BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

IN THE MATTER OF THE PASS-THROUGH APPLICATION OF DOMINION ENERGY UTAH FOR AN ADJUSTMENT IN RATES AND CHARGES FOR NATURAL GAS SERVICE IN UTAH	Docket No. 17-057-20

REBUTTAL TESTIMONY OF DAVID C. LANDWARD

FOR DOMINION ENERGY UTAH

May 9, 2018

DEU Exhibit 1.0R

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I. INTRODUCTION

Q. Please state your name and business address.

A. My name is David Christian Landward. My business address is 333 South State Street, Salt Lake City, Utah.

Q. Are you the same David Landward who submitted direct testimony in this matter?

A. Yes.

Q. DEU Exhibits 1.01 through 1.02 are attached to your rebuttal testimony. Were these exhibits prepared by you or under your direction?

A. Yes.

Q. What is the purpose of your rebuttal testimony in this Docket?

A. The purpose of my rebuttal testimony is to address the Company's Design Peak Day firm sales demand modeling, the Design Peak Day temperature and wind speed assumptions used by the Company in its estimation of Design Peak Day firm sales demand, and my recommendation related to Design Peak Day demand. I also discuss alternative approaches to estimating Design Peak Day firm sales demand and the level of Design Peak Day demand that is prudent for the Company to base its planning on.

II. DESIGN DAY MODEL

Q. Please describe the history of your involvement with the DEU Design Peak Day model.

A. The Company's current Design-Day model was developed by my predecessor who left the Company in June of 2017. At that time, I was given primary responsibility for estimating Design-Day demand.

Q. Do you believe the DEU Design Peak Day model is reasonable and consistent with industry practice in estimating Design Peak Day?

A. Yes. Like DEU, many utilities use the linear regression to predict Design-Day demand using variables known to affect demand, primarily heating degree days. DEU has also included other established variables that affect daily demand such as wind speed and the day of the week.

Q. Did you review the direct testimony of Mr. Mierzwa in this matter?

A. Yes, I did. I also analyzed his model, and the criteria changes he recommends for the Design Peak Day analysis. His analysis in this docket is very similar to what he presented in Docket 17-057-09, and I have had the opportunity to review it thoroughly.

Q. Please describe Mr. Mierzwa's approach to modeling a Design Peak Day.

A. Mr. Mierzwa's model specification includes the same variables the Company currently uses. In addition, he has added a variable to account for the number of sales customers and a time trend variable to capture changes to demand over time resulting from improved efficiency in gas appliances and housing stock. Mr. Mierzwa has based his model on data from December of 2014 through January of 2018 and only includes data for the months of December, January, and February from those years.

Q. How does that differ from the Company's current Design Peak Day model?

A. The Company's current model is based upon data extending back to 2004 and includes all months of the year. It does not currently use the customer and time trend variables Mr. Mierzwa has used.

Q. Do you believe Mr. Mierzwa's modeling approach is unreasonable?

A. No, I believe Mr. Mierzwa's approach is reasonable and provides an estimate of Design Peak Day demand that is within an appropriate range. That said, I consider it to be at the lower end of that range. There are many approaches that could be employed to estimate Design Peak Day demand, and there is not necessarily only one correct approach.

Q. Both you and Mr. Mierzwa depend on a linear regression to develop your Design Peak Day models. Are there any challenges in utilizing this approach?

A. Yes. Ideally, regression would be used to predict values of a dependent variable – firm demand, in this case – within the range of the observed independent variables selected for modeling. But the Company does not have firm demand data for the days that had daily mean temperatures at or below the Design Peak Day temperature of -5 degrees. But such daily mean temperatures have occurred, and the Company must produce an estimate of demand for these occurrences.

Any method the Company adopts, simple or rigorous, will suffer from a lack of Design-Day observations. Notwithstanding this shortcoming, the Company must still estimate a Design-Day demand level for planning purposes, such that the Company can maintain safe and reliable service during extreme weather events that could occur. It must therefore be derived in some fashion using the data that are available. When a Design-Day event occurs, the accuracy of the estimate can be evaluated, and the modeling adjusted accordingly. Until that time, the Company is, in a manner of speaking, aiming at a target that it cannot see. The Company cannot afford to miss that target on the low side. Ultimately, the best modeling approach is one that produces an estimate that assures that the Company can meet all of its firm demand obligations under Design Peak Day conditions, including the peak hour within that day.

Q. Given that the Company does not have sufficient data, what is the best way to estimate this demand?

A. There are various ways a prudent utility might derive a reasonable estimate of Design Peak Day demand. For example, Mr. Mierzwa has created a model that can reasonably estimate Design Peak Day demand if proper values for the independent variables are utilized.

Q. Have you used Mr. Mierzwa's model to conduct further analysis?

A. I have. I have used his model to calculate four other estimates using variations on the heating degree days (HDD) and prior-day demand inputs in his model. These scenario results are summarized in the table below.

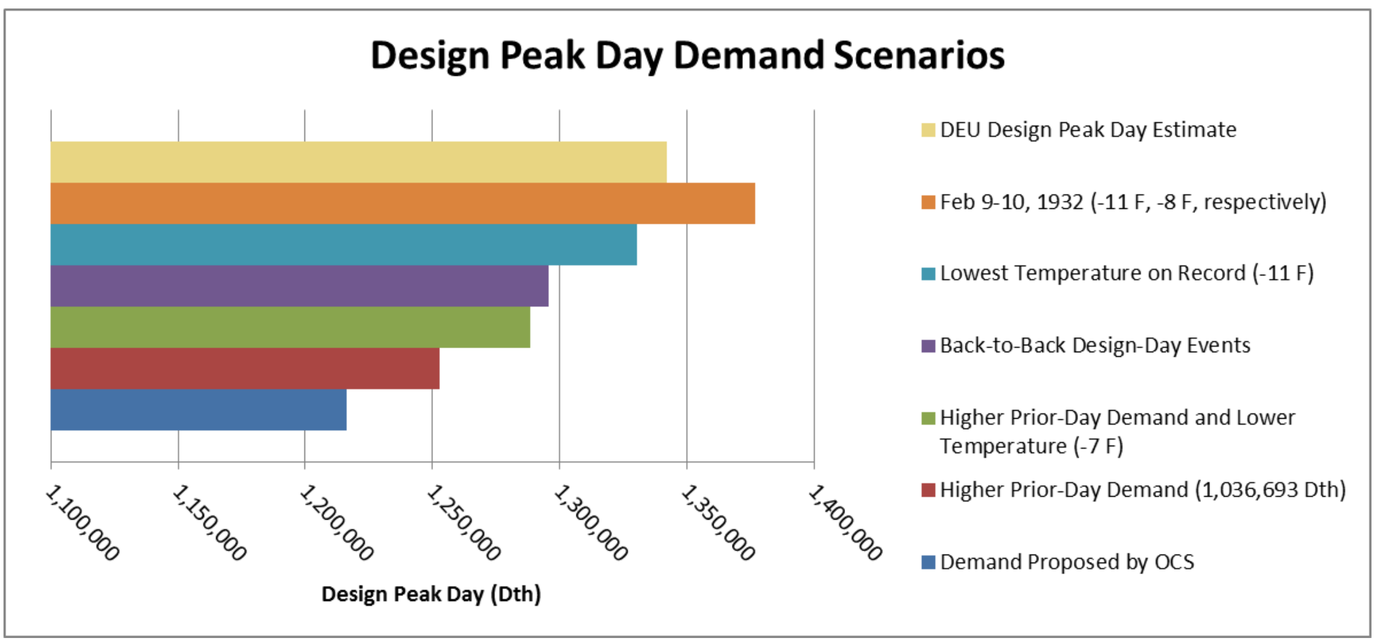

Figure 1

Q. Please describe each scenario in more detail.

A. The Design Peak Day estimate calculated by Mr. Mierzwa is shown in the blue bar at the bottom of the chart. The tan bar at the top is the Design Peak Day estimate the Company used for the 2017/2018 IRP year.

Q. Please explain the red bar labeled "Higher Prior-Day Demand"

A. In this scenario, I have utilized the inputs from Mr. Mierzwa's model, except that I have increased the prior-day demand assumption from 882,609 Dth to 1,036,693 Dth. The Design Peak Day estimate that results is 1,252,964 Dth/Day.

Q. Why did you model a scenario with higher prior-day demand?

A. Prior-day demand is an important explanatory variable in demand analysis (Steven R. Vitullo, Ronald H. Brown, George F. Corliss, Brian M. Marx, *Mathematical Models for Natural Gas Forecasting*, Canadian Applied Mathematics Quarterly, Volume 17, Number 4, Winter 2009, p 814). It provides what might be described as an inertial effect that is common in time series data. In other words, including prior day demand in the model captures demand momentum from the prior day that influences the subsequent day's demand.

I believe the prior-day demand input currently used in the DEU model and in Mr. Mierzwa's model is a reasonable one. However, it is at the lower end of a plausible range. An examination of the highest sales demand days from 2004 through 2017 shows that the demand on the day prior to each of those high-sendout days is lower, and the difference ranges from 1% to 33%. Of the 14 observations, 12 are at or below 10%. The current prior-day demand assumption of 882,609 Dth is 27% below Mr. Mierzwa's proposed Design Peak Day estimate. That analysis is presented in DEU Exhibit 1.01.

Q. How did you derive the alternative prior-day demand level?

A. I used Mr. Mierzwa's modeling approach, but I excluded the prior-day demand variable. Using the estimated coefficients for the remaining variables, I used 62 HDD, 5 miles per hour for mean wind speed, and 9 miles per hour for maximum wind speed. These inputs were derived using the approach I've described in my direct testimony on lines 142 through 147. The prior-day demand estimate using this approach is 1,036,693. The worksheet for this estimate is provided as DEU Exhibit 1.02.

Q. Please explain the green bar labeled "Higher Prior-Day Demand and Lower Temperature".

A. This scenario builds on the higher prior-day demand scenario by using a lower temperature assumption of -7 degrees (72 HDD). The Design Peak Day estimate under this scenario is 1,288,361 Dth/day.

Q. Why did you choose a -7 F temperature?

A. A daily mean temperature of -7 degrees has occurred three times in the Company's temperature history, most recently on January 12, 1963.

Q. Please describe the purple bar in Figure 1 labeled "Back to Back Design Day Events."

A. For this scenario, I estimated the Design Peak Day demand using Mr. Mierzwa's model and inputs, except that I changed the prior-day input to indicate back-to-back Design Peak Day events when a Design-Day mean daily temperature occurs on two consecutive days. To construct this scenario, I simply used Mr. Mierzwa's estimated Design Peak Day demand of

1,216,139 Dth as the prior-day demand input. The resulting estimate shown in Figure 1 is 1,295,850 Dth/day and represents the level of demand on the second of the two consecutive Design Peak Day events.

Q. How often have there been days with extreme temperatures two days in a row?

A. Among the eight instances of daily mean temperatures in the Salt Lake regions at or below -5 degrees, there are two occurrences of consecutive days at such mean temperatures:

Date	**Mean Daily Temperature**
December 12, 1932	-6
December 13, 1932	-5
February 9, 1932	-11
February 10, 1932	-8

Q. Do you believe this assumption is reasonable?

A. Yes. The data show that this back-to-back scenario has happened before.

Q. Please explain the teal bar labeled "Lowest Temperature on Record (-11 F).

A. For this scenario, I took Mr. Mierzwa's estimated Design Peak Day and adjusted one variable—the temperature. Instead of a -5 F temperature, I used -11 F.

Q. What is the likelihood of an -11 F day occurring?

A. This is a one-in-fifty-year mean temperature event – a 2% likelihood of occurrence in any given year.

Q. Is the coldest temperature on record an assumption used by other prudent utilities?

A. Yes. As I previously testified, the American Gas Association (AGA) issued an SOS asking, among other things, what temperatures other utilities used in their Design Peak Day analyses. Three of the respondents use the coldest temperature on record as the temperature basis for estimating Design Peak Day demand. The coldest temperature on record in DEU's Utah service territory is -11 F.

Q. Please describe the estimate from this scenario?

A. As you can see on Figure 1, this scenario results in an estimated Design Peak Day demand of 1,330,247 Dth/day.

Q. Please explain the orange bar labeled "Feb 9-10, 1932 (-11 F, -8 F, Respectively)

A. This is a simulation of the extreme temperature event of February 9 and 10, 1932 when the mean temperature on the 9th was -11 degrees and the mean temperature of the following day was -8. The bar shows the estimated Design Peak Day demand level on the second day of such a temperature scenario. To calculate the estimate, I used the estimated demand of the "Lowest Temperature on Record (-11 F)" scenario as the prior-day demand assumption and a temperature assumption of -8 degrees for the following day.

Q. Please describe the estimate resulting from this scenario.

A. The estimated Design Peak Day demand of day two in this scenario is 1,377,137 Dth/day.

Q. How do the results of these scenarios compare to the Company's proposed Design Peak Day Demand of 1,342,345 Dth?

A. The Company's proposed Design Peak Day demand estimate is within a reasonable range. While admittedly toward the higher end of that range, the consequences of failing to maintain adequate resources to meet Design Peak Day requirements certainly support a conservative approach to determining those requirements.

Q. Is it prudent for the Company to use an estimate on the high end of the range of possibilities?

A. Yes. As I mentioned above, the Company must plan to maintain safe and reliable service to its customers even on the coldest days and during the most extreme weather events. Because we do not have observations of demand under a Design-Day temperature event, we must estimate that demand. Estimating too low could result in customers losing service when they can least afford to do so—on extremely cold days. Accordingly, the Company believes it is prudent to use an estimate at the high end of a reasonable range to account for all of the extreme outcomes that the Company could experience.

Q. Does selecting an estimate at the high end of the range result in unnecessary additional costs for customers?

A. No. Again, the Company's goal is to ensure safe and reliable service in all conditions. Consider, for example, the events of February 3, 2011. On that day, the Southwest United States experienced severe cold temperatures. Those extreme conditions led to upstream supply disruptions, and New Mexico Gas Company and Southwest Gas Company lost natural gas service to more than 40,000 customers. The 30-year Design-Day HDD used by Southwest Gas for the Tucson region at that time was calculated at 35.5, or 29.5° F but the actual HDD were 37 or 28 ° F. Similarly, the 30-year HDD for the Sierra Vista region were 40.5 or 24.5° F, but the actual HDD were 49.5 or 15.5° F. This was explained as a 1-in-60-year weather event. *See* Arizona Corporation Commission, Utilities Division, e-Docket No.

11-0081 *Reporters Transcript of Proceedings Agenda Item No. U-21* March 2, 2011 and *Southwest Gas Corporation Southern Arizona Update* (ppt) March 2, 2011 accessed May 8, 2018, http://www.azcc.gov/Divisions/Utilities/gas/SWG%20Storage%202011/SWGstorage.asp.

DEU does not want to utilize a lower Design Peak Day estimate and then experience a Design Peak Day demand at the higher range.

Q. You've referred to a range of reasonable estimates by which these results can be assessed. How can one determine such a range prior to model development without the benefit of observed demand on a Design Peak Day?

A. A very simple approach one can use to calculate a potential range of Design Peak Day firm demand is to calculate usage per heating degree day (HDD) after reducing the usage by the summer baseload amount. That average is then multiplied by 70 HDD, the Company's Design-Day heating degree days assumption. That result is added back to baseload to arrive at an estimate of total firm demand at 70 HDD. Doing this simple calculation on the three highest firm demand levels gives a range of 1.24 MMDth to 1.31 MMDth. This is a similar range to the scenarios shown in the table above.

Date	Firm Dth (FD)	Baseload (July Avg)	HDD	(FD-Baseload)/ HDD	Firm Demand at 70 HDD (Dth/day)
12/30/14	996,189	82,083	53.67	17,031.97	1,274,321
02/01/11	987,789	88,728	51.46	17,471.06	1,311,702
01/14/13	984,588	81,125	54.58	16,553.00	1,239,835

While this is not a rigorous approach and not one I would recommend to estimate a final Design Peak Day demand number, it provides a rough gauge of the range of firm demand the Company might experience on a Design Peak Day.

III. DESIGN PEAK DAY TEMPERATURE

Q. In lines 232-254 of Mr. Lubow's testimony, he cites his historical analysis as a basis for skepticism about the Company's Design Peak Day calculation. How do you respond?

A. Mr. Lubow points out that none of the actual peak days in the last fifty years lined up with the 92% statistical probability I discussed in testimony. The purpose of the Design Peak Day calculation is to enable the Company to plan to maintain reliable service during extreme events. The Company does not believe it is prudent to ignore extreme cold temperatures on record simply because they are rare and occur infrequently. With over 1 million customers depending upon the Company to meet heating needs in all weather conditions, the Company cannot afford to gamble on the unsupported assumption that rare episodes of extreme cold that have occurred in the past will not occur again. On line 235 of his testimony, Mr. Lubow admits that although the Company's customers have not recently experienced peak day conditions, that does not mean they will not see such conditions in the future.

Q. Should the Company undertake a trend analysis of mean temperatures in recent history and increase the Design Peak Day temperature to account for what may appear to be a recent warming trend?

A. No. The implication underlying this suggestion is that there may have been a recent, permanent upward shift in the minimum temperatures that are possible, and that those approaching or falling below -5 degrees in the Salt Lake Valley are unlikely to occur in the future. The Company is not aware of any scientific research that would support this approach. What may appear to some to be a recent trend may not be permanent in nature.

Q. The last time a daily mean temperature approached the Company's Design Peak Day temperature was in December of 1990. That was 27 years ago. After so long a period, can the Company safely assume such occurrence will not happen again in the future?

A. Certainly not. The lowest daily temperature during 1990 occurred on December 22 and was -4 degrees F, only one degree above the Company's Design-Day temperature. At that time, such a low daily mean temperature had not occurred in nearly 27 years. Given this, it would be irresponsible for the Company to fail to procure adequate gas supply for its customers on the assumption that a similar temperature drop will not occur in the future where it has in the past. On line 235 of Mr. Lubow's testimony, he admits that historical experience does not preclude the possibility of more extreme conditions occurring during a Design Peak Day.

Q. In his direct testimony, beginning on line 236, Mr. Ditzel suggests that the probability of a Design Peak Day event occurring is less than 5%. Is he correct?

A. No. The probabilities in the table on line 266 of my direct testimony express the likelihood of occurrence of the Design Peak Day temperature only; they are not calculated on the joint probability of wind speed and the day of the week. A Design Peak Day event is the occurrence of a mean temperature of -5 degrees for the day. There is a range of gas consumption that is possible when the daily mean temperature is at or below a Design Peak Day level. Ancillary conditions such as wind speed and the day of the week are incorporated to refine the estimate of Design Peak Day demand so as to encapsulate all variations of demand when a Design Peak Day temperature event occurs. The Company wants to plan for the highest level of gas consumption that is possible when the daily mean temperature reaches the Design Peak Day level. The Company believes this to be a more prudent planning goal, one that provides a safety buffer and reduces the likelihood of losing service to customers because of inadequate supply acquisition.

IV. WIND SPEED AND OTHER VARIABLES

Q. Should the Company ignore wind speed when estimating Design-Day demand?

A. No. Buildings lose heat more quickly during windy conditions, and the effect of wind on heat loss increases as temperature decreases. *See* Vitullo supra at line 90. The importance of wind speed in DEU data modeling can be illustrated, again using Mr. Mierzwa's proposed model specification as a basis. The estimation error is higher when the wind-related variables are excluded from the model specification. A common error metric is derived by squaring the difference between each observed data point and the model's estimation of the same data point, averaging each of those products, and then taking the square root of the average. This is called the root mean squared error (RMSE). The lower the RMSE, the better the accuracy of the estimation. The RMSE that results from Mr. Mierzwa's specification is 25,326. By comparison, the RMSE produced when the wind-related variables are excluded from that model specification is 32,072. This means that including wind speed improves the accuracy of estimation by about 21%.

Q. Since you were given responsibility for Design-Day demand estimation, have you had occasion to evaluate wind speeds that may be possible under extreme cold conditions?

A Yes, I have.

Q. Please summarize your findings.

A. I examined hourly wind speeds and temperatures in the Salt Lake region during the months of October through April for the years 1950 through 2016. I summarized the temperatures by gas day and examined those days when the daily mean temperature was at -4 degrees Fahrenheit or below. I chose -4 degrees because such a data point exists in December of 1990 and is only 1 degree warmer than the Company's Design Peak Day temperature. My findings are consistent with those of Mr. Mierzwa.

Q. Based on your findings, could you support the assumption of a mean daily speed of 9 miles per hour and maximum speed of 17 miles per hour as proposed by Mr. Mierzwa for use as Design-Day wind conditions?

A. Yes, I could.

Q. Mr. Ditzel raises general concern about the variable selection the Company has made for its Design Peak Day Demand model. How do you respond?

A. The data conditions that Mr. Ditzel describes can be problematic when trying to establish the statistical significance of independent variables. However, the significance of the variables the Company has selected is already well established and has been documented in literature used by the Company for guidance. *See* Vitullo supra at line 90. Mr. Ditzel correctly states that these data conditions do not bias the estimate.

Q. Mr. Ditzel suggests that the exclusion of cooling degree days (CDD) as an independent variable in the Company's model may introduce a bias. What is your response?

A. The firm sales demand that the Company is modeling with linear regression comes primarily from space heating customers. Demand in warm periods is baseload and includes consumption that is largely invariant. Accounting for CDD is important when demand may fluctuate in warmer temperature from power generation or a large base of natural-gas-fueled air conditioners. However, neither of these demand sources exist in the firm sales demand that the Company is modeling.

V. REASONABLENESS OF THE COMPANY'S DESIGN PEAK DAY DEMAND ESTIMATE

Q. You have stated that you could agree to Mr. Mierzwa's proposed wind speed assumptions. Does this mean that the Company's Design Peak Demand estimate is unreasonable for supply planning?

A. No. The Company's current estimate, though derived from the assumption of higher wind speed, is still at a level appropriate for supply planning.

I believe it is beneficial to discuss and debate approaches to modeling and the inputs that are assumed, and in my opinion, Mr. Mierzwa's model is a reasonable alternative that should be a part of that discussion. However, any modeling approach or set of assumptions will have strengths and weaknesses, particularly in the absence of observed demand data under extreme but possible temperature conditions. The goal is not to identify and select the lowest possible level or even the midpoint. Rather, the goal is to cover all possibilities to avoid a shortfall.

Figure 1 illustrates that the Company's estimate is at the high end of the range of demand possibilities. That is the level that the Company believes to be prudent for Peak Day Demand planning.

VI. SUMMARY

Q. Please summarize your testimony.

A. The Company maintains that planning for the extreme low temperature scenario remains prudent to ensure that its customers do not experience a loss of service during the worst conditions. The challenge the Company faces is to estimate a demand level that will meet all of the demand possibilities should the daily mean temperature fall to the extreme low level that it has in the past. There are many approaches to this, and there is a range of answers that can be provided. Any approach will have inherent strengths and weaknesses. I agree that the modeling approach and wind speed assumptions proposed by Mr. Mierzwa are reasonable. However, I believe that the Company's Design Peak Day estimate, though based upon higher wind speed assumptions, is not unreasonably high. It is at the high end of demand possibilities and meets the Company's overarching goal of being prepared for extreme conditions.

Q. Does this conclude your testimony?

A. Yes.

State of Utah)
) ss.
County of Salt Lake)

I, David C. Landward, being first duly sworn on oath, state that the answers in the foregoing written testimony is true and correct to the best of my knowledge, information and belief. Except as stated in the testimony, any exhibits attached to the testimony were prepared by me or under my direction and supervision, and they are true and correct to the best of my knowledge, information and belief. Any exhibits not prepared by me or under my direction and supervision are true and correct copies of the documents they purport to be.

David C. Landward

SUBSCRIBED AND SWORN TO this 9th day of May, 2018.

Notary Public

LEORA N. PRICE
Notary Public State of Utah
My Commission Expires on:
August 19, 2018
Comm. Number: 677685