**EXH. LIM-1T**
**DOCKETS UE-19___/UG-19___**
**2019 PSE GENERAL RATE CASE**
**WITNESS: LORIN I. MOLANDER**

**BEFORE THE**
**WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

| | |
|---|---|
| **WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION,**<br><br>**Complainant,**<br><br>**v.**<br><br>**PUGET SOUND ENERGY,**<br><br>**Respondent.** | **Docket UE-19____**<br>**Docket UG-19____** |

# PREFILED DIRECT TESTIMONY (NONCONFIDENTIAL) OF

# LORIN I. MOLANDER

# ON BEHALF OF PUGET SOUND ENERGY

**JUNE 20, 2019**

**PUGET SOUND ENERGY**

**PREFILED DIRECT TESTIMONY (NONCONFIDENTIAL) OF LORIN I. MOLANDER**

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## I. INTRODUCTION

**Q. Please state your name and business address.**

A. My name is Lorin I. Molander, and my business address is 355 110th Ave NE, Bellevue, Washington 98004. I am employed by Puget Sound Energy ("PSE") as Manager, Load Forecasting and Analysis.

**Q. Have you prepared an exhibit describing your education, relevant employment experience, and other professional qualifications?**

A. Yes. Please see the First Exhibit to the Prefiled Direct Testimony of Lorin I. Molander, Exh. LIM-2, for an exhibit describing my education, relevant employment experience, and other professional qualifications.

**Q. Please summarize the purpose of your testimony.**

A. The purpose of my testimony is to present PSE's electric and gas temperature adjustment methodologies and results used to develop the pro forma electric and gas sales for the test year in this proceeding, January through December 2018.

## II. ELECTRIC AND GAS SALES WEATHER NORMALIZATION

**Q. Generally speaking, what is sales weather normalization and how does PSE perform its sales weather normalization?**

A. The sales weather normalization is performed to adjust the test year sales volume so that the adjusted sales represent what the test year sales volume would have been if the weather had been normal. Weather normalization modifies the test year billing determinants and revenue requirements to be more representative of the average weather conditions expected when the rates proposed in this case go into effect.

PSE first analyzes the relationship between actual loads and temperatures for the most recent four-year period (2014 through 2017) and develops econometric models to measure temperature sensitivity of electric and gas energy use. Multivariate regression analysis is used to isolate the weather effects from other factors such as type of day (*e.g.,* weekdays, weekends or holidays) and seasonal effects not related to temperature. The estimated model coefficients of temperature variables are called "weather sensitivity coefficients."

Then, PSE uses the weather sensitivity coefficients and "normal" weather data to convert the actual test year sales to "normal weather" sales. PSE calculates the "normal" weather values from the actual historical temperature data compiled for the most recent thirty years.

**Q. Did PSE use the same weather normalization methodology in this case as in its last general rate case?**

A. Yes. The methodology used in this case is the same temperature adjustment methodology PSE used in Dockets UE-170033 and UG-170034 (the "2017 GRC"), except that the modeling input data period was updated from the four-year period of 2012–2015 to the period of 2014-2017 and the daily electric energy usage history by customer and rate schedule was collected from the samples refreshed in April 2015. The temperature adjustments of electric sales and gas sales performed by PSE were not contested in 2017 GRC.[1]

## A. Normal Versus Actual Test Year Weather

**Q. Please describe the actual weather experienced during this proceeding's test year.**

A. Based on monthly history of heating degree days, Table 1 compares the actual monthly weather in the test year and the previous ten years with the normal weather defined by the average values calculated for the most recent thirty years of 1988-2017. The hourly temperatures recorded at Seattle-Tacoma International Airport ("Sea-Tac") were used to calculate daily average temperatures. The daily average temperatures were then converted to heating degree days ("HDDs") with a base temperature of 65˚F.[2] Monthly total HDDs were obtained by summing the

[1] *See* Dockets UE-170033/UG-170034 (consolidated), Order 08, App. A (December 5, 2017).

[2] A heating degree day (HDD) is the negative deviation in average daily temperature from the base temperature. For a base temperature of 65˚F, heating degree days equal 65 minus the average daily

daily HDD for the month. For the test year, the overall weather, as measured by the sum of monthly total HDDs in January through December 2018, was significantly milder than normal. The only exception was February 2018 when it was 9 percent colder than normal. Total number of test year HDDs was 4,278 and was 10.9 percent lower than the annual sum of normal HDDs, 4,800.

**Table 1**

**Monthly History of HDD65, Jan. 2008 - Dec. 2018**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 30-Year Normal* | % Diff from Normal (1/2018-12/2018) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan | 820 | 813 | 562 | 716 | 778 | 828 | 666 | 629 | 664 | 846 | 629 | **723** | -13.1% |
| Feb | 630 | 660 | 515 | 726 | 629 | 581 | 657 | 457 | 516 | 672 | 673 | **617** | 9.0% |
| Mar | 694 | 725 | 564 | 624 | 684 | 539 | 536 | 456 | 510 | 603 | 589 | **592** | -0.5% |
| Apr | 568 | 486 | 486 | 596 | 436 | 444 | 405 | 428 | 290 | 451 | 419 | **450** | -6.9% |
| May | 306 | 294 | 388 | 406 | 317 | 235 | 213 | 213 | 189 | 258 | 172 | **297** | -41.9% |
| Jun | 252 | 95 | 224 | 199 | 220 | 77 | 126 | 44 | 123 | 125 | 125 | **163** | -23.2% |
| Jul | 71 | 41 | 113 | 80 | 68 | 23 | 21 | 8 | 34 | 19 | 17 | **57** | -70.9% |
| Aug | 77 | 59 | 95 | 44 | 31 | 8 | 13 | 18 | 32 | 5 | 25 | **48** | -47.2% |
| Sep | 144 | 122 | 155 | 96 | 110 | 114 | 63 | 165 | 137 | 102 | 117 | **137** | -14.7% |
| Oct | 422 | 404 | 377 | 412 | 360 | 432 | 239 | 260 | 340 | 389 | 366 | **386** | -5.1% |
| Nov | 482 | 556 | 652 | 659 | 550 | 519 | 583 | 636 | 428 | 564 | 494 | **584** | -15.4% |
| Dec | 866 | 841 | 683 | 788 | 733 | 774 | 624 | 694 | 841 | 781 | 653 | **748** | -12.6% |
| Total | 5,332 | 5,095 | 4,816 | 5,346 | 4,916 | 4,573 | 4,145 | 4,007 | 4,105 | 4,813 | 4,278 | **4,800** | |
| % Diff. from Normal | 10.6% | 6.1% | 0.3% | 11.4% | 2.0% | -4.7% | -13.6% | -16.5% | -14.8% | 0.3% | -10.9% | | |

*February normal value is shown for a non-leap year. Percent differences from normal for 2008, 2012 and 2016 are based on the leap-year normal value of 4,809 HDD's.

Normal weather values are 30-year average values for 1988-2017.

The deviation from normal weather was more substantial for some months. As shown in the last column of Table 1, the winter weather in January and November 2018 was 13.1 percent and 15.4 percent warmer than normal, respectively. The summer weather in July and August 2018 was also warmer than normal by 70.9 percent and 47.2 percent, respectively.

temperature (if the average temperature is less than 65). If the average daily temperature is greater than 65, HDD is 0. Thus, one day that averages 35˚F would have 30 HDDs (using a base of 65˚F). Similarly, 30 days with an average temperature of 64˚F each day would also have 30 HDDs.

## B. Temperature Adjustment of Electric Sales

**Q. Please describe how the electric sales temperature adjustment was calculated.**

A. The system-level temperature adjustment was calculated by month and allocated to each of the applicable rate schedules, based on a temperature adjustment methodology identical to the one used in PSE's 2017 GRC, with the hourly temperature and daily energy use data updated for Jan. 1, 2014 through Dec. 31, 2017.

**Q. Please describe how the system-level test year load was normalized for weather.**

A. PSE used weather sensitivity coefficients based on actual daily load data and actual temperature data at Sea-Tac to adjust system-level delivered load (Generated, Purchased and Interchanged load, or "GPI") for weather. The weather sensitivity coefficients were estimated by developing an econometric model with a four-year (2014-2017) history of daily GPI, HDDs and cooling degree days ("CDDs").[3] The temperature variable coefficients vary by month. This is the same methodology PSE used in its last three general rate cases.

PSE's "normal" weather dataset was developed using the hourly temperature data recorded at Sea-Tac over the 30-year period from 1988 through 2017 by calculating daily HDDs and CDDs using several base temperatures (45˚F and

[3] A CDD is calculated in the same way as an HDD is calculated, except that it counts number of degrees above the base temperature.

65˚F for HDDs; 60˚F and 65˚F for CDDs). PSE then calculated the amount of temperature adjustment by taking the temperature variable coefficients from the econometric model and multiplying them by the difference between the actual and normal HDDs and CDDs. This process was performed on a monthly basis and aggregated for all of the HDD and CDD variables included in the model.

**Q. Please summarize the results of electric sales weather normalization at system-level.**

A. As shown in Table 2, below, applying the process described above to the test year GPI load of 22,233,672 megawatt hours ("MWh") resulted in a total adjustment of 145,584 MWh, or 135,248 MWh delivered load when adjusted for losses. Because the test year winter was warmer than normal, this adjustment resulted in a pro forma delivered system load that is larger than actual load delivered during the test year.

**Table 2**

**Temperature Adjustment of Test Year Electric GPI**

| Month | Actual GPI (MWh) | Temp. Adj. GPI (MWh) | Adj. (MWh) | Adj. (MWh) net of Losses |
|---|---|---|---|---|
| (1) | (2) | (3) | (4)=(3)-(2) | (5)=(4)*(1-0.071) |
| Jan-18 | 2,215,266 | 2,305,584 | 90,318 | 83,905 |
| Feb-18 | 2,064,899 | 2,007,992 | (56,907) | (52,866) |
| Mar-18 | 2,062,414 | 2,068,533 | 6,119 | 5,685 |
| Apr-18 | 1,768,078 | 1,779,404 | 11,327 | 10,522 |
| May-18 | 1,593,061 | 1,611,520 | 18,459 | 17,148 |
| Jun-18 | 1,565,952 | 1,559,953 | (5,999) | (5,573) |
| Jul-18 | 1,749,554 | 1,684,288 | (65,267) | (60,633) |
| Aug-18 | 1,709,932 | 1,675,731 | (34,200) | (31,772) |
| Sep-18 | 1,543,736 | 1,545,952 | 2,216 | 2,059 |
| Oct-18 | 1,770,978 | 1,778,614 | 7,636 | 7,093 |
| Nov-18 | 1,944,415 | 2,027,306 | 82,891 | 77,006 |
| Dec-18 | 2,245,387 | 2,334,378 | 88,991 | 82,673 |
| Total | 22,233,672 | 22,379,256 | 145,584 | 135,248 |

**Q. How did you allocate the temperature adjustment among electric rate schedules?**

A. PSE used a three-step process to allocate the system-level temperature adjustment to rate schedules (classes) in order to produce rate schedule pro forma temperature-adjusted billing determinants. The first step was to develop econometric model equations to characterize the relationship between the temperature variables and the daily energy use per customer by class. The temperature variable coefficients of those equations vary by rate class. The data source for this step was a large sample of daily energy readings by rate schedule from PSE's automated meter reading database. The historical data period set for modeling is the same four-year period of 2014 through 2017 as used for the system weather sensitivity modeling.

The second step was to calculate the temperature adjustment to monthly energy use per customer for each rate schedule by taking the temperature variable

coefficients from the class model equation and multiplying them by the difference between the actual and normal HDDs and CDDs for the month.

The third step was to estimate monthly adjustment to class total sales by multiplying the monthly adjustment per customer calculated in the previous step by the actual number of customers by month and rate schedule. The amount of monthly adjustment at the GPI level was allocated to each of the applicable schedules by calculating the percentage share of each schedule's adjustment amount relative to the sum of temperature adjustment for all classes as estimated through the rate class normalization process, and by multiplying the system total temperature adjustment by this percentage share.

**Q. Are the proposed changes to schedule 40 reflected in the electric sales weather normalization?**

A. Yes. As described in the Prefiled Direct Testimony of Jon A. Piliaris, Exh. JAP-1T, Schedule 40 will be closed and current customers under this schedule will be migrated to the schedules that best fit their usage characteristics. The pro forma revenue adjustment presented in Exh. JAP-3 is an allocation of the current schedule 40 customers' historical usage during the test year to their receiving schedules. For weather normalization, current Schedule 40 customers' test year sales were adjusted as a class, and then the adjusted sales were allocated to their receiving schedules.

**Q. What are the impacts of the proposed Schedule 40 changes to the electric sales weather normalization?**

A. For temperature normalization, test year sales of Schedule 40 customers were normalized using the Schedule 40 coefficients, then allocated to other schedules in proportion to load moving to those schedules from Schedule 40. For the Schedule 40 customer loads that are proposed to move to the Special Contract, the temperature normalization methodology remains the same as if they were on Schedule 40 before the schedule migration. Given that loads for this class are included in total system sales during the test year, the system level temperature adjustment includes the temperature adjustment for this Special Contract class. Therefore, the total system weather adjustment reflects the sales classes and the proposed wheeling class combined.

**Q. Please summarize the final results of rate schedule level electric sales weather normalization.**

A. When the GPI temperature adjustment was allocated to the rate schedules, residential sales increased by 128,083 MWh. The sales for general service, small demand general service, interruptible primary general service, and resale also increased. The irrigation load is sensitive only to the summer weather. The sum of monthly CDDs calculated with the base temperature of 60˚F in May through September 2018 was 749 and it was 42.3 percent higher than the thirty-year normal value of 527. Consequently, the actual irrigation sales were lowered by 2.8 percent when the sales were temperature normalized for the warmer-than-

normal summer weather. The large demand general service, primary general service, and special contract classes have significant electric energy use in the summer. Therefore, temperature normalization lowered the test-year actual sales slightly by 0.2 percent, in spite of the warmer-than-normal winter weather that prevailed in the test year. Table 3 presents the temperature adjustment of electric sales by rate schedule.

# Table 3

**Temperature Adjustment of Test Year Electric Sales by Rate Schedule (MWh)**

| | Residential (Sch. 7, 17, 27, 37 & 47) | | | General Service (GS) (Sch. 8 & 24) | | | Small Demand GS (Sch. 7A, 11 & 25) | | |
|---|---|---|---|---|---|---|---|---|---|
| Month | Actual | Normalized | Adj. | Actual | Normalized | Adj. | Actual | Normalized | Adj. |
| Jan-18 | 1,245,600 | 1,312,478 | 66,878 | 270,133 | 278,761 | 8,627 | 268,815 | 274,364 | 5,549 |
| Feb-18 | 1,123,203 | 1,081,188 | (42,015) | 250,689 | 245,207 | (5,482) | 261,334 | 257,735 | (3,599) |
| Mar-18 | 1,119,824 | 1,124,112 | 4,288 | 249,869 | 250,614 | 745 | 262,628 | 263,224 | 596 |
| Apr-18 | 924,598 | 933,663 | 9,065 | 222,463 | 223,276 | 813 | 243,874 | 244,220 | 346 |
| May-18 | 741,370 | 757,682 | 16,313 | 203,775 | 204,638 | 863 | 238,525 | 238,373 | (152) |
| Jun-18 | 663,353 | 659,762 | (3,591) | 201,892 | 201,196 | (696) | 233,344 | 232,698 | (646) |
| Jul-18 | 670,337 | 631,250 | (39,087) | 209,798 | 202,216 | (7,582) | 237,185 | 230,189 | (6,996) |
| Aug-18 | 735,329 | 714,848 | (20,481) | 226,736 | 222,762 | (3,973) | 268,208 | 264,545 | (3,663) |
| Sep-18 | 680,363 | 681,692 | 1,328 | 214,191 | 214,449 | 258 | 242,319 | 242,557 | 237 |
| Oct-18 | 687,721 | 693,718 | 5,998 | 199,478 | 199,994 | 516 | 230,322 | 230,523 | 201 |
| Nov-18 | 842,221 | 905,701 | 63,480 | 210,677 | 217,580 | 6,903 | 236,704 | 240,607 | 3,903 |
| Dec-18 | 1,085,745 | 1,151,653 | 65,908 | 239,355 | 247,769 | 8,415 | 261,158 | 266,747 | 5,589 |
| Total | 10,519,663 | 10,647,747 | 128,083 | 2,699,055 | 2,708,462 | 9,407 | 2,984,416 | 2,985,781 | 1,365 |

| | Large Demand GS (Sch. 12 & 26) | | | Primary GS (Sch. 10 & 31) | | | Seasonal Irrigation (Sch. 29) | | |
|---|---|---|---|---|---|---|---|---|---|
| Month | Actual | Normalized | Adj. | Actual | Normalized | Adj. | Actual | Normalized | Adj. |
| Jan-18 | 161,946 | 162,580 | 634 | 123,559 | 124,239 | 680 | 269 | 269 | - |
| Feb-18 | 162,491 | 162,103 | (389) | 126,618 | 126,188 | (431) | 276 | 276 | - |
| Mar-18 | 151,989 | 151,967 | (22) | 110,877 | 110,858 | (19) | 281 | 281 | - |
| Apr-18 | 148,168 | 148,238 | 70 | 117,464 | 117,539 | 75 | 267 | 267 | - |
| May-18 | 153,898 | 153,786 | (112) | 114,578 | 114,626 | 48 | 709 | 692 | (17) |
| Jun-18 | 158,919 | 158,542 | (377) | 109,383 | 109,243 | (141) | 1,879 | 1,853 | (25) |
| Jul-18 | 167,929 | 163,803 | (4,126) | 123,016 | 121,357 | (1,659) | 3,447 | 3,164 | (284) |
| Aug-18 | 190,165 | 188,002 | (2,163) | 124,370 | 123,539 | (831) | 4,528 | 4,378 | (150) |
| Sep-18 | 171,079 | 171,219 | 140 | 119,716 | 119,769 | 53 | 3,436 | 3,445 | 10 |
| Oct-18 | 159,566 | 159,694 | 128 | 116,171 | 116,308 | 137 | 1,100 | 1,100 | - |
| Nov-18 | 149,974 | 150,672 | 698 | 105,107 | 105,819 | 711 | 310 | 310 | - |
| Dec-18 | 164,291 | 164,936 | 645 | 120,611 | 121,282 | 670 | 224 | 224 | - |
| Total | 1,940,413 | 1,935,540 | (4,873) | 1,411,472 | 1,410,766 | (706) | 16,726 | 16,260 | (466) |

| | Special Contract (Proposed Wheeling Services) | | | Interrupt. Primary GS for Schools (Sch. 43) | | | Resale (Sch. 5) | | |
|---|---|---|---|---|---|---|---|---|---|
| Month | Actual | Normalized | Adj. | Actual | Normalized | Adj. | Actual | Normalized | Adj. |
| Jan-18 | 32,012 | 32,238 | 226 | 14,706 | 15,985 | 1,279 | 997 | 1,029 | 32 |
| Feb-18 | 28,239 | 28,113 | (126) | 13,348 | 12,543 | (805) | 897 | 877 | (20) |
| Mar-18 | 32,730 | 32,717 | (13) | 14,774 | 14,881 | 107 | 944 | 945 | 2 |
| Apr-18 | 29,653 | 29,678 | 24 | 12,168 | 12,291 | 123 | 777 | 781 | 5 |
| May-18 | 28,627 | 28,627 | 0 | 9,528 | 9,723 | 195 | 591 | 601 | 10 |
| Jun-18 | 27,310 | 27,236 | (74) | 8,208 | 8,186 | (22) | 388 | 387 | (0) |
| Jul-18 | 29,390 | 28,739 | (651) | 6,333 | 6,091 | (243) | 316 | 311 | (5) |
| Aug-18 | 31,556 | 31,174 | (382) | 5,565 | 5,439 | (126) | 285 | 283 | (3) |
| Sep-18 | 30,001 | 30,026 | 25 | 5,746 | 5,755 | 8 | 298 | 298 | 0 |
| Oct-18 | 17,505 | 17,538 | 34 | 7,996 | 8,073 | 77 | 353 | 357 | 3 |
| Nov-18 | 35,966 | 36,240 | 274 | 9,194 | 10,199 | 1,005 | 515 | 547 | 31 |
| Dec-18 | 28,405 | 28,614 | 209 | 12,573 | 13,778 | 1,206 | 769 | 799 | 31 |
| Total | 351,393 | 350,941 | (453) | 120,139 | 122,943 | 2,803 | 7,131 | 7,217 | 86 |

| | Total (Including Proposed Wheeling Services) | | |
|---|---|---|---|
| Month | Actual | Normalized | Adj. |
| Jan-18 | 2,118,038 | 2,201,943 | 83,905 |
| Feb-18 | 1,967,096 | 1,914,230 | (52,866) |
| Mar-18 | 1,943,915 | 1,949,600 | 5,685 |
| Apr-18 | 1,699,431 | 1,709,953 | 10,522 |
| May-18 | 1,491,601 | 1,508,749 | 17,148 |
| Jun-18 | 1,404,676 | 1,399,103 | (5,573) |
| Jul-18 | 1,447,752 | 1,387,120 | (60,633) |
| Aug-18 | 1,586,742 | 1,554,970 | (31,772) |
| Sep-18 | 1,467,149 | 1,469,209 | 2,059 |
| Oct-18 | 1,420,211 | 1,427,305 | 7,093 |
| Nov-18 | 1,590,668 | 1,667,674 | 77,006 |
| Dec-18 | 1,913,129 | 1,995,802 | 82,673 |
| Total | 20,050,409 | 20,185,656 | 135,248 |

**Q. What is the effect of weather normalization on the electric revenue in the test year?**

A. The positive adjustment to electric load had the effect of increasing pro forma revenue by $14,386,106, as shown in the Second Exhibit to Prefiled Direct Testimony of Jon A. Piliaris, Exh. JAP-3.

**Q. Is PSE's electric cost of service analysis and rate design study based on the weather-normalized sales?**

A. Yes. Please see the Prefiled Direct Testimony of Birud D. Jhaveri, Exh. BDJ-1T, for an explanation of PSE's electric cost of service analysis and the Prefiled Direct Testimony of Jon A. Piliaris, Exh. JAP-1T, for an explanation of PSE's electric rate design. PSE's electric cost of service analysis includes the temperature-adjusted power costs, and the electric rate design is based on the pro forma adjustment of energy sales made for the milder-than-normal winter and warmer-than-normal summer weather in the test year. In addition, the energy cost allocation factors used in PSE's electric cost of service analysis reflect the temperature-adjusted loads.

## C. <u>Temperature Adjustment of Gas Sales</u>

**Q. Please describe how the gas sales weather normalization was calculated.**

A. The system-level temperature adjustment was calculated in total and allocated to each of the applicable classes by month based on the same gas temperature adjustment methodology as the one used in PSE's 2017 GRC. The hourly

temperature and daily and monthly gas sales data used for modeling were updated for this proceeding.

**Q. Please describe how the system-level gas throughput in the test year was normalized for weather.**

A. As was done in PSE's 2017 GRC, PSE used the weather-sensitivity model coefficients based on actual daily load data and actual temperature at Sea-Tac to adjust system-level delivered gas loads (Firm, Interruptible and Transport) for weather. The weather-sensitivity model coefficients were estimated on the basis of the daily gas load and weather data compiled for the most current four-year period of 2014 through 2017. As with the electricity model, PSE's "normal" weather dataset was developed using the hourly temperature data recorded at Sea-Tac over the 30-year period from 1988 through 2017. Also consistent with the electric model, the actual daily HDDs were calculated using the average of the 24 hourly temperatures compared against the base temperature. The amount of temperature adjustment was calculated by multiplying the weather sensitivity coefficients by the difference between the actual and normal HDDs. This calculation was performed on a monthly basis and aggregated for all of the HDD variables included in the system model.

**Q. Please summarize the results of gas throughput weather normalization at system-level.**

A. As shown in Table 4, below, applying the process described above to the test year total gas throughput of 1,130,612,460 therms resulted in a total adjustment of

56,683,958 therms. Because the test year winter was warmer than normal, this adjustment resulted in a pro forma delivered system load that is greater than actual load delivered during the test year.

**Table 4**

**Temperature Adjustment of Test Year Gas Throughput**

| Month | Actual Therms | Normalized Therms | Adjustments Therms |
|---|---|---|---|
| (1) | (2) | (3) | (4)=(3)-(2) |
| Jan-18 | 145,858,120 | 163,068,250 | 17,210,130 |
| Feb-18 | 149,355,720 | 138,709,275 | (10,646,445) |
| Mar-18 | 131,713,410 | 132,362,277 | 648,867 |
| Apr-18 | 97,640,820 | 100,983,310 | 3,342,490 |
| May-18 | 56,729,800 | 65,906,147 | 9,176,347 |
| Jun-18 | 51,041,240 | 52,881,154 | 1,839,914 |
| Jul-18 | 43,564,290 | 43,564,290 | - |
| Aug-18 | 44,162,010 | 44,162,010 | - |
| Sep-18 | 50,757,360 | 51,901,678 | 1,144,318 |
| Oct-18 | 88,421,440 | 90,700,437 | 2,278,997 |
| Nov-18 | 117,489,220 | 132,898,253 | 15,409,033 |
| Dec-18 | 153,879,030 | 170,159,337 | 16,280,307 |
| Total | 1,130,612,460 | 1,187,296,418 | 56,683,958 |

**Q. How did you allocate the temperature adjustment among gas rate schedules?**

**A**. Initially, monthly gas usage patterns by rate schedule were evaluated to identify which rate classes are weather sensitive. Monthly histories of class gas sales and HDDs were plotted for the most recent four years and the scatter grams were evaluated for any correlation between the changes in class gas sales and temperature. This analysis revealed that the following rate classes are temperature sensitive:

- Schedule 23 (Residential),
- Schedule 31 (Commercial, Industrial),
- Schedule 41 (Commercial, Industrial, Transport Commercial),
- Schedules 85 (Interruptible Commercial, Transport Commercial),
- Schedule 86 (Interruptible Commercial),
- Schedule 87 (Interruptible Commercial, Transport Commercial), and
- Special Contracts.

Econometric model equations were developed and estimated to characterize the relationship between monthly HDDs and average use per customer for each of the above weather sensitive classes. For each month of the test year, the amount of temperature adjustment to system total delivered load was then allocated to each of the applicable classes by taking the percentage share of each schedule's temperature adjustment relative to the sum of temperature adjustments for all weather sensitive schedules as calculated by the class sales normalization equations, and by then multiplying the system load temperature adjustment by this percentage share. The Schedule 31 Transport Industrial class included only one customer, and that customer had switched from Schedule 31 Industrial class in August 2017. Since there were very limited historical usage data for this schedule, we applied the same coefficient developed for Schedule 31 Industrial to Schedule 31 Transport Industrial to calculate the weather adjustment for this class.

**Q. Please summarize the final results of schedule-level gas sales weather normalization.**

A. Table 5 presents the temperature adjustment of sales by rate schedule. As shown in the table, applying the process described above to the test year gas total sales to the weather sensitive rate schedules results in a total temperature adjustment of 56,683,958 therms. When the system temperature adjustment was allocated to the rate schedules, the total test year sales of the weather-sensitive schedules were increased. The residential class represents 73.4 percent of the total temperature adjustment, increasing by 41,587,358 therms.

# Table 5

**Temperature Adjustment of Test Year Gas Sales by Rate Schedule (Therms)**

| | Residential (Sch.23) | | | General service - commercial (Sch.31) | | | Large volume - commercial (Sch.41) | | | Trans. large volume - commercial (Sch.41T) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Actual | Normalized | Adjustments | Actual | Normalized | Adjustments | Actual | Normalized | Adjustments | Actual | Normalized | Adjustments |
| Jan-18 | 85,104,432 | 97,231,115 | 12,126,683 | 28,406,290 | 31,599,790 | 3,193,500 | 6,582,986 | 7,214,331 | 631,345 | 1,255,972 | 1,309,932 | 53,960 |
| Feb-18 | 80,987,939 | 73,373,167 | (7,614,772) | 26,930,630 | 25,012,813 | (1,917,817) | 6,376,976 | 5,993,205 | (383,771) | 1,219,491 | 1,187,686 | (31,805) |
| Mar-18 | 75,376,979 | 75,850,007 | 473,028 | 25,554,926 | 25,673,601 | 118,675 | 6,238,487 | 6,265,432 | 26,945 | 1,249,376 | 1,250,468 | 1,092 |
| Apr-18 | 47,865,394 | 50,273,385 | 2,407,991 | 17,577,729 | 18,118,327 | 540,598 | 4,791,691 | 4,928,873 | 137,182 | 1,121,320 | 1,133,841 | 12,521 |
| May-18 | 24,076,170 | 30,885,642 | 6,809,472 | 10,860,039 | 12,139,670 | 1,279,631 | 3,331,563 | 3,787,247 | 455,684 | 1,056,153 | 1,082,137 | 25,984 |
| Jun-18 | 17,720,710 | 19,280,945 | 1,560,235 | 8,913,208 | 8,913,208 | 0 | 2,788,619 | 2,913,206 | 124,587 | 1,066,639 | 1,066,639 | 0 |
| Jul-18 | 13,445,152 | 13,445,152 | 0 | 7,744,333 | 7,744,333 | 0 | 2,291,090 | 2,291,090 | 0 | 1,034,134 | 1,034,134 | 0 |
| Aug-18 | 13,243,857 | 13,243,857 | 0 | 7,814,836 | 7,814,836 | 0 | 2,322,665 | 2,322,665 | 0 | 1,072,056 | 1,072,056 | 0 |
| Sep-18 | 20,690,219 | 21,691,921 | 1,001,702 | 9,638,897 | 9,638,897 | 0 | 2,861,816 | 2,910,931 | 49,115 | 1,024,131 | 1,024,131 | 0 |
| Oct-18 | 42,558,824 | 44,274,555 | 1,715,731 | 15,331,465 | 15,665,380 | 333,915 | 4,195,812 | 4,284,149 | 88,337 | 1,214,628 | 1,221,207 | 6,579 |
| Nov-18 | 66,477,180 | 77,701,214 | 11,224,034 | 22,131,530 | 24,779,678 | 2,648,148 | 5,387,399 | 5,931,243 | 543,844 | 1,262,887 | 1,315,468 | 52,581 |
| Dec-18 | 84,527,896 | 96,411,150 | 11,883,254 | 28,131,199 | 31,215,172 | 3,083,973 | 6,479,350 | 7,062,948 | 583,598 | 1,392,881 | 1,430,167 | 37,286 |
| Test Year | 572,074,751 | 613,662,109 | 41,587,358 | 209,035,080 | 218,315,703 | 9,280,623 | 53,648,452 | 55,905,318 | 2,256,866 | 13,969,669 | 14,127,867 | 158,198 |

| | Trans. interrupt with firm option - com (Sch.85T) | | | Trans. non-exclus inter w/ firm option - com (Sch.87T) | | | Interruptible with firm option - com (Sch.85) | | | Limited interrupt w/ firm option - com (Sch.86) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Actual | Normalized | Adjustments | Actual | Normalized | Adjustments | Actual | Normalized | Adjustments | Actual | Normalized | Adjustments |
| Jan-18 | 2,118,212 | 2,213,985 | 95,773 | 1,951,460 | 2,119,317 | 167,857 | 1,710,516 | 1,780,825 | 70,309 | 1,186,743 | 1,258,725 | 71,982 |
| Feb-18 | 2,005,289 | 1,964,790 | (40,499) | 1,961,094 | 1,871,109 | (89,985) | 1,579,737 | 1,536,380 | (43,357) | 1,096,746 | 1,049,739 | (47,007) |
| Mar-18 | 2,104,201 | 2,105,814 | 1,613 | 1,857,443 | 1,860,192 | 2,749 | 1,642,259 | 1,643,991 | 1,732 | 1,108,344 | 1,110,166 | 1,822 |
| Apr-18 | 1,832,042 | 1,852,946 | 20,904 | 1,599,861 | 1,637,012 | 37,151 | 1,243,655 | 1,250,763 | 7,108 | 835,353 | 842,757 | 7,404 |
| May-18 | 1,801,033 | 1,863,363 | 62,330 | 1,278,690 | 1,388,276 | 109,586 | 920,235 | 920,235 | 0 | 473,407 | 473,407 | 0 |
| Jun-18 | 1,732,174 | 1,750,711 | 18,537 | 1,168,041 | 1,192,988 | 24,947 | 733,126 | 733,126 | 0 | 313,207 | 313,207 | 0 |
| Jul-18 | 1,682,576 | 1,682,576 | 0 | 1,014,528 | 1,014,528 | 0 | 646,477 | 646,477 | 0 | 213,504 | 213,504 | 0 |
| Aug-18 | 1,684,576 | 1,684,576 | 0 | 1,093,444 | 1,093,444 | 0 | 706,237 | 706,237 | 0 | 207,293 | 207,293 | 0 |
| Sep-18 | 1,685,125 | 1,685,125 | 0 | 1,127,082 | 1,127,082 | 0 | 840,775 | 840,775 | 0 | 346,636 | 346,636 | 0 |
| Oct-18 | 1,955,499 | 1,965,728 | 10,229 | 1,437,828 | 1,451,825 | 13,997 | 1,111,617 | 1,118,634 | 7,017 | 669,628 | 678,088 | 8,460 |
| Nov-18 | 1,997,482 | 2,082,838 | 85,356 | 1,539,689 | 1,692,685 | 152,996 | 1,379,652 | 1,393,487 | 13,835 | 911,643 | 927,405 | 15,762 |
| Dec-18 | 2,140,110 | 2,203,011 | 62,901 | 1,913,417 | 2,024,831 | 111,414 | 1,648,220 | 1,648,220 | 0 | 1,140,252 | 1,140,252 | 0 |
| Test Year | 22,738,318 | 23,055,462 | 317,144 | 17,942,576 | 18,473,288 | 530,712 | 14,162,505 | 14,219,149 | 56,644 | 8,502,756 | 8,561,179 | 58,423 |

| | Non-excl interrupt w/ firm option - com (Sch.87) | | | General service - industrial (Sch.31) | | | Large volume - industrial (Sch.41) | | | Special contracts - ind (Sch.SC) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Actual | Normalized | Adjustments | Actual | Normalized | Adjustments | Actual | Normalized | Adjustments | Actual | Normalized | Adjustments |
| Jan-18 | 2,488,073 | 2,582,095 | 94,022 | 1,964,847 | 2,219,902 | 255,055 | 946,436 | 984,924 | 38,488 | 4,032,428 | 4,443,468 | 411,040 |
| Feb-18 | 2,506,046 | 2,453,870 | (52,176) | 1,883,109 | 1,725,084 | (158,025) | 901,078 | 881,329 | (19,749) | 4,114,898 | 3,867,486 | (247,412) |
| Mar-18 | 2,429,944 | 2,432,020 | 2,076 | 1,683,126 | 1,692,829 | 9,703 | 919,255 | 921,279 | 2,024 | 3,806,411 | 3,813,819 | 7,408 |
| Apr-18 | 2,066,251 | 2,074,670 | 8,419 | 1,065,369 | 1,110,311 | 44,942 | 811,446 | 819,888 | 8,442 | 3,156,368 | 3,266,173 | 109,805 |
| May-18 | 1,485,710 | 1,485,710 | 0 | 562,256 | 680,690 | 118,434 | 700,123 | 725,124 | 25,001 | 2,317,402 | 2,607,580 | 290,178 |
| Jun-18 | 1,430,551 | 1,430,551 | 0 | 430,018 | 454,548 | 24,530 | 670,895 | 670,895 | 0 | 2,136,885 | 2,223,953 | 87,068 |
| Jul-18 | 1,280,281 | 1,280,281 | 0 | 369,763 | 369,763 | 0 | 638,238 | 638,238 | 0 | 1,816,114 | 1,816,114 | 0 |
| Aug-18 | 1,275,025 | 1,275,025 | 0 | 382,879 | 382,879 | 0 | 644,626 | 644,626 | 0 | 1,897,096 | 1,897,096 | 0 |
| Sep-18 | 1,372,716 | 1,372,716 | 0 | 535,010 | 552,108 | 17,098 | 662,632 | 662,632 | 0 | 2,160,926 | 2,237,329 | 76,403 |
| Oct-18 | 1,747,771 | 1,756,850 | 9,079 | 946,105 | 975,720 | 29,615 | 795,181 | 802,617 | 7,436 | 2,895,916 | 2,944,519 | 48,603 |
| Nov-18 | 2,133,442 | 2,152,439 | 18,997 | 1,460,899 | 1,668,489 | 207,590 | 876,759 | 909,907 | 33,148 | 3,341,001 | 3,753,743 | 412,742 |
| Dec-18 | 2,585,495 | 2,585,495 | 0 | 1,858,886 | 2,097,195 | 238,309 | 898,129 | 931,087 | 32,958 | 3,972,972 | 4,219,586 | 246,614 |
| Test Year | 22,801,307 | 22,881,724 | 80,417 | 13,142,269 | 13,929,520 | 787,251 | 9,464,798 | 9,592,546 | 127,748 | 35,648,418 | 37,090,867 | 1,442,449 |

| | Trans. General Service - Industrial (Sch.31T) | | | Total weather normalized portion of volume | | |
|---|---|---|---|---|---|---|
| Month | Actual | Normalized | Adjustments | Actual | Normalized | Adjustments |
| Jan-18 | 2,531 | 2,646 | 115 | 137,750,927 | 154,961,056 | 17,210,129 |
| Feb-18 | 3,906 | 3,837 | (69) | 131,566,938 | 120,920,494 | (10,646,444) |
| Mar-18 | 2,821 | 2,823 | 2 | 123,973,571 | 124,622,440 | 648,869 |
| Apr-18 | 1,981 | 2,003 | 22 | 83,968,460 | 87,310,949 | 3,342,489 |
| May-18 | 596 | 643 | 47 | 48,863,377 | 58,039,724 | 9,176,347 |
| Jun-18 | 27 | 37 | 10 | 39,104,101 | 40,944,015 | 1,839,914 |
| Jul-18 | 0 | 0 | 0 | 32,176,190 | 32,176,190 | 0 |
| Aug-18 | 0 | 0 | 0 | 32,344,589 | 32,344,589 | 0 |
| Sep-18 | 0 | 0 | 0 | 42,945,966 | 44,090,284 | 1,144,318 |
| Oct-18 | 0 | 0 | 0 | 74,860,273 | 77,139,271 | 2,278,998 |
| Nov-18 | 0 | 0 | 0 | 108,899,562 | 124,308,595 | 15,409,033 |
| Dec-18 | 0 | 0 | 0 | 136,688,807 | 152,969,114 | 16,280,307 |
| Test Year | 11,862 | 11,989 | 127 | 993,142,761 | 1,049,826,721 | 56,683,960 |

**Q. What is the effect of the temperature adjustment on the gas revenue for the test year in this proceeding?**

A. The positive adjustment to volume had the effect of increasing pro forma revenue by $35,164,424, as shown in Exh. JAP-4.

**Q. Is PSE's gas cost of service analysis and rate design study based on the weather-normalized sales?**

A. Yes. Please see the Prefiled Direct Testimony of John D. Taylor, Exh. JDT-1T, for a description of PSE's gas cost of service analysis and gas rate design study. PSE's gas cost of service and rate design are based on the pro forma adjustment of gas sales made for the milder than normal test year weather. In addition, the gas energy cost allocation factors used in PSE's cost of service analysis reflect the temperature-adjusted loads.

## III. CONCLUSION

**Q. Does this conclude your testimony?**

A. Yes, it does.