EXH. CD -1T
DOCKETS UE-22___/UG-22___
2022 PSE GENERAL RATE CASE
WITNESS: DR. CHHANDITA DAS

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **PUGET SOUND ENERGY,** **Respondent.**	**Docket UE-22____** **Docket UG-22____**

PREFILED DIRECT TESTIMONY (NONCONFIDENTIAL) OF

DR. CHHANDITA DAS

ON BEHALF OF PUGET SOUND ENERGY

JANUARY 31, 2022

PUGET SOUND ENERGY

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I. INTRODUCTION

Q. Please state your name, business address, and position with Puget Sound Energy.

A. My name is Dr. Chhandita Das and my business address is Puget Sound Energy, P.O. Box 97034, Bellevue, Washington 98009-9734. I am employed by Puget Sound Energy ("PSE") as Sr. Economic Analyst in the Pricing and Cost of Service Team since March 2019.

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

A. Yes, I have. Please see the First Exhibit to the Prefiled Direct Testimony Exh. CD-2 for a narrative describing my education, relevant employment experience and other professional qualifications.

Q. What are your duties as Sr. Economic Analyst for PSE?

A. As the Sr. Economic Analyst for the Pricing and Cost of Service team, I primarily support the load research effort within the group, which includes conducting load research studies for general rate case fillings. In addition, I work towards improving the load research methodology and process by using new tools, new

sources of data such as Advanced Metering Infrastructure, and increasing efficiency through automation. I also explore new data products using load data such as net meter load profiles study.

Q. What topics are you covering in your testimony?

A. My testimony presents the results of PSE's 2022 Class Load Research, which was used to perform the electric cost of service study and rate design for this proceeding. PSE's 2022 Load Research Report is provided as Exh. CD-3.

II. Electric Load Research

A. Electric Load Research

Q. How does PSE perform its electric load research?

A. PSE performs its electric load research to develop hourly load profiles by rate class and calculate monthly total and average load estimates, non-coincident, and coincident peak demand estimates for a test year period to support its electric cost of service study and rate design. The 15-minutes interval load data were collected from approximately 1,500 metering device locations sampled for large and medium-size rate classes and for the entire population of metering device locations for some small rate classes. PSE then validates and analyzes these interval load data for the test year and develops class hourly load profiles by applying a variety of statistical estimation and testing techniques to the data.

Q. Did PSE use the same load research methodology in this case as in its last general rate case?

A. Yes, with some improvements and modifications. One major improvement that was implemented in this proceeding is the use of a software tool for conducting load research study. PSE used a software tool called Load Research Software ("LRS"), developed by DNV to estimate the hourly class load profiles. The LRS tool replaces the manual process PSE had been using to conduct its load research. LRS follows the same analytical steps that were taken in the past to estimate class load profiles with few exceptions; it consolidates different steps, creates efficiency by automating some of the steps and it improves upon some of the existing methodologies. The detailed methodology of the load research study is explained in Exh. CD-3.

In addition to these changes in tool and methodology, PSE also made a refinement in the class load estimates by making a distinction between net meter and non-net meter customers. This distinction was made for only those rate classes for which sufficient sampled device location data were available for the net meter customers. Accordingly, net meter profiles are estimated for only residential and small general service commercial class customers. For these rate classes, the load profiles for net meter and non-net meter customers were estimated separately, and then they were summed to get the final class load profiles. The net meter load profiles estimation methods and results are described Exh. CD-4.

Q. Please elaborate on the changes and enhancements introduced by the LRS software in this proceeding.

The LRS tool is a comprehensive software system used by many major utilities for conducting load research, program evaluation, and sample design. It uses industry-standard methodology to estimate class loads. The LRS tool is programmed in SAS (a leader in analytics software), and hence can be customized to any special requirements. It can accommodate any types of data such as 15-minunte interval or hourly data, any arbitrary rate classes and subclasses, etc. This flexibility helps companies adapt the software to their own data and structure. The changes and improvements introduced into this year's load research study by LRS are highlighted below.

Validation, Editing and Estimation ("VEE") Process: LRS uses a multistage VEE process to validate data. The software investigates each sampled unit to 1) identify bad or erroneous data for removal or editing, 2) estimate missing intervals with appropriate values, and 3) validate metered load data with associated billing data. Previously, data validation was done by examining the profiles manually and correcting them as necessary. This was a very tedious and time-consuming task, and it did not allow for any sophisticated rules for identifying data anomalies, such as comparing metered data with the billed data by sampled unit. However, LRS not only creates efficiency by automating tasks, it also enhances the VEE process by allowing sophisticated and standard rules to detect and correct data errors. For details on VEE approaches, see Exh. CD-7.

Post-stratification: The LRS framework uses a Model-based Statistical Sampling ("MBSS") technique to post-stratify the sample instead of using a "Mean Per Unit" approach, which was used in PSE's 2019 general rate case. Both techniques are valid ways to post-stratify the sample, and both are widely used in the field. In fact, PSE used the MBSS method in past rate proceedings but moved to a Mean Per Unit approach for the 2019 general rate case because the Mean Per Unit method is preferred in highly manual applications due to its simplicity.[1] Because PSE is using LRS software in this proceeding, the MBSS method is a suitable method to calculate stratification weights.

The MBSS methodology has been applied in load research for more than thirty years. In addition, MBSS is often the preferred method when used with "ratio estimation" for population expansion, which is used in this study as well as in the 2019 general rate case for population expansion. For details on post-stratification methodology and MBSS, please see Exh. CD-7.

Net Meter Profiles: LRS allows the estimation of net meter profiles along with the other non-net meter profiles within the same framework. Net meter data is different from the non-net meter data due to its bi-directional energy flows. LRS framework is able to accommodate these different data types and also enable estimation of profiles for each direction of energy flows with minimal additional effort.

[1] PSE started using the Mean Per Unit approach in 2011 for new sample design and load profiling.

Q. Please describe how PSE's load research samples were selected for 15-minute interval load readings.

A. The class load research samples used in PSE's 2022 Load Research were selected through a sample design and selection study performed in 2017. The historical data and statistical methodology used for the 2017 sample design study are explained in detail in Exh. CD-5, "2017 Class Load Research Sample Design and Deployment". For this proceeding, PSE used the study year's data (July 2020 to June 2021) for the same sampled list of device locations, which are still active for estimating the load profiles. The use of this sample is in compliance with the cost of service study inputs stated in WAC 480-85-050.

PSE intends to use AMI data for load research in the near future, but the AMI coverage is not yet sufficient to support the electric load study in this proceeding. AMI is currently active in less than 60 percent of PSE's service territory. In addition, the coverage varies by rate class and geographical area, making AMI data infeasible for use in the load study.

Q. Please describe the statistical methodologies and the historical 15-minute interval load data, energy sales and customer data used for PSE's 2022 Class Load Research.

A. PSE's 2022 Load Research Report, Exh. CD-3, contains detailed descriptions of the statistical methodologies and validation tests performed and the historical data analyzed.

Table 1 below shows the rate classes studied in this proceeding and the total number of accounts, total annual sales in kWh, and the average annual kWh sales per account for each rate class. The Residential class (Schedule 7) contains 1,046,434 accounts (87.9 percent of all accounts) with a total annual energy use of 11,334 GWh (54.6 percent of the total system energy use).

Table 1: Population Count and Consumption Data

Rate Schedule	Description	No. of Accounts	Total Annual kWh Use	Avg. kWh Use per Account	% of Total kWh Sales
7	Residential	1,046,434	11,333,893,562	10,831	54.59%
5	Sales for Resale	8	7,298,620	912,328	0.04%
8 & 24	Small General Services <50 kW	124,107	2,662,847,989	21,456	12.82%
11 & 25	Medium General Services 50-350 kW	7,915	2,862,860,605	361,697	13.79%
12 & 26	Large General Service >350 kW	832	1,770,292,475	2,127,116	8.53%
29	Seasonal Irrigation	611	15,293,728	25,017	0.07%
10 & 31	Primary Voltage General Service	489	1,309,927,369	2,679,245	6.31%
35	Primary Voltage Seasonal Irrigation	2	4,387,644	2,193,822	0.02%
43	Primary Voltage Interruptible Service For Total Electric School	146	112,161,995	768,233	0.54%
46	High Voltage Interruptible Service	6	100,810,051	16,801,675	0.49%
49	High Voltage General Service	18	513,293,737	28,782,826	2.47%
50 - 59	Street & Area Lighting	8,683	69,892,883	8,049	0.34%
System Total		1,189,251	20,762,960,658	17,459	100.00%
Non System Loads					
449HV	Retail Wheeling - High Voltage	12	1,629,551,277	135,795,940	73.29%
449PV	Retail Wheeling - Primary Voltage	1	20,203,165	20,203,165	0.91%
459	Back-up Generation	3	295,459,725	98,486,575	13.29%
Special Contract	Retail Wheeling & Distribution Service	83	278,070,311	3,350,245	12.51%
Non System Totals		99	2,223,284,478	22,457,419	100.00%

Q. Please summarize the results of PSE's 2022 load research results.

A. PSE's 2022 load research results are illustrated via charts and summary tables in Exh. CD-3. For this proceeding's test year the load research results presented in Exh. CD-3 include class hourly load shapes for the year, class hourly loads during the system peak week, monthly non-coincident peak demand by class, monthly coincident demand by class (class contributions to system peak), monthly load

factors, and coincidence factors by class. In addition, statistical summary tables in the report also show class monthly non-coincident peak and system coincident peak demand values averaged for twelve months and for the mid-winter months.

Figure 1: Composition of System Load during Annual System Peak Week

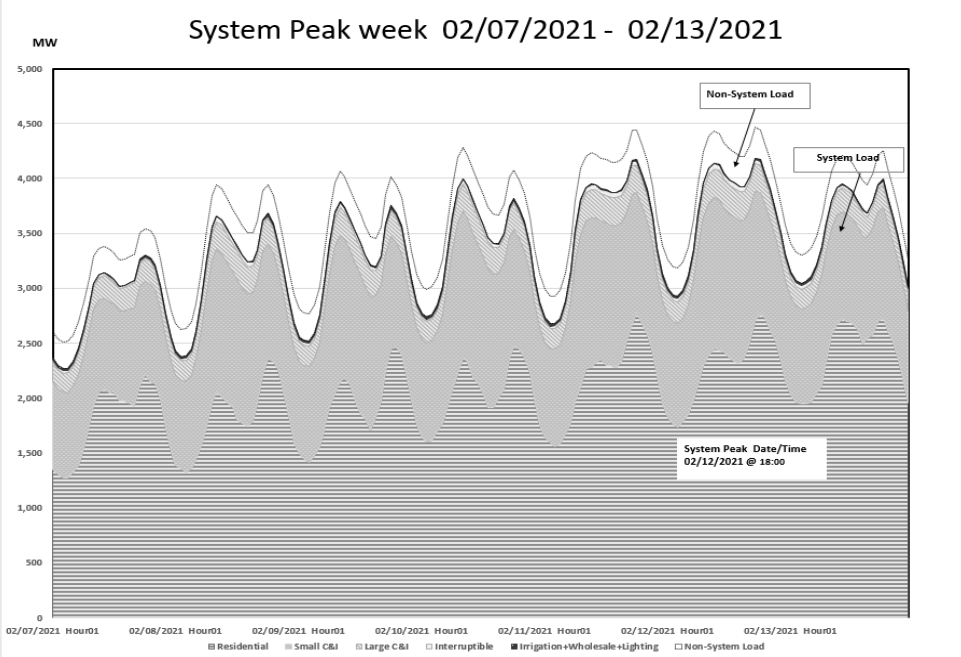

Figure 1 above shows how the total PSE system loads are composed of the class loads during the annual system peak demand week. Like past years, PSE system load is winter peaking. During the test year the system peak occurred on February 12, 2021, at 6 pm, with a total load at 4,182 MW. As shown in the graph, the Residential class contributes to the largest share of the system peak demand and the Small C&I class is the second largest contributor to the system peak. Figure 1 also superimposes non-system loads on top of the system loads to illustrate the total loads transmitted by PSE during its system peak week.

Table 2: Coincident Peak Load and Factor by Rate Class

Rate Class	Peak Demand (kW)	Coincidence Factor
System Peak	4,182,000	-
System Rate Classes		
7	2,708,079	97.5%
8 & 24	478,558	84.9%
11 & 25	451,244	78.8%
12 & 26	260,827	79.8%
29	396	4.8%
10 & 31	178,913	80.5%
43	24,819	55.0%
5	1,724	78.7%
35	9	0.2%
46	9,025	44.7%
49	61,025	82.0%
50 - 59	7,380	41.8%
Non System Rate Classes		
449HV	201,703	93.4%
449PV	3,800	84.7%
459	27,453	67.5%
Special Contract	47,608	90.8%

Table 2 above shows the class coincident peak ("CP") loads and the coincidence factors by rate class. The data shows residential being the largest rate schedule, accounts for 65 percent of the peak system load with a coincident peak load of 2,708 MW. The small and medium general service classes, each of them accounts for about 11 percent of the system peak load. In addition, residential class has the highest coincidence factor of 97.5 percent and schedule 29 and 35 have the lowest (<5 percent). Because of the seasonality of schedules 29 and 35, these low co-incident factors are justified. For details on class peaks by months, load factors and other detail summary results, please see Exh CD-3.

B. Net Meter Load Profile

Q. How did you develop the net meter load profiles?

A. The net meter load profiles are developed using the same methodology as described above along with the other non-net meter load profiles. The date for developing net meter load profiles came from the list of device locations selected via a sampling study which was conducted and deployed during late 2017 to early 2018 time frame. See Exh. CD-6 for details on this net meter sampling study. For this proceeding, to develop class load profiles PSE used the interval load data for the study year using the same sample from this 2017 sampling study. The net meter load profiles were estimated only for the residential (7) and small general service (8 & 24) -commercial rate classes as these were the only classes with sufficient net meter population and sampling coverage. Table 3 shows the population and sample size by rate classes with net meters.

Table 3: Population and Sample Count by Rate Class for Net Meter Customers

Rate Class	Population (Device Location Count)	Sample (Device Location Count)
8 & 24 (commercial)	583	67
7	9139	186
24 Industrial	2	-
25 (commercial)	27	-
29	1	-
Total	9,752	

To estimate separate net meter profiles for 7 and 8 & 24 (commercial) classes, they were treated separately within LRS framework. At the final stage of LRS, the net meter and non-net meter customer load profiles were added up to produce class level load profiles before calculating class summary statistics. The details of

the method and treatment of these customers and the final result summaries are explained in Exh. CD-4.

Q. Please summarize the net meter load profile study results.

A. A brief summary of the findings from the net meter load profile study is presented here.

Table 4: Population Count and Consumption Data for Net Meter Classes

Rate Class	No. of Accounts	Total Annual kWh Use	Avg. kWh use per account	% of Total kWh Sales
7 - Net Meter	9,105	54,894,856	6,029	0.40%
7- Non-net Meter	1,044,922	11,216,505,662	10,734	81.25%
8 & 24 (Commercial) - Net Meter	578	5,537,837	9,581	0.04%
8 & 24 (Commercial) - Non-net Meter	125,965	2,527,404,941	20,064	18.31%
Total	1,180,570	13,804,343,296	11,693	100%

Table 4 shows the breakdown of annual sales by customer types for schedule 7 and 8 & 24 (commercial) customers. The net meter customers' account for less than 1 percent of all sales for rate class 7 and less than 0.1 percent for the 8 & 24 (commercial) class. For details on hourly load profiles for net meter and non-net meter customers, monthly CP, coincidence factors, class peaks and load factors, please see Exh. CD-4.

Table 5: Net Meter Customer's Coincident Peak and Coincident Factor

Rate Class	Coincident Peak Demand (kW)	Coincidence Factor	Class Peak Demand (kW)
System Peak	4,182,000	-	
Net Meter Rate Schedules			
7 - Non-net meter	2,674,696	97.5%	2,744,028
7 - Net meter	33,383	94.9%	35,175
8 &24 Comm.- Non-net meter	461,327	85.1%	542,381
8 &24 Comm.- Net meter	3,729	90.2%	4,134

Table 5 above shows the net meter and non-net meter customers' CPs and coincident factors. Since majority of class 7 customers are non-net meter, their CP and coincidence factor are similar to the full class coincidence factor. The net meter residential customers' CP was 33.4 MW kW, about 1 percent of the system peak load. The net meter class peak was on February 13, 2021 at 9 a.m. with 35 MW net load. Further, it was observed that peak demand per net meter customer was 3.85 kW, higher than 2.65 kW for non-net meter customer. In addition, the minimum load, or the maximum return to the grid for residential net meter customers occurred on May 20, 2021 at 2 PM with -48.3 MW of net load (returned load 50.86 MW).

The 8 & 24 (commercial) class's non net meter CPs and coincidence factor are similar to the full class CP. The net meter CP load was 3,739 kW which is only 0.1 percent of the system peak load. The class peak for 8 & 24 (commercial) class net meter customer was 4.1 MW on February 12, 2021 at 9 a.m. Comparing peak demand per customer, like residential class, net meter customers again had a

higher average peak demand (7.15 kW) than non-net meters customers (4.52 kW). The minimum load for 8 & 24 (commercial) net meter customers was on May 16, 2021 at 2 p.m. with -5.8 MW load (returned load 6.03 MW).

III. CONCLUSION

Q. What do you recommend based on the 2022 load research performed by PSE?

A. The load research results presented in Exh. CD-3 and Exh. CD-4 are based on a thorough analysis of the 15-minute interval load data by class, system hourly load data, monthly and annual class sales, and customer data. They were statistically validated for accuracy and reasonableness. In addition, PSE's use of the new tool LRS has created efficiency and improved the existing process resulting in better data and results. The distinction of net meter and non-net meter customers created another layer of sophistication, which further refined the results. PSE is continuously striving to improve data and methodologies. The current load research analysis was conducted using the best available data sources and technology at hand, and I recommend that the Commission approve the load research results provided in Exh. CD-3 as a basis for PSE's electric cost of service study and rate design in this proceeding.

Q. Does that conclude your prefiled direct testimony?

A. Yes, it does.