State of Utah
Department of Commerce
Division of Public Utilities

CHRIS PARKER
Executive Director

ARTIE POWELL
Director, Division of Public Utilities

GARY HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

June 8, 2020

PATRICIA E. SCHMID (#4908)
JUSTIN JETTER (#13257)
Assistant Attorney Generals
Counsel for the DIVISION OF PUBLIC UTILITIES
SEAN REYES (#7969)
Attorney General of Utah
160 E 300 S, 5th Floor
P.O. Box 140857
Salt Lake City, UT 84114-0857
Telephone (801) 366-0380

Selendy & Gay PLLC
Jennifer M. Selendy
Philippe Z. Selendy
Joshua S. Margolin
Margaret M. Siller
Attorneys for Vote Solar
1290 Avenue of the Americas
New York, NY 10104
212-390-9000
jselendy@selendygay.com
pselendy@selendygay.com
jmargolin@selendygay.com
msiller@selendygay.com

Re: Docket No. 17-035-61 Phase Two, Application of Rocky Mountain Power to Establish Export Credits for Customer Generated Electricity, Division of Public Utilities response to Vote Solar's Data Request Set 1.

Affirmative Testimony of Robert A. Davis

VS-DPU2-1 Please refer to DPU's direct testimonies filed on March 3, 2020, specifically the testimony of Robert A. Davis and associated exhibits and workpapers.

VS-DPU2-1.1 Refer to lines 186-188. Please provide all data, analysis, studies, reports, or other evidence supporting the statement, "*It is a reasonable assumption that additional variability has the potential to wear out certain distribution equipment at a faster rate than otherwise would occur*."

A: The Division has not compiled a comprehensive list of every published work on the topic as there are too many studies, white papers, and articles on this topic to cite or mention here. Please refer, as an example, to the presentation slide decks from the "Moving Parties Technical Conference" held on July 11, 2019 presented by the Lawrence Berkley National Laboratory and Pacific Northwest National Laboratory.[1] The presenters included: Kevin Schneider from Pacific Northwest National Laboratory, Juliet Homer from Pacific Northwest National Laboratory, and Galen Barbose from Lawrence Berkeley National Laboratory. Specifically, Mr. Schneider presented the fundamental components of the distribution system and how they operate with and without variable distributed energy. Among one of his many references cited during his presentation is NERC's Distributed Energy Resources: Connection Modeling and Reliability Considerations published in February of 2017.[2] Another white paper claims that high penetrations of PV might mitigate transformer insulation temperatures by serving to balance loads and therefore extend the lives of oil based transformers.[3]

VS-DPU2-1.2 Refer to lines 226-229. Please provide all data, analysis, studies, reports, or other evidence supporting the statement, "*Although distribution equipment is designed to meet load under such variable conditions, the addition of weather related or other solar induced variability attributes likely cause additional wear-and-tear on system components*."

A: See response to VS-DPU2-1.1.

VS-DPU2-1.3 Refer to lines 313-31.

(1) Please provide all data, analysis, studies, reports, or other evidence supporting the statement, *"The bi-directional flow of customer generation raises questions about the wear-and-tear on the system to reliably meet load."*

A: Mr. Davis's Workpapers for the LRS indicates noticeable variability in the exports and deliveries across all the sample sets throughout the year. Rather from customer generators using their own generation to meet load, or exporting to the grid, the

[1] Please refer to the attached Presentations slide decks accompanying this filing.
[2] See Executive Summary, and Chapter 2, Reliability Considerations for DER, pages 3-4 http://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/Distributed_Energy_Resources_Report.pdf.
[3] See https://core.ac.uk/download/pdf/19541682.pdf.

system has to adjust accordingly to meet load reliably and instantaneously. The system does this for non-customer generation customers as well but only for power flows in a single direction. When customer generation is added, the system has to adjust for not only deliveries but also exports including weather and other events that solar generation resources are prone to.

(2) Please provide the specific questions about the wear-and-tear on the system that the bi-directional flow of customer generation raises.

A: The *"specific questions"* referenced in Mr. Davis's testimony are rhetorical to make a point on the expansive topic of the numerous academic studies, national laboratory studies, utility studies, distribution company studies, etc., underway that attempt to identify and quantify the addition of renewable resources at every level of the bulk electric system. Most recently, WEIB and WIRAB offered a 5-Part Webinar series presented by Dr. Debbie Lew and Nick Miller on the reliability implications of going 100-percent renewable. The series included the following topics:[4]

Resource Adequacy – Long-Term Reliability
System Balancing – Medium-Term Reliability
System Stability Part 1 – Short-Term Reliability
System Stability Part 2 – Short-Term Reliability
100% Clean Energy and Distribution Energy

Specifically, part five, 100% Clean Energy and Distribution Energy, slide 40, *"DG can impact system costs and reliability,"* Impacts on the distribution system: 1) depends on DG profile compared to feeder loading; 2) depends on DG capabilities and functionalities; and 3) impacts of inverter based resources DG on protection. Impacts on the bulk power system: 1) variability and uncertainty of wind and solar; 2) generation not aligned with demand; 3) may lead to overbuilding of capacity; 4) may lead to oversupply, but DG can't be easily curtailed; 5) typically provision of energy only (may not include capacity or ancillary services); and 6) operational reliability – visibility, controls, and communication.

VS-DPU2-1.4 Refer to lines 340-347.

(1) Please provide all data, analysis, studies, reports, or other evidence supporting the statements, *"The distribution system … (has) to be available and adjust accordingly to keep the system reliable. This likely leads to additional wear-and-tear."*

A: See response to VS-DPU2-1.1.

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[4] The complete presentation recordings and slides can be found at: https://westernenergyboard.org/2020/04/wirab-webinar-series-grid-reliability-and-the-changing-resource-mix/.

(2) Please explain the DPU's understanding of what adjustments the distribution system makes to keep the system reliable in response to delivery and export variability.

A: Please refer to Mr. Davis's Direct testimony lines 358-366 and footnote 23. At a high level, regulators and tap-changing transformers make adjustments to keep the voltage and frequency within reliability standards as delivery and export changes throughout the day as the result of various reasons including weather events and usage patterns of customer generation located anywhere on any of RMP's numerous circuits in Utah.

VS-DPU2-1.5 Refer to lines 353-357. Please provide all data, analysis, studies, reports, or other evidence supporting the statements, " … *if customer generation levels increase, it is intuitive that … system components might wear out faster than normal, leading to increased costs to all rate payers.*"

A: See response to VS-DPU2-1.3. Numerous studies, data, analysis, reports, articles, exist on this topic. The Division has not compiled a comprehensive list. See for example: Seguin, Woyak, Costyk, Hambrick, and Mather. "High-Penetration PV Integration Handbook for Distribution" Jan. 2016.[5]

VS-DPU2-1.6 Please refer to all illustrations and figures included in the testimony and exhibits of Mr. Davis, as well as supporting workpapers.

(1) Please provide all workpapers, electronically, that support the illustrations and figures, with all analyses and equations included and no pasted values.

A: All of Mr. Davis's workpapers were provided to Vote Solar in VS-DPU1-1.1. Any pasted values used in any worksheet are sourced from a worksheet contained within the workbook for each sample set and month. Having links in every cell on one worksheet to every cell on another worksheet within the workbook do not function well for workbooks with such voluminous data.

(2) Please identify the unit(s) of measure in which all amounts are reported in these illustrations, figures, and supporting workpapers.

a. In particular, please identify the unit(s) of measure in which the amounts are reported in the spreadsheet included in DPU's Confidential Attachments to DPU's Response to Vote Solar's First Data Request (April 13, 20120[SIC]), titled "UT LRS Study_New Production Sample Residential_201906 CONF (DPU Analysis)," Sheet "Exports," Rows "1384 & 1417."

[5] https://www.nrel.gov/docs/fy16osti/63114.pdf .

A: Each fifteen-minute interval for rows 1384 and 1417 are in kW as reported by RMP.

(3) Please provide a step-by-step description of how the sampling weights were used to produce each of these illustrations and underlying workpapers, including how those sampling weights were derived, and all equations used to perform the calculations.

A: Please refer to Rocky Mountain Power's response to UCE Data Request 4.2, – Attach UCE 4.2-1, for the sampling weights used throughout Mr. Davis's workpapers.

1. Each Meter ID was verified across the Exports, Deliveries, and Production for each customer sample over the twelve-month study period using the function =LEFT(Exports!A2,7), =LEFT(Deliveries!A2,7), and =LEFT(Production!A2,7) to capture the common meter ID. The function =IF(AND(A2=B2,A2=C2,B2=C2),"",1) was then used to verify that the Exports, Deliveries, and Production contained the meter ID. If any one or two ID registers did not exist for all three, the meter ID was deleted from the data set for consistency.

2. A VLOOKUP Table was created for each customer class sample (i.e., Residential, Non-Residential and Schedule 135). Please refer to the Exports Tab in the file above for the following steps.

3. The ID was sampled for the Strata it fell into based on RMP's notes on the Notes Tab using the function =ABS(MID(A2,4,1)) for example.

4. The Strata Weight ("Strata Wgt") is determined using the VLOOKUP previously created and the function =VLOOKUP(IF(CV2=1,"Strata 1",IF(CV2=2,"Strata 2",IF(CV2=3,"Strata 3",IF(CV2=4,"Strata 4")))),$CV$1421:$CW$1424,2,0) for example.

5. The Strata Weight is then multiplied by each interval of every ID and divided by the average strata weight from the VLOOKUP Table for the customer class using the function =(D2*$CW2)/$CW$1425 for example.

6. This process is repeated for every interval of every ID for Exports, Deliveries, and Production for each sample set over the 12-month study period.

7. The mean of the daily averages for Exports, Deliveries, and Production for each month of the study period are determined with the function =AVERAGEIF($C$2:$C$1351,$A1354,CX$2:CX$1351) for example.

8. The Export tab for each of the sample classes over the study period has a sum of the daily sums ("Total Interval Exports") for each meter ID using the function =SUMIF($C$2:$C$1351,$A1387,CX$2:CX$1351) for example.

9. The strata weighted data gathered from the Exports, Deliveries, and Production is used to determine the full requirement, data, and charts on the Full Req Tab with the function =Deliveries!CX2+(Production!CX2-Exports!CX2) for example. This interval data is then used to find the Mean of the Daily Average Full Requirement using the function previously mentioned. The first, second, and third standard deviation is determined and added to the mean. Additionally, the Maximum Daily Interval is found using the function =MAX(CX1359:CX1388) for example from the mean of the daily average full requirement data, and the Month Max is the maximum of Max Daily Interval.

10. The Mean of the Daily Average Full Requirement, 3rd Std Dev plus Mean, Mean of Daily Average Exports, Mean of Daily Average Deliveries, and Mean of Daily Average Production are charted for each sample and month of the study period.

11. The Total Interval Exports from the Exports Tab of each sample and month is also charted in kW.

(4) Please identify all industry sources (e.g., textbooks, academic journals, etc.) which were used as references or guides for the derivation and usage of the sampling weights.

A: The Division relied on Rocky Mountain's revised LRS plan approved by the Commission in Phase One of the proceeding. See response to VS-DPU2-1.6(3).