BEFORE THE

NORTH DAKOTA PUBLIC SERVICE COMMISSION

In the Matter of Montana-Dakota Utilities Co.,

a Division of MDU Resources Group, Inc.

2016 Electric Rate Increase Application

Case No. PU-16-666

DIRECT TESTIMONY

OF

JACOB M. THOMAS, P.E.

ON BEHALF OF THE

NORTH DAKOTA PUBLIC SERVICE COMMISSION

ADVOCACY STAFF

February 24, 2017

Table of Contents

Q. Please state your name and place of employment.

A. My name is Jacob M. Thomas. I am employed by GDS Associates, Inc. ("GDS"), and my office is located at 1850 Parkway Place, Suite 800, Marietta, Georgia 30067.

Q. What position do you hold?

A. I hold the position of Senior Project Manager.

Q. On whose behalf are you submitting this testimony?

A. I am submitting this testimony on behalf of North Dakota Public Service Commission Advocacy Staff ("Staff").

Q. What is your educational background?

A. I graduated from the Georgia Institute of Technology with a Bachelor of Science in Industrial Engineering in 2000. I received a Master's in Business Administration with a concentration in Finance from Auburn University in 2006.

Q. Please describe your work experience.

A. I began working with GDS in June 1996 as a cooperative student while attending the Georgia Institute of Technology. After graduation in December 2000, I accepted a full-time position in GDS' Distribution Services department and have risen to my current position of Senior Project Manager in that department. In the past 20 years, I have provided statistical, financial, and economic consulting to utilities and regulatory agencies nationwide.

In the area of statistics, I have provided services to clients with respect to load forecasting, market research, sample design, load research, measurement and verification, and other statistical modeling. I have produced dozens of load forecasts, managed multiple customer survey processes, and performed impact evaluations of demand response and energy efficiency programs for several clients. I have also evaluated short-term and long-term price elasticity of demand for forecasting purposes.

In the areas of finance and economics, I specialize in retail and wholesale cost of service development and design, retail and wholesale rate design, financial forecasting, economic impact analysis, and benefit-cost analysis of demand response programs. In the past three years, I have managed or had significant input into cost of service, rate design, and financial forecasting projects for twenty different clients. I have performed benefit-cost analyses for an additional eight clients in that time.

My resume is provided as exhibit PSC-8.

Q. Do you have any professional registrations and memberships?

A. Yes, I am a registered Professional Engineer in Georgia. I am a member of the Institute of Industrial Engineers and the American Statistical Association.

Q. Have you testified in North Dakota in the past?

A. I have not.

Q. Have you testified in any other regulatory proceedings?

A. I have testified as an expert witness in several other states and been a co-author of joint reports filed in cases as well. I testified as an expert before the Vermont Public Service board, providing testimony regarding the economic impacts of continued operations of the Vermont Yankee nuclear power plant. I testified in the area of weather normalization of gas sales before the Michigan Public Service Commission. I also testified before the North Carolina Utilities Commission, providing testimony supporting cost of service computations for an intervenor. I have also been a co-author of reports in connection to cases before the Delaware Public Service Commission, the Kentucky Public Service Commission, and the Utah Public Service Commission. In those joint reports, prepared in coordination with other GDS experts, I was tasked with focusing on demand response, load research, and load forecasting issues.

TESTIMONY PURPOSE AND SUMMARY

Q. What is the purpose of your testimony?

A. My testimony introduces revised cost of service results and revenue allocations to rate classes reflecting the revenue requirement

recommended by Staff witness Richard A. Polich. Furthermore, I discuss the load research study used by Montana-Dakota Utilities, Co. ("MDU") to estimate class contributions to demands used to allocated demand-related costs in the cost of service study. Finally, I recommend changes to several components of MDU's proposed rate designs.

Q. How is your testimony organized?

A. I have organized my testimony into the following sections:

1. **Cost of Service** – Calculation of Cost of Service results that reflect all adjustments to the revenue requirement recommended by Staff witness Richard A. Polich.
2. **Recommended Revenue Allocation to Classes** – Allocation of the revenue requirement to classes reflecting Staff witness Richard A. Polich's recommended revenue requirement.
3. **Load Research** – Review of and recommendations related to load research supporting estimates for class demand allocators.
4. **Rate Design** – Recommendations related to rate design irrespective of class revenue requirements.
5. **Conclusions** – Summary of testimony and recommendations.

Q. Have you prepared any Exhibits?

A. Yes, the following is a list of Exhibits included with my testimony:

EXHIBIT	DESCRIPTION
PSC-8	Jacob M. Thomas Resume
PSC-9	Adjusted Cost of Service Results
PSC-10	Adjusted Revenue Allocation to Customer Classes
PSC-11	General Winter Bill Rate Comparisons

COST OF SERVICE

Q. What have you prepared with respect to cost of service?

A. I have prepared a cost of service study that reflects all recommended adjustments to the revenue requirement, including changes to investments, and expenses made by Staff witness Richard A. Polich. The resultant study outputs are shown in Exhibit PSC-9.

Q. Please summarize how you prepared the Staff adjusted cost of service study.

A. I used MDU's electronic spreadsheet version of their cost of service model provided in response to Staff Data Request 1 question 2. First, I computed an updated version of the Cost of Service to reflect new projected income statements and rate base for 2017. Then, I created a second version of that model and adjusted certain inputs to reflect the changes recommended by Mr. Polich.

Q. Please describe how you prepared the Cost of Service that reflects new projected information.

A. I used revised projected income and rate base information provided by MDU in their response to Staff Data Request Set 1, Question 1 to obtain updated 2017 projections[1]. I then input that data into the Cost of Service model provided by MDU in response to Staff Data Request Set 1, Question 2[2]. I then checked to ensure that the resultant North Dakota income statement and Rate of Return from my Cost of Service model matched that in the data supplied by MDU in response to Staff Data Request Set 1 Question 1.

Q. Please describe how you prepared the Cost of Service that reflects Mr. Polich's recommended adjustments.

A. I started with the Cost of Service model that reflects the updated 2017 projections, described above. Then, I adjusted certain inputs in the Cost of Service model to reflect those adjustments recommended by Staff witness Mr. Polich. The following list describes each of the adjustments I made to produce the adjusted study.

[1] Two Excel files as provided by MDU were used to update all inputs into the Cost of Service model: "ND Elec Rate Base 16 – Excl Wind.xlsm" and "ND Electric Income Statement (2016).xlsx".
[2] The Cost of Service Model was provided in Excel format and is called "Response No. 1.2 Statement M.xlsx"

- Production plant in service and accumulated depreciation rate base adjustments and an adjustment to production plant depreciation expense to reflect Mr. Polich's recommendations with respect to the Lewis & Clark RICE units.
- Working capital adjustments in rate base to reflect Mr. Polich's recommendations with respect to the loss on the sale of housing and plant decommissioning.
- Adjustment to operating expenses to reflect recommended adjustment to bonus and incentive compensation expenses.
- Adjustments to accumulated deferred income tax in working capital and income tax expenses to reflect the tax implications of the all adjustments recommended by Mr. Polich.

Q. Please summarize the resultant adjusted cost of service results.

A. Table JMT 1 provides the North Dakota system and class rates of return for the MDU cost of service as filed and for the Cost of Service model that reflects the updated 2017 projections. Furthermore, I show the relative rate of return, which is the class rate of return divided by the North Dakota system rate of return.

Table JMT 2 provides the rates of return and relative rates of return for the Cost of Service that reflects the updated 2017

projections and the model adjusted to reflect Staff's recommended adjustments.

TABLE JMT-1
Comparison of North Dakota Class Cost of Service Rates of Return
As Filed COS versus COS Adjusted to Reflect Updated 2017 Projections

Line No.	Class	As Filed MDU ROR[1]	As Filed Relative ROR[2]	Updated 2017 ROR	Updated 2017 Relative ROR[3]
(a)	(b)	(c)	(d)	(e)	(f)
1	Residential Rate 10	3.818%	0.654	4.027%	0.665
2	Small General Rate 20	5.395%	0.924	5.638%	0.931
3	Irrigation Rate 25	-1.195%	(0.205)	-1.012%	(0.167)
4	Large General Primary Rate 30	7.580%	1.298	7.781%	1.284
5	Large General Secondary Rate 30	8.416%	1.441	8.636%	1.426
6	TOD Large General Rate 31 Primary	4.198%	0.719	4.010%	0.662
7	TOD Large General Rate 31 Secondary	5.844%	1.001	6.060%	1.000
8	Space Heating Rate 32	6.077%	1.041	6.233%	1.029
9	Small Municipal Rate 40	2.701%	0.463	3.135%	0.517
10	Municipal Lighting Rate Primary 41	13.080%	2.240	13.420%	2.215
11	Municipal Lighting Rate Secondary 41	10.847%	1.858	11.516%	1.901
12	Municipal Pumping Primary Rate 48	2.020%	0.346	2.261%	0.373
13	Municipal Pumping Secondary Rate 48	4.070%	0.697	4.349%	0.718
14	Outdoor Lighting Rate 52	11.879%	2.034	12.011%	1.983
15	Interruptible Demand Response Rate 38	6.616%	1.133	6.844%	1.130
16	**Total North Dakota**	**5.839%**	**1.000**	**6.058%**	**1.000**

1 - From Statement M, Pages 1-15.
2 - Column C in each row divided by column C, line 16, Total North Dakota, 5.839%.
3 - Column E in each row divided by column E, line 16, Total North Dakota, 6.058%.

TABLE JMT-2
Comparison of North Dakota Class Cost of Service Rates of Return
COS Adjusted to Reflect Updated 2017 Projections versus COS Adjusted to Reflect Staff Recommendations

Line No.	Class	Updated 2017 ROR	Updated 2017 Relative ROR[1]	Staff Adjusted ROR	Staff Adjusted Relative ROR[2]
(a)	(b)	(c)	(d)	(e)	(f)
1	Residential Rate 10	4.027%	0.665	4.643%	0.690
2	Small General Rate 20	5.638%	0.931	6.273%	0.933
3	Irrigation Rate 25	-1.012%	(0.167)	-0.407%	(0.061)
4	Large General Primary Rate 30	7.781%	1.284	8.525%	1.267
5	Large General Secondary Rate 30	8.636%	1.426	9.396%	1.397
6	TOD Large General Rate 31 Primary	4.010%	0.662	4.910%	0.730
7	TOD Large General Rate 31 Secondary	6.060%	1.000	6.729%	1.000
8	Space Heating Rate 32	6.233%	1.029	6.940%	1.032
9	Small Municipal Rate 40	3.135%	0.517	3.588%	0.533
10	Municipal Lighting Rate Primary 41	13.420%	2.215	14.978%	2.227
11	Municipal Lighting Rate Secondary 41	11.516%	1.901	11.918%	1.772
12	Municipal Pumping Primary Rate 48	2.261%	0.373	2.797%	0.416
13	Municipal Pumping Secondary Rate 48	4.349%	0.718	4.937%	0.734
14	Outdoor Lighting Rate 52	12.011%	1.983	13.004%	1.933
15	Interruptible Demand Response Rate 38	6.844%	1.130	7.486%	1.113
16	**Total North Dakota**	**6.058%**	**1.000**	**6.727%**	**1.000**

1 - Column C in each row divided by column C, line 16, Total North Dakota, 6.058%.
2 - Column E in each row divided by column E, line 16, Total North Dakota, 6.727%.

Although the class-by-class rates of return are similar in all three versions of the Cost of Service, the Staff recommended adjustments do narrow the range of outcomes. By observing the relative ROR statistic, one can see that the range of class returns as a ratio of the overall North Dakota system return narrows under the Staff recommended version. Relative rates of return range from -0.205 to 2.240 under the MDU filed Cost of Service. Under the Staff adjusted Cost of Service, relative rates of return range from -0.061 to 2.227.

REVENUE ALLOCATION TO CLASSES

Q. Please describe your recommended revenue allocation.

A. I started with the overall revenue requirement as recommended by Staff witness Richard A. Polich. Mr. Polich recommends a base rate revenue increase of $513,316. Then, I evaluated the rates of return by class from the Staff adjusted cost of service, as shown in Table JMT 2 above. Finally, I prepared an allocation of the Staff recommended rate increase to the classes as shown in Table JMT 3 below:

TABLE JMT-3
Staff Recommended Base Rate Revenue Increases by Customer Class

Customer Class	Recommended Rate Increase* Amount ($000)	%
Residential Service	$316	0.43%
Small General Service	$45	0.35%
Large General Service	$136	0.15%
Lighting	$3	0.15%
Municipal Pumping	$15	0.55%
Total North Dakota Electric	$515	0.28%

*Exclusive of Renewable Rider and Transmission Cost Adjustment Rider.

Q. Please describe how you allocated Mr. Polich's recommended revenue increase to the various customer classes.

A. MDU witness Tamie Aberle describes the method by which the Company allocated their requested revenue increase to the classes. On page 6 of her direct testimony in lines 8-14, she describes a two-step process used to determine the maximum and minimum increases to be placed on any one class because "It was determined that mitigation was necessary in order to balance the fair return standard with the recognition of customer impacts." I employed a similar two-step process to Ms. Aberle, although I modified it to reflect the lower overall percent increase recommended by Staff witness Polich. I set a maximum percent increase of 2.0 times the

overall North Dakota recommended increase and a minimum of 0.5 times the overall increase. The resultant maximum increase is 0.56% and minimum increase is 0.14%. Exhibit PSC-10, page 1 shows the revenue allocation I recommend.

Next, I looked at the class rates of return prior to the revenue increase, and assigned minimum and near minimum increases to the two classes earning higher than system rates of return. Total Lighting and Total General Service received a 0.15% increase.

Total Municipal Pumping, which currently has a rate of return below the North Dakota system was then assigned the highest rate increase of 0.55%. Next, the Total General Service increase was set at 0.35% to recognize it has a lower than system return but higher return than Residential and Municipal Pumping. The Residential increase was then computed to recover the remaining revenue increase, which results in an increase of 0.43%.

My recommended revenue allocation provides for reasonable increases on all classes and moves all classes closer to equitable rates of return, as shown in Table JMT 4.

TABLE JMT-4
Resultant Rates of Return After Staff Recommended Revenue Increases

	Prior to Rate Increase		After Rate Increase	
Customer Class	Rate of Return	Relative ROR	Rate of Return	Relative ROR
Residential Service	4.643%	0.690	4.724%	0.696
Small General Service	6.103%	0.907	6.174%	0.909
Large General Service	9.050%	1.345	9.088%	1.339
Lighting	12.314%	1.831	12.344%	1.818
Municipal Pumping	4.252%	0.632	4.357%	0.642
Total North Dakota Electric	6.727%	1.000	6.789%	1.000

LOAD RESEARCH

Q. What did you review with respect to MDU's load research?

A. In response to Staff data request Set 2, Question 30, MDU provided several spreadsheets and responses describing the load research used in their cost of service study allocator development. I reviewed this information to ascertain if industry standard techniques were used by MDU. The load research information is used to compute the 12-CP demands for each class and is therefore an important aspect of MDU's cost of service model.

Q. Do you have any recommended adjustments to the load research study?

A. Yes, I do. I recommend MDU use a different methodology for sample selection. I also recommend MDU use a different methodology to perform the data expansion to expand sample demands to class demands. I will discuss each in more detail below.

Q. How does MDU select its load research samples?

A. According to MDU's response to Staff data request Set 2, Question 30.c: "Montana-Dakota prepared random samples for rate classes having sufficient numbers of customers to make a census impractical and for which interval data were available." In load research, when interval data is used for every customer in a class, it is called a census. The sample size was designed to achieve a 90% confidence level with a 10% error tolerance. For the sampled classes, the Company randomly selected accounts that had 12 months of 2015 billing data. Data for all customers on Rate class 130 were included so this class was not sampled. Very small sample sizes were used in some cases including class 250 (2 out of 40 accounts), class 300 (2 out of 36 accounts), class 323 (2 out of 536 accounts), and class 400 (8 out of 39 accounts).

Q. What changes do you recommend for sample design and selection?

A. I recommend that MDU generally employ a stratified random sampling scheme for its load research program. With a stratified random sample, the class is divided into strata and a random sample of customers from each stratum are drawn. If the individual strata of customers are more homogenous than the overall population, then stratification can increase the precision of sample estimates and/or reduce the overall sample size required. For those classes that have demand charges and demands are recorded in MDU's billing system, then the demand can be a natural stratification variable. For other classes, stratifying based on energy is often employed in the industry. For classes with very few customers (less than 50) or classes with highly homogenous load characteristics, a simple random sample is likely to be equally representative and provide similar precision to a stratified approach. For classes with fewer than 50 accounts, using interval data for all customers is preferable to either a stratified or simple random sample.

Q. What changes do you recommend for the data expansion?

A. Data expansion is the process by which a load researcher uses the sample data to expand it to represent the entire rate class. Based on MDU's response to Staff data request 2, question 30, I conclude that MDU uses a mean-per unit ("MPU") expansion approach. In an MPU

expansion, the load research data is used to calculate a variable of interest (for instance, a CP demand for a given month) on a per-customer basis. That variable per customer ratio is then multiplied by the total number of customers in the class to estimate the variable of interest for the entire class.

I recommend MDU change to a ratio expansion technique. In ratio expansion, correlation of the variable of interest with another variable that is available for the sample customers and the population is used to obtain increased precision in the expanded estimate. As described in the *Load Research Manual*, produced by the Association of Edison Illuminating Companies:

> "Ratio estimation is a technique that can take advantage of the correlation of the variable of interest y with another variable *x* to obtain increased precision. Class demand estimates for rate classes and other populations with 'known' total energy use *X* are adjusted by the ratio of demand y to energy use x for the sample. When *x* and *y* are sufficiently correlated, the relative variance of the estimated ratio is less than the relative variance of either *x* or *y* alone. That is, knowledge of *x* provides information about *y*. As a result, the ratio estimator has better precision than the mean-per-unit estimator, which ignores the information about *x*."[3]

This paragraph concludes that, if there is positive correlation between class energy and class demand, then the ratio estimation technique will improve precision. Given the high likelihood that such a

[3] Association of Edison Illuminating Companies. *Load Research Manual*. 2nd ed. 2001. Page 7-8.

positive correlation exists for MDU's rate classes, I recommend use of the ratio estimation technique to improve the precision of demand estimates.

Q. Do you recommend these adjustments to the load research be incorporated into MDU's cost of service and rate design for Case PU-16-666?

A. I do not recommend that these changes be made in this case. Changing the sample requires starting the load research process from step 1 and could not be accomplished in a timely manner for the purposes of this case. Rather, I recommend MDU make these changes to its load research program for future rate case and other load research needs.

RATE DESIGN

Q. Please summarize the issues you will discuss with respect to rate design.

A. I make recommendations with respect to the rate design for three rates: Residential Service Rate 10, Optional Residential ETS Rate 13, and SGS Rate 20. I also discuss the concept of a residential demand rate as a future concept for MDU to consider.

Q. What do you recommend regarding rate design for Residential Service Rate 10?

A. I recommend MDU eliminate the declining block rate for the energy charge in winter months. A declining block rate design is typically one that incorporates customer-related fixed costs into the first energy block when the basic service charge does not recover full customer-related costs. With MDU's proposed basic service charge of $0.65 per day, the full customer-related cost is being recovered through the basic service charge, eliminating the need to recover additional customer costs in the first 750 kWh per month in winter months.

Furthermore, the long-run marginal cost of energy produced is increasing and not decreasing, as utilities rely on newer and more emission-efficient units to produce marginal energy in the future. A declining block rate does not reflect the fact that marginal costs will increase over the long-run.

Q. How does moving from a declining block rate to a flat rate in the winter impact residential consumers?

A. Changing the rate structure in winter months to a flat energy charge will help ease the impacts on low usage customers associated with the increasing Basic Service Charge. In Exhibit PSC-11, I provide general winter bill rate comparisons that demonstrate that fact. On page 1, I show a comparison of the present Rate 10 for winter months versus MDU's

proposed rate with the declining block rate. On page 2, I show a comparison of the present Rate 10 for winter months versus a flat rate energy charge designed to recover the same revenue for those kWh as MDU's proposed design. When comparing the bills at lower usage levels, it is clear that the flat energy charge helps lower usage customers absorb the impact of increasing the Basic Service Charge. For instance, looking at line 7 on pages 1 and 2 of Exhibit PSC-11, a customer that uses 500 kWh in a given winter month will see an increase of $8.14, or 13.7%, on that bill under MDU's proposed rates with a declining energy block. Under the flat energy charge, that customer would see a $2.31, or 3.9%, increase on that bill.

Q. **How did you compute the flat energy charge you used in Exhibit PSC-11, Page 2?**

A. I used the rate design statements provided by MDU to compute a flat energy charge in winter months of $0.04900 per kWh. In Statement N, page 7, MDU shows that the winter energy charges are designed to recover $25,688,615 in revenue over 524,290,825 kWh. That results in an average rate of $0.04900 per kWh, which is what I used for the rate comparison in Exhibit PSC-11 page 2.

Q. What recommendations do you have for Residential Electric Thermal Storage Service Rate 13?

A. To be consistent with the design of the Residential Service Rate 10, I recommend MDU eliminate the declining block energy charge in the winter on-peak energy component of the rate. The same reasoning with respect to recovery of customer-related fixed costs and reflecting that marginal costs will increase over the long-run apply to the Residential Electric Thermal Storage customers during their on-peak period.

Q. What recommendations do you have for Small General Service Rate 20?

A. To be consistent with the design of the Residential Service Rate 10, I recommend MDU eliminate the declining block energy charge in the winter on-peak energy component of the rate. The same reasoning with respect to recovery of customer-related fixed costs and reflecting that marginal costs will increase over the long-run apply to the Small General Service class of customers.

Q. Have you prepared rate comparisons that demonstrate the comparative impacts of this change on Rate 20?

A. I have, they are shown in Exhibit PSC-11 pages 3 and 4. The flat energy charge was computed in a manner consistent with the approach I described for Rate 10, using Schedule N page 10.

CONCLUSION

Q. Can you summarize the recommendations you make in your testimony?

A. Yes. First, I have prepared and presented adjusted cost of service results that reflect the adjustments recommended by Staff witness Richard A. Polich. Second, I have developed a recommended schedule of revenue increase allocations to the rate classes that reflect the total North Dakota system revenue requirements recommended by Mr. Polich.

I also reviewed MDU's load research information provided in this case and have made two recommendations for future load research studies. I recommend using a stratified random sampling technique for selecting samples in the next load research study. I also recommend using a ratio estimation technique to expand the sample data into class demand estimates.

Finally, I have recommended elimination of the declining block energy charge structure for Rate 10, Rate 13, and Rate 20 winter months. I prepared rate comparisons that demonstrate eliminating the declining block structure helps lower usage customers absorb the bill increases associated with increasing the Basic Service Charges on those rates.

Q. Does this conclude your testimony?

A. Yes, it does.