online or readily available to comply with NERC's reliability standard.

64,688, 81 FERC ¶ 61,248 (1997), *order on reh'g*, Order No. 888-C, 82 FERC ¶ 61,046 (1998), *aff'd in relevant part sub nom. Transmission Access Policy Study Group, et al. v. FERC*, 225 F.3d 667 (D.C. Cir. 2000), *aff'd sub nom., New York v. FERC*, 535 U.S. 1 (2002).

[3] *Allegheny Power Service Corp*., 85 FERC ¶ 61,275 at 62,120 (1998) ("[L]oad following must be available at all times both to cover the moment-to-moment load fluctuations and to match resources (including those which may be block scheduled) to load throughout the hour. . ."); *Kentucky Utilities Co*., 85 FERC ¶ 61,274 at 62,108 (1998) (explaining that, through Regulation and Frequency Response Service, "utilities are required to 'provide for the continuous balancing of resources with load,' by which we meant not just the moment-to-moment balancing, but also any other on-going balancing of generation resources with load that might be required to maintain system reliability (e.g., the balancing needed to accommodate block schedules between control areas.").

- For the Fast-Moving component of Regulation and Frequency Response Service, reserve requirements are equal to the maximum difference in NorthWestern's one-minute Supervisory Control and Data Acquisition ("SCADA") load data and the 15-minute Centered Moving Average ("CMA") for the Load class net of non-VER Generation, Wind and Solar one minute output (i.e., Total Net Load). For the non-VER and VER Generator classes, Fast-Moving Reserves equals the maximum difference between the one-minute generator output data and 15-minute CMA of generator output.[4] The derivation of CMA is described in greater detail in subsequent sections of my testimony. GMS's study confirmed that the total amount of generating capacity that NorthWestern must reserve for Fast-Moving Reserves is 37.2 MW.

- For the Load Following component of Regulation and Frequency Response Service, reserve requirements are derived based on the maximum difference in CMA values within a 15-minute clock interval. Consistent with the 2019 Study and FERC precedent, GMS defined Load Following Reserves as the difference between the highest and lowest values for downward ramps within each 15-minute clock interval. GMS selected 15-minute clock intervals for Load Following to comply with FERC's position and prior OATT rulings that wholesale customers must be allowed to schedule generation on a 15-minute basis. My analysis using

[4] Because generators produce electric output, the signs are reversed to account for the fact that when generator output ramps upward, net load decreases and vice-versa when generator output ramps downward.

the 2023 data determined that the total amount of generating capacity that NorthWestern must reserve for Load Following Reserves is 56.1 MW.

- Under rules adopted in 2016, NorthWestern is required to bring its system within Balancing Authority Area Control Error Limits ("BAAL") within each 30-minute clock interval, on a rolling basis, under NERC's BAL-001-2 reliability standard.[5] To comply with this requirement and avoid monetary penalties, NorthWestern must have sufficient reserves readily available to meet this limit during each 30-minute interval for all hours of the year. The current NERC standard requires 100% compliance – each and every hour.

- Consistent with the 2019 Study, a 95% dispersion interval was used in the derivation of Flex Reserves. GMS's 2024 LV study found that the amount of generation NorthWestern must reserve to provide Flex Reserves Service to wind generators located in its BAA is 46.8 MW.

- GMS's analysis is consistent with the 2019 Study methodology and accurately derives the amount of Fast-Moving, Load Following, and Flex Reserves that NorthWestern must have online or readily available to

[5] Under the prior NERC standard, NorthWestern was required to comply with Control Area Performance Standard ("CPS-2"), under which it had to achieve 90% compliance with the L10 Area Control Error (ACE). Under these prior rules, NERC required "Each Balancing Authority shall operate such that, on a rolling 12-month basis, the average of the clock-minute averages of the Balancing Authority's Area Control Error (ACE) divided by 10B (B is the clock-minute average of the Balancing Authority Area's Frequency Bias) times the corresponding clock-minute averages of the Interconnection's Frequency Error is less than a specific limit."

comply with NERC's current reliability standard. Further, the use of the Fair Allocation methodology approved by FERC in prior OATT rate applications was used to allocate the reserves to each of the four wholesale customer classes that receive Regulation and Frequency Response Service to maintain consistency between the analyses. According to GMS's recent analysis, the amount of generating capacity that NorthWestern must reserve to provide these ancillary services under its OATT for each customer class is summarized below.

Fast Moving	Load	4.0
	Wind	9.7
	Solar	14.5
	Non-VER Generation	9.0
	Total	**37.2**
Load Following	Load	7.7
	Wind	23.8
	Solar	7.5
	Non-VER Generation	17.1
	Total	**56.1**
Flex Reserves	**Wind**	**46.8**
Total		**140.1**

Q. How do the results of the updated study compare to the 2019 Study?

A. The total amount of required reserves for the Fast-Moving and Load Following components of Regulation and Frequency Response Service has increased by 7% and 20%, respectively, as presented in the table below. Flex Reserves Service requirements have decreased by 11% between the two studies.

Reserve Requirement	2023 Results (MW)	2019 Results (MW)
Fast Moving	37.2	34.8
Load Following	56.1	46.8
Flex Reserves	46.8	52.5
Total	**140.1**	**134.1**

Methodology for Regulation and Frequency Response Service

Q. What are the two components of Regulation and Frequency Response Service?

A. Regulation and Frequency Response Service is the amount of generating capacity NorthWestern must reserve to (1) respond to “moment-to-moment fluctuations in load” or “Fast-Moving Reserves” and (2) the capacity necessary for the on-going balancing of generation resources with load or “Following Reserves.” I have calculated NorthWestern’s generation reserve requirements for Regulation and Frequency Response Service consistent with the approach used in 2019 to derive Fast-Moving and Following reserves, including use of a 15-minute CMA.

Q. Please describe the methodology GMS used to derive the Fast-Moving and Load Following components of Regulation and Frequency Response Service.

A. First, I explain the method GMS used to calculate the amount of generating capacity that NorthWestern must reserve for the Fast-Moving component, followed by the methodology we applied to derive Load Following reserves.

At the outset, I note that, consistent with the 2019 Study, GMS used a 15-minute CMA to measure the deviations for which NorthWestern must hold reserves.

Fast-Moving Reserves

Consistent with the 2019 Study, GMS obtained one-minute SCADA data for load, and VER and non-VER generator output data from NorthWestern, and used this data to derive values for Total Net Load,[6] and for the Load, Wind, Solar, and Non-VER Generation components for the January 1, 2023 through December 31, 2023 test year within its service territory.[7] GMS then calculated the 15-minute CMA for each one-minute interval over the test year. The resulting data set contains approximately 525,000 one-minute and 35,000 15-minute CMA interval readings for each customer class.

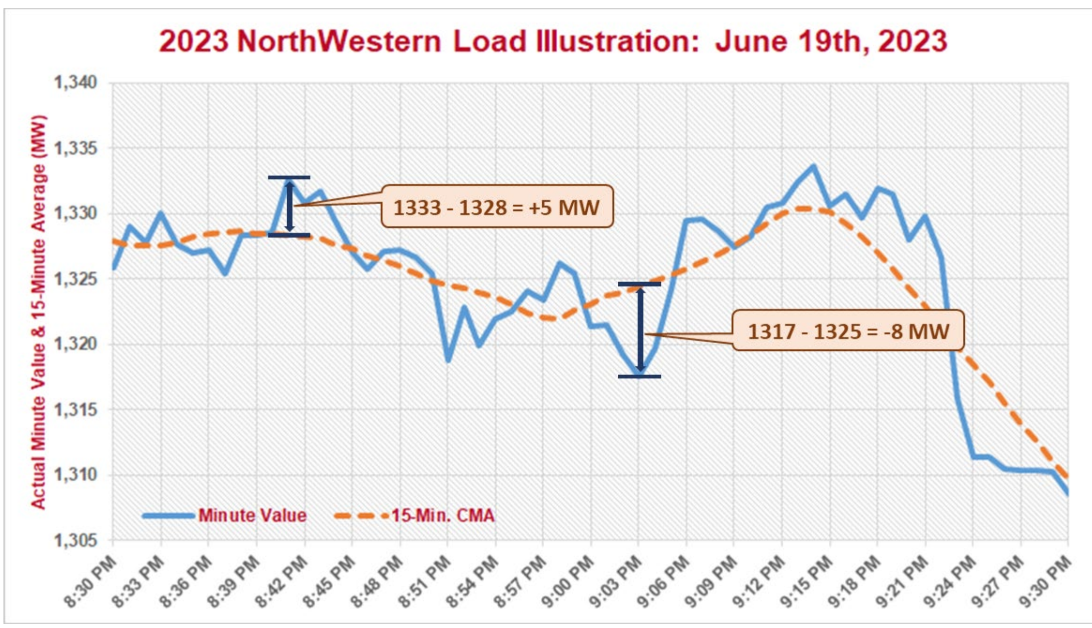
Next, for each one-minute interval, GMS compared the one-minute reading to the 15-minute CMA for each minute over the entire test year. The difference between the one-minute interval data and the 15-minute CMA is the amount of Fast-Moving generation that NorthWestern must supply to respond to rapid changes in load or generator output.[8] The following chart provides two

[6] Total Net Load is the difference between total BAA load minus wind, solar and non-generation output.

[7] References to NorthWestern's service territory and BAA are used interchangeably. Both represent the same amount of load and customers that receive OATT service from NorthWestern.

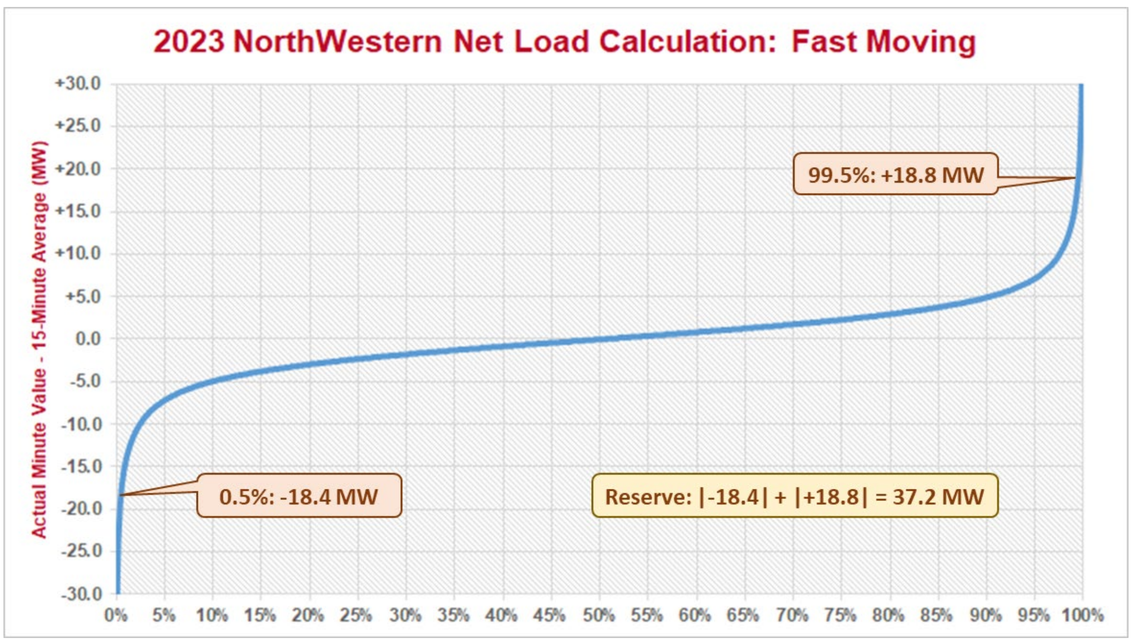
[8] The 15-minute CMA trend represents the Load Following component, whereas the minute-by-minute difference is the amount of Fast-Moving generation needed to respond to variable load and generating output.

examples of this calculation using a randomly selected date. In the following excerpt of NorthWestern's load data on June 19, 2023, the solid line represents the minute-by-minute load in NorthWestern's Montana service territory while the dashed line is the 15-minute CMA. The difference between the one-minute load of 1,328 MW minus the 15-minute CMA of 1,333 MW at 8:41 pm on June 19, 2023 is 5 MW; that is, the point where the downward ramp intersects the 15-minute CMA at 8:41 pm. The Fast-Moving Reserve requirement at this time is 5 MW. Similarly, the Fast-Moving value at 9:03 pm is the difference between the 15-minute CMA of 1,325 MW and the one-minute load of 1,317 MW, or -8 MW.



The process described above is repeated for each one-minute interval over the entire test year, with the one-minute difference in each interval sorted from maximum to lowest value. The difference between the highest value and the lowest value over the 99% dispersion interval is the amount of generating capacity assigned to Fast-Moving Reserves.

The following chart presents the one-minute differences for Total Net Load for the test year. The absolute values that appear at the intersection of the 0.5 and 99.5 percentiles, or 99% after the largest absolute values are removed, are then added to produce the Fast-Moving Reserve component. This methodology is consistent with the 2019 Study. According to GMS's analysis, the total amount of generating capacity that NorthWestern must reserve for the Fast-Moving component is 37.2 MW. The allocation of the 37.2 MW of Fast-Moving Reserves between the Load, VER, and Non-VER classes is discussed later in my testimony.

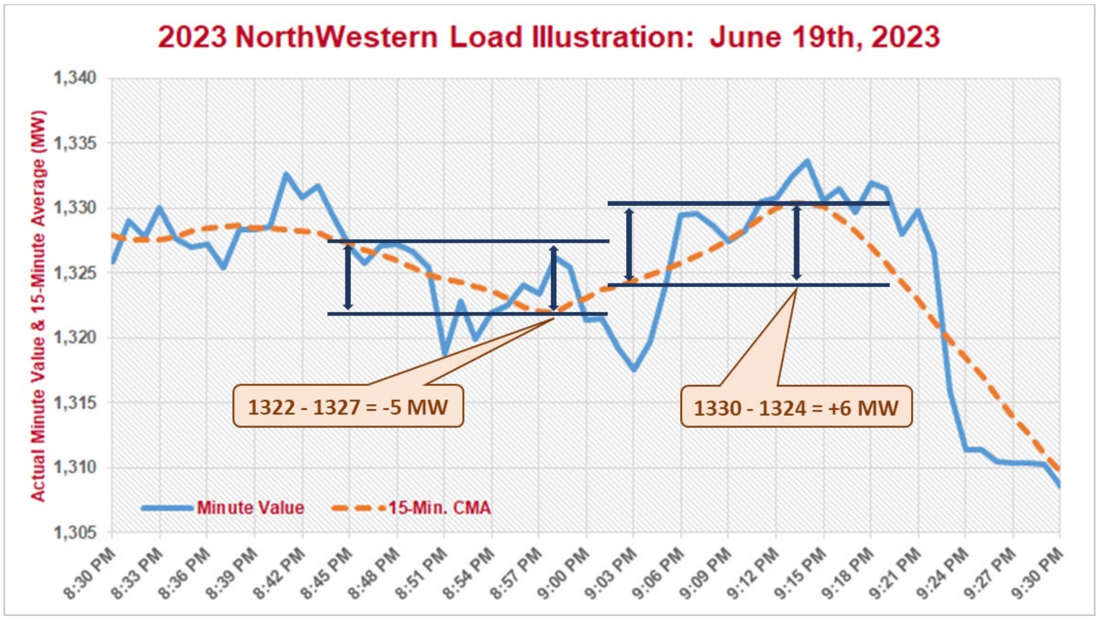


<u>Load Following Reserves</u>

For Load Following, GMS followed a process similar to the methodology it used to calculate Fast-Moving Reserves. GMS applied the same one-minute load and generator output data for Total Net Load, Load, VER, and non-VER wholesale customer classes used to derive Fast-Moving Reserves to calculate the 15-minute CMA for each minute over the test year.[9] The resulting data set contains approximately 525,000 15-minute CMA interval readings. The maximum difference between 15-minute CMA values within each 15-minute clock interval is the amount of generation that NorthWestern must reserve for the Load Following component of Frequency and Regulating Reserve Service.

The following chart provides two examples of the Load Following calculation on the same day and time that appears in the Fast-Moving chart above. Load Following Reserves are derived for each consecutive 15-minute clock interval on the chart. The Load Following component for each interval is equal to the difference between the highest and lowest 15-minute CMA within the interval, but only for upward ramps when NorthWestern generating resources must increase output to make up the deficit. (The solid line representing the minute-by-minute load in NorthWestern's Montana service territory is shown for illustration purposes only.)

[9] Non-VER generation is excluded as it includes the generators that provide Load Following. The non-VER generators maintain energy balances, with output that changes in the opposite direction of changes in load or VER output.

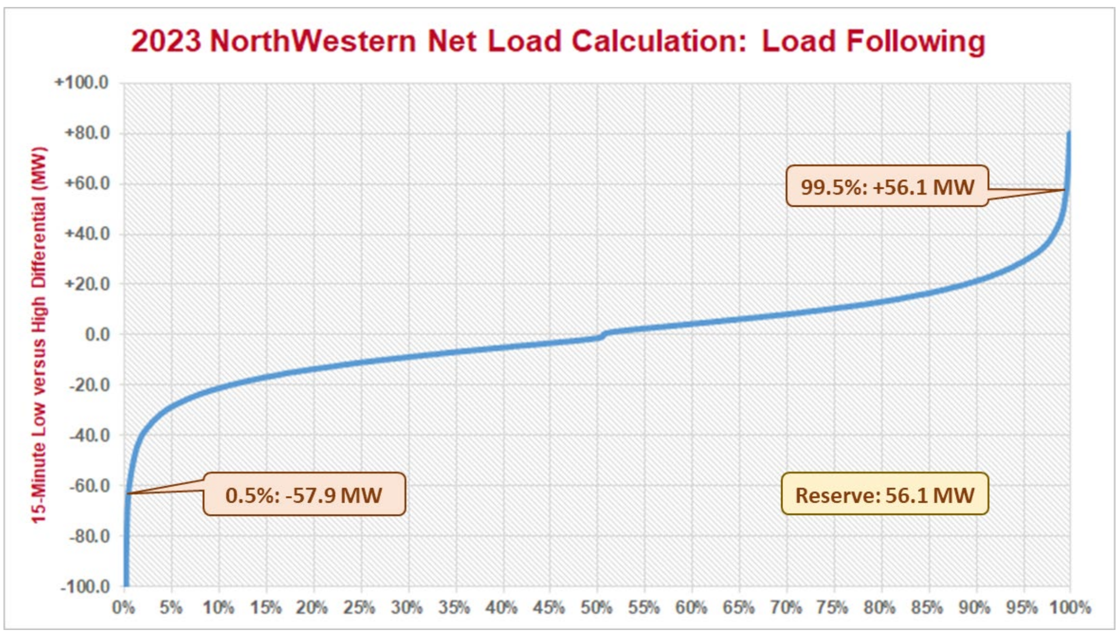


In the chart, the highest load at the beginning of the 15-minute interval beginning at 8:45 pm is 1,327 MW; the lowest is 1,322 MW during the interval (note that the highest and lowest values do not always occur at the beginning and end points of the 15-minute clock interval). In this example, the difference in the highest and lowest MW value is -5 MW. The Load Following component is derived only during intervals when upward ramping occurs during each 15-minute interval; consistent with the 2019 Study. Accordingly, the 5 MW downward ramp is excluded from the Load Following calculation.

The reserve requirement is 6 MW for the 15-minute interval ending on 9:15 pm in this example. In this instance, the highest and lowest measurements occur at the endpoints of the interval.

The process described above is repeated for each 15-minute clock interval over the entire test year, with the maximum difference for each interval sorted from maximum to lowest value. The value at the 99.5% dispersion interval is the amount of generating capacity assigned to Load Following Reserves.

The following chart presents the 15-minute differences for total net load and the four wholesale customer classes. Similar to Fast-Moving Reserves, the values that appear at the intersection of the 0.5 and 99.5 percentiles appear in the chart; however, the Load Following Reserve component is derived only for upward ramps (i.e., 99.5% dispersion interval). Thus, GMS's analysis results in a value of 56.1 MW for Load Following Reserves.



<u>Allocation of Regulation and Frequency Response Service to</u>

<u>Wholesale Customer Classes</u>

Q. Please describe the four wholesale customer classes evaluated in GMS's analysis and explain why GMS selected them.

A. GMS allocated generating reserves that NorthWestern uses to provide for Regulation and Frequency Response Service to four customer classes: (1) Load, which includes all load, including non-NorthWestern load such as rural electric cooperatives, within NorthWestern's BAA; (2) Non-VER generation, which includes generation located within NorthWestern's BAA exclusive of wind and solar, (3) wind generators, and (4) solar generators located and operating within NorthWestern's BAA during the test year. The solar customer class is a new customer class that was not included in the 2019 Study.

The Load class includes all Non-Choice retail (NorthWestern's bundled retail customers) and Choice retail customers including cooperatives that receive service under NorthWestern's Montana retail and wholesale electric tariffs.

The non-VER class includes all generators other than VERs that are electrically located within NorthWestern's BAA. The Non-VER class requires Fast-Moving Reserve service to account for unexpected changes in output or generator contingencies. Similar to the 2019 LV study, the Non-VER class is comprised of generators that do not provide Fast-Moving Reserve service; that is, output from generators that are not on Automatic Generation Control ("AGC") were excluded from the minute-by-minute and CMA calculations as these units respond to instantaneous changes in BAA net load to maintain frequency within NERC requirements.

The VER customer class is comprised solely of wind and solar generators located within NorthWestern's BAA. The output from these generators is highly variable and, as a class, requires Fast-Moving and Load Following Reserves services.

Q. Please describe GMS's approach for allocating Regulation and Frequency Response Service to NorthWestern's four wholesale customer classes.

A. The methodology GMS followed is consistent with the 2019 Study. This approach, referred to as the Fair Allocation methodology for regulating reserves, offers an analytically rigorous and consistent method to allocate the Fast-Moving and Load Following components of Regulation and Frequency Response Service.

The following table summarizes the results of GMS's use of the Fair Allocation methodology to derive the Fast-Moving and Load Following components for the current analysis.

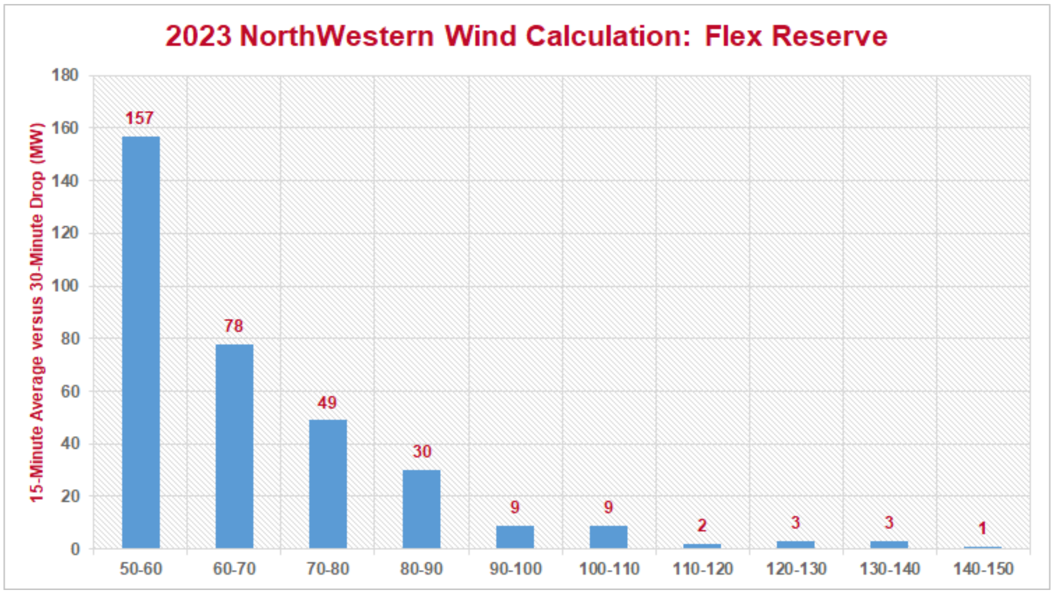
Reserve Requirement	Customer Class	Allocation (MW)
Fast Moving	Load	4.0
	Wind	9.7
	Solar	14.5
	Non-VER Generation	9.0
	Total	**37.2**
Load Following	Load	7.7
	Wind	23.8
	Solar	7.5
	Non-VER Generation	17.1
	Total	**56.1**

Flex Reserves Service

Q. Please describe the methodology GMS used to derive the values used to support Schedule 11 in NorthWestern's OATT.

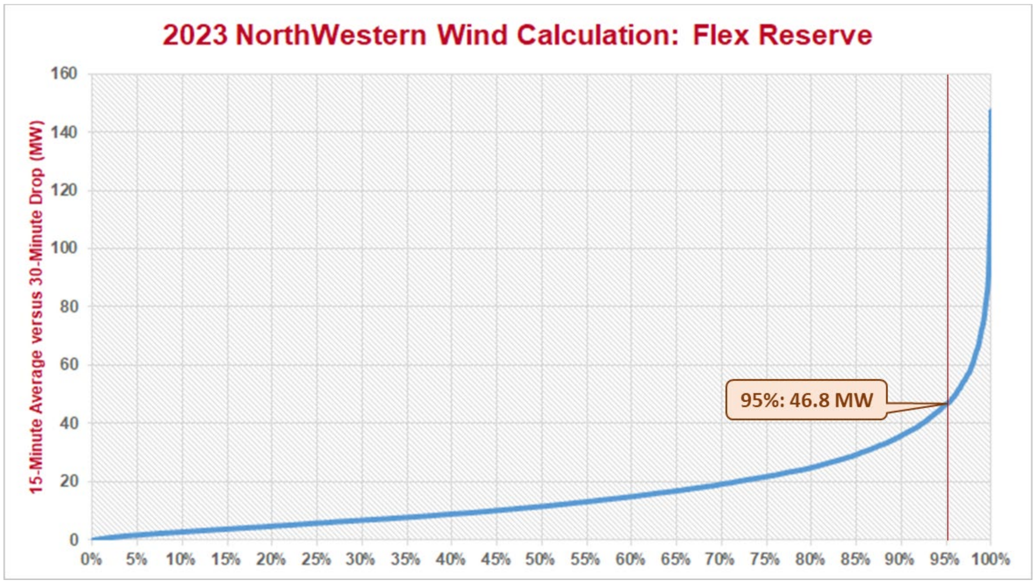
A. Like other utilities located within the Western Electricity Coordinating Council and other regions in the United States, NorthWestern has encountered large increases in wind generation over the past three to four years. A maximum coincident output of 440 MW was measured during the test year for wind generators within NorthWestern's service territory (for comparison, NorthWestern's Montana BAA peak load during the 2023 test year was just over 1,900 MW). Similar to wind generators located in other utility BAAs, those located in Montana tend to produce output that is highly variable with unpredictable patterns. The magnitude of wind ramps in NorthWestern's Montana service territory is sizable.

There were 342 instances during the test year where wind output dropped by over 50 MW within 30 minutes. The chart below presents the cumulative number of downward wind ramping events during the test year. Notably, there were 18 instances when wind output dropped by over 100 MW and one instance where a drop of up to 150 MW occurred within a 30-minute interval.



Again, NorthWestern must achieve 100% compliance with NERC's BAL-001 reliability standard. To achieve compliance, NorthWestern must reserve generation beyond the amount needed for Fast-Moving and Load Following Reserves to respond to downward ramps in wind generation. The additional amount of generation NorthWestern reserves to respond to downward wind ramps is the Flex Reserves component.

Consistent with the 2019 Study, GMS obtained 30-minute downward wind ramps for the test year and sorted these ramps from lowest to highest. The resulting value in the recent analysis of 46.8 MW is well below the installed wind generating capacity of 440 MW and the numerous maximum down ramps of over 100 MW that occurred during 2023.



<u>Conclusion</u>

Q. Please summarize GMS's recommendations.

A. GMS used the methodology to derive Fast-Moving Reserves, Load Following Reserves, and Flex Reserves as was used and accepted by FERC for the 2019 Study. The results of this analysis are as follows:

Fast-Moving Reserves:	37.2 MW
Load Following Reserves:	56.1 MW
Flex Reserves:	46.8 MW

Q. Does this conclude your direct testimony?

A. Yes, it does.

Verification

This Direct Testimony of Eugene L. Shlatz is true and accurate to the best of my knowledge, information, and belief.

/s/ Eugene L. Shlatz
Eugene L. Shlatz