EXH. CD-5
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____**

FOURTH EXHIBIT (NONCONFIDENTIAL) TO THE PREFILED DIRECT TESTIMONY OF

DR. CHHANDITA DAS

ON BEHALF OF PUGET SOUND ENERGY

JANUARY 31, 2022

2017 Class Load Research Sample Design and Deployment

Puget Sound Energy (PSE) selected and deployed its new class load research samples in November 2017. The new samples replaced the old samples deployed in March 2011. In total, 3,605 device locations were sampled from PSE electric service population to collect 15-minute interval load data for Residential, Small, Medium and Large Commercial and Industrial (C&I), Seasonal Irrigation, and Total-Electric Schools rate class customers.[1] Out of 3,605 sampled device locations, 1,674 device locations are "Primary" samples, 1,374 device locations are the "First Backup" samples, and 557 device locations are the "Second Backup" samples. The new Primary and Backup samples have been producing interval load data since November 11, 2017 and being monitored regularly for their reliability. The following sections discuss the billing and interval load data analyzed for sampling, the statistical methods and analyses performed for sample design and the initial sampling results. The sample design methodology also leveraged some existing sampled meters from other studies for their statistical substitutability and interval load reading performance which is discussed below as well.

Data

The following three databases were used to analyze and evaluate the population and the old sample data and to develop a new sample design:

1. Annualized kWh use data by active location device and rate schedule at the end of December 2016;
2. 15-minute interval load data collected from the old load research samples and the energy efficiency and conservation program samples for September 2016 through February 2017; and
3. Individual sample location device and class hourly load profiles developed for the twelve months ending September 2016.

The 15-minute interval load data were collected from PSE's wireless automatic meter reading (AMR) system, which relies on Landis & Gyr's Cellnet® technology.

Statistical Methods and Analyses

One of the main purposes of class load research is to support the cost of service study and rate design analyses, which are included as parts of PSE's general rate case filings. In PSE's cost-of-service study, demand-related production and transmission costs are allocated on the basis of the average of class loads coincident with system monthly peaks in four mid-winter months. Distribution substation and feeder costs are allocated to each rate class based on a 12-month average of the class' contribution to the monthly peak

[1] *Since the sampling unit is a device location and the population billing data are compiled by device location, all of the use-per-customer calculations and the customer usage stratifications are performed on the basis of electric device locations. Therefore, the terms, "device location" and "customer" are being used interchangeably in this report.*

loads of individual substations. Each class' contribution to a substation's monthly peak load is calculated by dividing an estimate of the average hourly load of the class on the substation by an estimate of the class' non-coincident peak load factor for the month.

When developing a sample design for class load research, a major problem we encounter is that actual population data is not available for class hourly loads, the target variable. In search for a surrogate variable, the correlation between annual energy use and the average of monthly system-coincident loads for four mid-winter months (4 CP) was evaluated for each rate class using the sampled customers' hourly load profiles developed for October 2015 - September2016 with the 2011 load research sample data. The correlation between annual energy use and the average of 12 monthly non-coincident peaks (12 NCP) was also analyzed for each rate class. The correlation coefficients presented in Table 1 provide a measure of how closely a customer's system-coincident peak loads (4CP) are correlated with the same customer's annual use and separately, how closely a customer's average monthly class-coincident peak load (12 NCP) is correlated with the same customer's annual energy use. Except the irrigation rate class (Schedule 29) in which number of active customers and energy sales are highly seasonal, most of the rate classes demonstrate consistently a strong positive correlation between the peak loads and the energy use, with the correlation coefficients of 0.85 or higher. Even in the case of irrigation rate class a high correlation is detected for annual energy use and average of their class non-coincident peaks (12 NCP) with a correlation coefficient higher than 0.91.

Table 1

2017 Correlation coefficient by Rate Class

Rate Class	4 CP Avg. vs. Ann. kWh Use	12 NCP Avg. vs. Ann. kWh Use
07	0.8514	0.9512
24	0.9134	0.9404
25	0.9122	0.9466
26	0.8577	0.9466
29	0.6406	0.9149
31	0.9767	0.9837
43	0.9590	0.9910

A stratified Mean per Unit (MPU) estimation approach was used for 2017 load research sample design. The MPU approach assumes a close correlation between class hourly loads and annual kWh across the customers in each rate class. Based on the correlation analysis discussed above, it is reasonable to adopt annual kWh energy use as an instrumental (or a surrogate) variable. The class load research sample design was developed by analyzing the population statistics of electric energy use and customers for a twelve month period ending December 31, 2016. The population statistics were calculated only for the active customers at the end of 2016.

By using the additional information regarding the relationship between system-coincident (or non-coincident) peaks ("Y" variable) and annual energy use ("X" variable) obtained from a no-intercept linear (ratio) model coefficients and the model's error ratio estimated with the previous load research sample data, an Model-Based Statistical Sampling (MBSS) sample design tends to require a smaller sample size than an MPU sample design to meet a given error margin and confidence limit criteria. However, complexity of the modeling and estimation procedures involved in an MBSS approach makes the monitoring and load research routines impractical. On the other hand, MPU sample design and class load estimation procedures are quite simple and easy to maintain. In an MPU approach, the analytical process and working assumptions are fairly straightforward and transparent.

An MBSS approach is also bound by its assumption of the estimation errors (residuals) of the ratio model to be positively correlated ("heteroscedastic") with the "X" variable (annual energy use). However, it is easily conceivable that this assumption of heteroscedastic residuals may be not applicable to some of the customers in the population or even to a rate class in general. On the other hand, an MPU approach uses the population statistics of actual energy use and customers and is free of the estimation bias or error. The only assumption made for this approach is a close correlation between the coincident (or non-coincident) peaks and the annual energy use, which is proven through the correlation analysis presented above. Considering that the interval-load reading cost gets lower with the wireless technology being used by PSE and in order to keep the load research process practical and manageable, a stratified MPU approach was chosen since 2011 for new sample design and load profiling over a Model-Based Statistical Sampling (MBSS) approach used for 2005 load research sample design.

To perform a stratified sampling, population data of customers and their annual kWh use by rate schedule were sorted by size of their kWh use. A frequency table was created by assigning the customers into appropriate usage brackets. The number and ranges of usage brackets were pre-defined on the basis of population size and density of its usage distribution. The frequency table was then stratified by 2 to 5 groups by combining the usage brackets and their frequencies. For efficiency and practicality, the most popular numbers of strata being used for a stratified sampling are 2 to 5. For the number of strata set for each of the rate classes, strata boundaries were determined following the Dalenius-Hodges (DH) procedure, also known as the cumulative square root (uf) procedure where "u" denotes kWh, width of a given usage bracket and "f" stands for frequency of the usage bracket. In the DH procedure, strata boundaries are set to have each of the strata yield a similar sum of square-rooted kWh values of (uf). The Neyman Optimum Allocation formula was then used to calculate total number of sample units for each rate class and the strata sample sizes. The Neyman Allocation formula estimates total and strata sample sizes required for a given error margin and confidence limit on the basis of the population statistics of number of customers and their kWh use. For each rate class, total and strata sample sizes were determined by using the following formulae:

$$n = (\sum W_h S_h)^2/((d/t)^2+1/N*\sum W_h S_h^2)$$

$$n_h = n*(W_h*S_h)/\sum(W_h*S_h)$$

Where N = Total Population size

N_h = Stratum population size

n = Total sample size

n_h = Stratum sample size

$W_h = N_h/N$

S_h = Stratum standard deviation of annual kWh use

d = Tolerable error margin; and

t = t-statistic value for pre-set confidence limit

The examples presented below illustrate how the stratified sample sizes were determined for the residential rate class (RC 07) through the two-step procedure explained above. The first step was to set strata boundaries through the DH procedure. At the beginning, all of the electric usage points under the residential rate schedules were sorted by sizes of their annual energy usage, A frequency table was created by counting the number of usage points (f) sorted to each of the usage brackets ascending with an increment (u) of 1,000 kWh for the annual usage of 20,000 kWh or lower, 2,000 kWh for the annual usage of 20,001 kWh through 30,000 kWh, 5,000 kWh for 30,001 kWh to 50,000 kWh, 10,000 kWh for 50,001 kWh to 60,000 kWh, 20,000 kWh for 60,001 kWh to 100,000 kWh and 300,000 kWh for the annual usage over 100,000 kWh. The sum of square rooted value of (uf) for all of the usage brackets was 186,068 kWh. The number of strata set for residential sampling was 5. The strata boundaries were then determined by making the cut-offs so that all of the five strata yield a sum of square rooted (uf) close to one fifth of 193,166 kWh (38,633 kWh). The strata boundaries set for residential sample design were 0 – 6,000 kWh for the first stratum, 6001 – 10,000 kWh for the second, 10,001 – 17,000 kWh for the third, 17,001 – 30,000 kWh for the fourth, and all of the customers with annual usage over 30,000 kWh assigned to the fifth stratum.

Step 1

Dalenius-Hodges Procedure (Based on Annualized Sales Data for 2016)

Bracket	Frequency (f)	u	uf	sqrt(uf)	Cum sqrt(uf)		% Distribution by Stratum
0-1,000	11,561	1,000	11,561,000	3,400	3,400		
1,001-2,000	14,533	1,000	14,533,000	3,812	7,212		
2,001-3,000	29,454	1,000	29,454,000	5,427	12,640		
3,001-4,000	51,372	1,000	51,372,000	7,167	19,807		
4,001-5,000	72,482	1,000	72,482,000	8,514	28,321		
5,001-6,000	86,724	1,000	86,724,000	9,313	37,633	38,633	26.6%
6,001-7,000	90,854	1,000	90,854,000	9,532	47,165		
7,001-8,000	87,939	1,000	87,939,000	9,378	56,542		
8,001-9,000	80,463	1,000	80,463,000	8,970	65,513		
9,001-10,000	70,797	1,000	70,797,000	8,414	73,927	77,266	33.0%
10,001-11,000	60,534	1,000	60,534,000	7,780	81,707		
11,001-12,000	51,930	1,000	51,930,000	7,206	88,913		
12,001-13,000	44,298	1,000	44,298,000	6,656	95,569		
13,001-14,000	37,962	1,000	37,962,000	6,161	101,730		
14,001-15,000	32,232	1,000	32,232,000	5,677	107,408		
15,001-16,000	27,375	1,000	27,375,000	5,232	112,640		
16,001-17,000	23,228	1,000	23,228,000	4,820	117,459	115,899	27.7%
17,001-18,000	19,828	1,000	19,828,000	4,453	121,912		
18,001-19,000	16,622	1,000	16,622,000	4,077	125,989		
19,001-20,000	14,018	1,000	14,018,000	3,744	129,733		
20,001-22,000	21,689	2,000	43,378,000	6,586	136,319		
22,001-24,000	15,176	2,000	30,352,000	5,509	141,829		
24,001-26,000	10,596	2,000	21,192,000	4,603	146,432		
26,001-28,000	7,408	2,000	14,816,000	3,849	150,281		
28,001-30,000	5,374	2,000	10,748,000	3,278	153,560	154,533	11.1%
30,001-35,000	7,669	5,000	38,345,000	6,192	159,752		
35,001-40,000	3,457	5,000	17,285,000	4,158	163,910		
40,001-45,000	1,863	5,000	9,315,000	3,052	166,962		
45,001-50,000	1,105	5,000	5,525,000	2,351	169,312		
50,001-60,000	1,120	10,000	11,200,000	3,347	172,659		
60,001-80,000	974	20,000	19,480,000	4,414	177,072		
80,001-100,000	389	20,000	7,780,000	2,789	179,862		
over 100,000	590	300,000	177,000,000	13,304	193,166	193,166	1.7%
Total	1,001,616						100.0%

38,633	5	=Number of Strata
38,633	1	Stratum 1
77,266	2	Stratum 2
115,899	3	Stratum 3
154,533	4	Stratum 4
193,166	5	Stratum 5

The second step was to calculate the minimum number of samples required to meet the sample design criteria of 3% error margin with 95% confidence limit for each residential rate schedule and to allocate the total number of samples to each stratum. The example provided below illustrates how the population statistics of customers and their annual energy usage were used in the Neyman Optimum Allocation formula to determine the residential rate-schedule total and strata sample sizes. The components of the formula calculated with the population statistics are shown in columns of the rate-schedule tables provided below. The final results for rate-schedule total and strata sample sizes are presented in column "n(h)."

Step 2

Neyman Allocation for Stratified Sampling
(Total Sample Size Required for 3% Error Margin @ 95% Confidence Limit)

RC *7*

Annual kWh Range	Max	N(h)	W(h)	Y(h)	S(h)	W(h)*S(h)	n(h)	S(h)^2	W(h)*S(h)^2
0 - 6,000*	6,000	266,125	0.2657	4,094	1,435	381	35	2,058,488	546,931
6,001 -10,000	10,000	330,052	0.3295	7,892	1,136	374	35	1,291,314	425,513
11,001 - 17,000	17,000	277,561	0.2771	12,864	1,957	542	50	3,829,260	1,061,139
17,001 - 30,000	30,000	110,710	0.1105	21,218	3,324	367	34	11,048,030	1,221,154
> 30,000	>30,000	17,168	0.0171	44,129	38,510	660	61	1,483,029,064	25,419,565
Total		1,001,616	1.0000	10,355		2,325	215		28,674,302

**The accounts not active as of December 31, 2016 were excluded from the analysis.*

Total sample size required = 77
(@ 5% error margin w/ 95% confidence limit)

Total sample size required = 215
(@ 3% error margin w/ 95% confidence limit)

Sample Design

As illustrated above for the case of residential rate schedules, use of the Dalenius-Hodges procedure and the Neyman Optimum Allocation method produced the following sample designs for non-residential rate classes:

RC 24C

Annual kWh Range	N(h)	n(h)
0 - 16,000*	90,438	116
16,001 -60,000	30,150	103
60,001 - 180,000	10,756	92
> 180,000	1,333	115
Total	132,677	426

RC 24I

Annual kWh Range	N(h)	n(h)
0 - 16,000*	1,676	31
16,001 -60,000	1,060	51
60,001 - 180,000	424	50
> 180,000	34	34
Total	3,194	166

RC 25C

Annual kWh Range	N(h)	n(h)
0 - 220,000*	2,605	22
220,001 - 450,000	2,578	24
450,001 - 1,000,000	1,498	32
> 1,000,000	451	25
Total	7,132	103

RC 25I

Annual kWh Range	N(h)	n(h)
0 - 220,000*	210	18
220,001 - 450,000	159	15
450,001 - 1,000,000	109	25
> 1,000,000	30	26
Total	508	84

RC 26C

Annual kWh Range	N(h)	n(h)
0 - 2,000,000*	369	39
2,000,001 -4,000,000	303	34
> 4,000,000	76	27
Total	748	100

RC 26I

Annual kWh Range	N(h)	n(h)
0 - 2,000,000*	58	24
2,000,001 -4,000,000	27	11
> 4,000,000	14	13
Total	99	48

RC 29

Annual kWh Range	N(h)	n(h)
0 - 50,000*	639	190
> 50,000	105	105
Total	744	295

RC 31C

Annual kWh Range	N(h)	n(h)
0 - 2,000,000*	248	44
2,000,001 - 8,000,000	100	63
> 8,000,000	19	19
Total	367	126

RC 31I

Annual kWh Range	N(h)	n(h)
0 - 2,000,000*	71	12
2,000,001 - 8,000,000	42	25
> 8,000,000	17	17
Total	130	54

RC 43

Annual kWh Range	N(h)	n(h)
0 - 1,000,000*	133	37
> 1,000,000	28	28
Total	161	65

The residential class (RC 07) sample size was determined to meet a 3% error margin with 95% confidence limit, while all the other rate class sample sizes were estimated to satisfy a 5% error margin with 95% confidence limit requirement. Since the variances of electric energy usage of the irrigation (RC 29) and the large C&I rate class (RC 26I, RC 31C, RC 31I and RC 43) customers were so high, it requires big sample sizes and takes up a third or even a higher portion of population to meet the criteria of 5% error margin. Total number of samples required for all of the rate classes was 1,682. Since all of the customers in the primary voltage seasonal irrigation (RC 35), the Campus Rate (RC 40), the high voltage interruptible service (RC 46) and the high voltage general service (RC 49) classes are metered with 15-minute interval load readings, no sampling was necessary for those rate classes. All of the non-system loads under the primary and high voltage retail wheeling services (RC 449PV and 449HV) and the back-up generation service (RC 459) class rates, are also metered with interval load readings.

Sample Drawing and Retention

A systematic sampling technique was used to draw the samples for each rate class stratum. The following procedures were followed to select the samples from the population list of active device locations by rate class and their annual billing data as of December 31, 2016:

1) Sort the rate class population in ascending order of annual kWh usage and stratify the sorted data by the same usage strata as was determined in the sample design.
2) Count the number of customers in each usage bracket (or stratum).
3) Calculate $K = N_h/n_h$ where N_h = population number of customers in stratum h and n_h = number of samples as required by the sample design for stratum h.
4) Draw stratum samples by taking the $(K/2)^{th}$ customer from the top of the stratum population list as the first sample and every k^{th} customer from the first and the samples drawn in sequence until the total number of samples drawn reaches the number of sampling units determined in the sample design.
5) Repeat 3) and 4) to draw the samples for the remaining strata.

To be able to replace the primary samples in case of poor metering quality or service termination/changes, two backup samples were also drawn using an approach similar to the one used for the primary samples.

The numbers of the first backup and the second backup samples were set equal to the number of primary samples. The backup samples for each stratum were drawn by taking every K^{th} device location from the same population list used for the primary sampling after selecting the $(K/2-1)^{th}$ device location to be the first backup sample and the $(K/2+1)^{th}$ device location as the second backup sample. For some of the high usage brackets in the irrigation and the large C&I classes, such as RC 29, RC 31 and RC 43, the whole population was selected as the primary sample. In such cases, there is no backup sample. Taking the residential class sampling as an example, Table 2 and Table 3 illustrate how the primary, first backup and second backup samples were selected for each of the rate class strata:

Table 2
Primary Sample Selection

Annual kWh Range	N(h)	n(h)	N(h)/n(h)	1st Sample	Obs. # for 1st Sample	Obs. # for Last Sample
0 - 6,000*	266,125	35	7,604	3,802	3,802	262,323
6,001 -10,000	330,052	35	9,430	4,715	275,555	596,177
11,001 - 17,000	277,561	50	5,551	2,776	598,953	870,963
17,001 - 30,000	110,710	34	3,256	1,628	875,366	982,820
> 30,000	17,168	61	281	141	984,589	1,001,476
Total	1,001,616	215				

Table 3

2017 Load Research Sample Drawing

Primary Sample for RC 07 (P) | **First Backup Sample for RC07 (FB)** | **Second Backup Sample for RC07 (SB)**

Sample #	Obs.	Device Location	Annualized KWH	Sample #	Obs.	Device Location	Annualized KWH	Sample #	Obs.	Device Location	Annualized KWH
1	3,802	6001675281	70	1	3,801	6001164538	70	1	3,803	6001413042	70
2	11,406	6000293318	985	2	11,405	6000343503	985	2	11,407	6000749822	986
3	19,009	6000082914	1,603	3	19,008	6001012606	1,603	3	19,010	6002051331	1,603
4	26,613	6000942730	2,025	4	26,612	6001818064	2,025	4	26,614	6001600983	2,025
5	34,216	6000425303	2,347	5	34,215	6001466089	2,347	5	34,217	6000803648	2,347
6	41,820	6000943789	2,612	6	41,819	6001481887	2,612	6	41,821	6000719061	2,612
7	49,423	6001915047	2,839	7	49,422	6000349354	2,839	7	49,424	6001982622	2,839
8	57,027	6000191623	3,037	8	57,026	6000578038	3,037	8	57,028	6001129701	3,037
9	64,631	6000959519	3,215	9	64,630	6001053869	3,215	9	64,632	6000048682	3,216
10	72,234	6001134702	3,378	10	72,233	6001412153	3,378	10	72,235	6000919383	3,378
11	79,838	6001237416	3,530	11	79,837	6000466213	3,530	11	79,839	6001567528	3,530
12	87,441	6002015711	3,671	12	87,440	6001452858	3,671	12	87,442	6001086120	3,671
13	95,045	6001742346	3,804	13	95,044	6000243136	3,804	13	95,046	6001340612	3,804
14	102,648	6000852353	3,931	14	102,647	6000853578	3,931	14	102,649	6000776693	3,931
15	110,252	6000731799	4,054	15	110,251	6000619200	4,054	15	110,253	6001906051	4,054
16	117,856	6001515525	4,168	16	117,855	6000776335	4,168	16	117,857	6000995381	4,168
17	125,459	6001025963	4,282	17	125,458	6001515981	4,282	17	125,460	6000980176	4,282
18	133,063	6001229231	4,392	18	133,062	6001148839	4,392	18	133,064	6001435959	4,392
19	140,666	6001313554	4,500	19	140,665	6000865262	4,500	19	140,667	6000667269	4,500
20	148,270	6001152572	4,603	20	148,269	6001354155	4,603	20	148,271	6000071641	4,603
21	155,873	6001937577	4,701	21	155,872	6000755985	4,701	21	155,874	6001302031	4,701
22	163,477	6001849463	4,799	22	163,476	6001594829	4,799	22	163,478	6000449876	4,799
23	171,081	6001001932	4,896	23	171,080	6001822294	4,896	23	171,082	6001478317	4,896
24	178,684	6000455082	4,991	24	178,683	6001110125	4,991	24	178,685	6000028558	4,991
25	186,288	6000709115	5,084	25	186,287	6001741734	5,084	25	186,289	6001909162	5,084
26	193,891	6000512224	5,175	26	193,890	6000722737	5,175	26	193,892	6000935160	5,175
27	201,495	6000826080	5,265	27	201,494	6000491741	5,265	27	201,496	6000389790	5,265
28	209,098	6000117423	5,355	28	209,097	6000944605	5,355	28	209,099	6000059574	5,355
29	216,702	6000125295	5,443	29	216,701	6000024332	5,443	29	216,703	6001298620	5,443
30	224,306	6001749434	5,530	30	224,305	6000696358	5,530	30	224,307	6001616883	5,530
31	231,909	6000879591	5,618	31	231,908	6001660293	5,618	31	231,910	6000647237	5,618
32	239,513	6000649420	5,704	32	239,512	6001661879	5,704	32	239,514	6001301724	5,704
33	247,116	6001306392	5,789	33	247,115	6000253227	5,789	33	247,117	6001803817	5,789
34	254,720	6000114553	5,874	34	254,719	6000336617	5,874	34	254,721	6000195242	5,874
35	262,323	6001120864	5,958	35	262,322	6001140316	5,958	35	262,324	6000798946	5,958
36	275,555	6001135520	6,105	36	275,554	6000343427	6,105	36	275,556	6000008274	6,105
37	284,985	6000414645	6,210	37	284,984	6000345238	6,210	37	284,986	6000838291	6,210
38	294,415	6000688475	6,313	38	294,414	6000637408	6,313	38	294,416	6000725737	6,313
39	303,845	6001647381	6,417	39	303,844	6001740421	6,417	39	303,846	6000393104	6,417
40	313,275	6001747532	6,520	40	313,274	6001795988	6,520	40	313,276	6001764549	6,520
41	322,705	6001812721	6,624	41	322,704	6000596946	6,624	41	322,706	6000603520	6,624
42	332,135	6000313311	6,727	42	332,134	6001954512	6,727	42	332,136	6001459264	6,727
43	341,565	6000050436	6,831	43	341,564	6001883098	6,831	43	341,566	6000825726	6,831
44	350,996	6000900439	6,934	44	350,995	6000948758	6,934	44	350,997	6000604174	6,934
45	360,426	6001351184	7,038	45	360,425	6001681141	7,038	45	360,427	6001355360	7,038
46	369,856	6001474939	7,144	46	369,855	6000316946	7,144	46	369,857	6000713599	7,144
47	379,286	6000387521	7,252	47	379,285	6001760032	7,252	47	379,287	6001997307	7,252
48	388,716	6001188994	7,357	48	388,715	6001007852	7,357	48	388,717	6001090477	7,358
49	398,146	6001032029	7,462	49	398,145	6000331934	7,462	49	398,147	6000448030	7,462
50	407,576	6000403712	7,569	50	407,575	6000305218	7,569	50	407,577	6001593316	7,569

Primary Sample for RC 07 (P) | **First Backup Sample for RC07 (FB)** | **Second Backup Sample for RC07 (SB)**

Sample #	Obs.	Device Location	Annualized KWH	Sample #	Obs.	Device Location	Annualized KWH	Sample #	Obs.	Device Location	Annualized KWH
51	417,006	6000913439	7,675	51	417,005	6000590301	7,675	51	417,007	6000741927	7,675
52	426,436	6001227437	7,785	52	426,435	6001764154	7,785	52	426,437	6001714929	7,785
53	435,866	6001870965	7,894	53	435,865	6000771050	7,894	53	435,867	6000136620	7,894
54	445,296	6001811101	8,005	54	445,295	6000168905	8,005	54	445,297	6001976064	8,005
55	454,726	6000798528	8,117	55	454,725	6000744179	8,117	55	454,727	6000331584	8,117
56	464,156	6000184434	8,229	56	464,155	6000115297	8,229	56	464,157	6000006831	8,229
57	473,586	6001507702	8,345	57	473,585	6000111094	8,345	57	473,587	6001524333	8,345
58	483,016	6000169346	8,459	58	483,015	6000007016	8,459	58	483,017	6001399748	8,459
59	492,446	6000825914	8,576	59	492,445	6000425865	8,576	59	492,447	6000949051	8,576
60	501,876	6001584061	8,694	60	501,875	6000105474	8,694	60	501,877	6000239350	8,694
61	511,306	6001481636	8,816	61	511,305	6001334666	8,816	61	511,307	6001292448	8,816
62	520,737	6000707345	8,939	62	520,736	6001821635	8,939	62	520,738	6000569887	8,939
63	530,167	6000586492	9,063	63	530,166	6001397272	9,063	63	530,168	6000355227	9,063
64	539,597	6001761082	9,191	64	539,596	6001671750	9,191	64	539,598	6000844832	9,191
65	549,027	6001335921	9,320	65	549,026	6000650658	9,320	65	549,028	6000860240	9,320
66	558,457	6001686250	9,451	66	558,456	6001216619	9,451	66	558,458	6000703980	9,451
67	567,887	6000383831	9,583	67	567,886	6000319194	9,583	67	567,888	6001592668	9,583
68	577,317	6000235850	9,719	68	577,316	6000367938	9,719	68	577,318	6000592204	9,719
69	586,747	6001371705	9,859	69	586,746	6001027625	9,859	69	586,748	6000559757	9,859
70	596,177	6000285514	10,000	70	596,176	6000077386	10,000	70	596,178	6000877294	10,000
71	598,953	6001197780	10,044	71	598,952	6000238665	10,043	71	598,954	6001643878	10,044
72	604,504	6000276929	10,129	72	604,503	6000471076	10,129	72	604,505	6000277775	10,129
73	610,055	6000151806	10,218	73	610,054	6000070340	10,218	73	610,056	6000646603	10,218
74	615,607	6001696359	10,306	74	615,606	6001253198	10,306	74	615,608	6000629261	10,306
75	621,158	6001780098	10,394	75	621,157	6000298719	10,394	75	621,159	6001631408	10,394
76	626,709	6001015284	10,483	76	626,708	6001763336	10,483	76	626,710	6001590805	10,483
77	632,260	6000861084	10,576	77	632,259	6000968116	10,576	77	632,261	6001863074	10,576
78	637,812	6000591775	10,670	78	637,811	6000634675	10,670	78	637,813	6001711413	10,670
79	643,363	6000030223	10,765	79	643,362	6000264975	10,765	79	643,364	6001547717	10,765
80	648,914	6001472143	10,863	80	648,913	6000349092	10,863	80	648,915	6000276539	10,863
81	654,465	6000813048	10,960	81	654,464	6001412584	10,960	81	654,466	6001250183	10,960
82	660,016	6000895369	11,059	82	660,015	6000251981	11,059	82	660,017	6000736163	11,059
83	665,568	6001650056	11,162	83	665,567	6001978852	11,162	83	665,569	6000748089	11,162
84	671,119	6000273434	11,264	84	671,118	6001548024	11,264	84	671,120	6001583571	11,264
85	676,670	6001674895	11,369	85	676,669	6001836621	11,369	85	676,671	6000950509	11,369
86	682,221	6000123442	11,475	86	682,220	6001193965	11,474	86	682,222	6001394726	11,475
87	687,773	6000496817	11,585	87	687,772	6000175285	11,585	87	687,774	6001074386	11,585
88	693,324	6001332931	11,693	88	693,323	6001438951	11,693	88	693,325	6001440381	11,693
89	698,875	6001085993	11,805	89	698,874	6000772355	11,805	89	698,876	6000594112	11,805
90	704,426	6001077033	11,914	90	704,425	6000701989	11,914	90	704,427	6000667665	11,914
91	709,977	6000891623	12,028	91	709,976	6000630217	12,028	91	709,978	6000818741	12,028
92	715,529	6000016818	12,145	92	715,528	6000355801	12,145	92	715,530	6001131881	12,145
93	721,080	6000281392	12,265	93	721,079	6000814603	12,265	93	721,081	6000690596	12,265
94	726,631	6001559282	12,386	94	726,630	6000885375	12,386	94	726,632	6001611393	12,386
95	732,182	6001021795	12,511	95	732,181	6000566548	12,511	95	732,183	6001572589	12,511
96	737,733	6001506802	12,636	96	737,732	6000079000	12,636	96	737,734	6001298577	12,636
97	743,285	6001131238	12,768	97	743,284	6000272136	12,767	97	743,286	6001096997	12,768
98	748,836	6001660780	12,901	98	748,835	6001457771	12,901	98	748,837	6000693440	12,901
99	754,387	6001310642	13,035	99	754,386	6000034271	13,035	99	754,388	6001126574	13,035
100	759,938	6001666247	13,173	100	759,937	6001522277	13,173	100	759,939	6001468278	13,173
101	765,490	6001014411	13,310	101	765,489	6001123817	13,310	101	765,491	6001142390	13,310
102	771,041	6001776251	13,454	102	771,040	6000424023	13,454	102	771,042	6001103024	13,454
103	776,592	6000059696	13,602	103	776,591	6000786585	13,602	103	776,593	6000694395	13,602
104	782,143	6001573923	13,755	104	782,142	6000064726	13,755	104	782,144	6001502721	13,755
105	787,694	6000430609	13,910	105	787,693	6000126657	13,910	105	787,695	6000620609	13,910
106	793,246	6000006917	14,070	106	793,245	6000837188	14,070	106	793,247	6001145625	14,070
107	798,797	6000928953	14,233	107	798,796	6000490157	14,233	107	798,798	6001508904	14,233
108	804,348	6001637318	14,402	108	804,347	6001619638	14,402	108	804,349	6001656985	14,402
109	809,899	6000009449	14,574	109	809,898	6001630249	14,574	109	809,900	6000271147	14,574
110	815,451	6001442227	14,751	110	815,450	6001604304	14,751	110	815,452	6001364941	14,751

Primary Sample for RC 07 (P) | **First Backup Sample for RC07 (FB)** | **Second Backup Sample for RC07 (SB)**

Sample #	Obs.	Device Location	Annualized KWH	Sample #	Obs.	Device Location	Annualized KWH	Sample #	Obs.	Device Location	Annualized KWH
111	821,002	6000268274	14,929	111	821,001	6001771831	14,929	111	821,003	6001834448	14,929
112	826,553	6001954975	15,115	112	826,552	6001429329	15,115	112	826,554	6000170628	15,115
113	832,104	6000487709	15,307	113	832,103	6000298057	15,307	113	832,105	6001016720	15,307
114	837,655	6001779777	15,508	114	837,654	6000211828	15,508	114	837,656	6000352771	15,508
115	843,207	6001358619	15,715	115	843,206	6000995047	15,715	115	843,208	6001624799	15,715
116	848,758	6001553993	15,932	116	848,757	6001691770	15,932	116	848,759	6001135024	15,932
117	854,309	6001405768	16,158	117	854,308	6001327750	16,158	117	854,310	6000457433	16,158
118	859,860	6001824900	16,390	118	859,859	6000700976	16,390	118	859,861	6000139941	16,390
119	865,412	6000043883	16,624	119	865,411	6001042912	16,624	119	865,413	6001190371	16,624
120	870,963	6000797308	16,872	120	870,962	6001824338	16,872	120	870,964	6000635082	16,872
121	875,366	6001876937	17,079	121	875,365	6000726162	17,078	121	875,367	6000930642	17,079
122	878,622	6000090911	17,235	122	878,621	6000467904	17,235	122	878,623	6000321567	17,235
123	881,878	6001198571	17,395	123	881,877	6001077762	17,395	123	881,879	6001001884	17,395
124	885,135	6000985709	17,559	124	885,134	6000869973	17,559	124	885,136	6000789409	17,559
125	888,391	6000351451	17,725	125	888,390	6000760170	17,725	125	888,392	6001029538	17,725
126	891,647	6000320517	17,894	126	891,646	6001288371	17,894	126	891,648	6001628339	17,894
127	894,903	6000855995	18,077	127	894,902	6001087309	18,077	127	894,904	6000888679	18,077
128	898,159	6000341168	18,265	128	898,158	6001753584	18,265	128	898,160	6000847795	18,265
129	901,415	6000645542	18,459	129	901,414	6001697562	18,459	129	901,416	6001085341	18,459
130	904,672	6001041240	18,653	130	904,671	6001443155	18,653	130	904,673	6001275026	18,653
131	907,928	6001719366	18,855	131	907,927	6001629409	18,855	131	907,929	6001621890	18,855
132	911,184	6001223080	19,065	132	911,183	6000526635	19,065	132	911,185	6000610850	19,065
133	914,440	6000685235	19,287	133	914,439	6001110295	19,287	133	914,441	6001968988	19,287
134	917,696	6001276676	19,520	134	917,695	6001103741	19,520	134	917,697	6000527036	19,520
135	920,952	6001459617	19,759	135	920,951	6000032323	19,759	135	920,953	6001687211	19,759
136	924,209	6001401279	20,000	136	924,208	6001512946	20,000	136	924,210	6000453778	20,000
137	927,465	6001438719	20,256	137	927,464	6001100976	20,256	137	927,466	6001653377	20,256
138	930,721	6001193004	20,530	138	930,720	6000412878	20,530	138	930,722	6000060654	20,530
139	933,977	6001053297	20,820	139	933,976	6001860290	20,820	139	933,978	6000018244	20,820
140	937,233	6000254855	21,117	140	937,232	6000705407	21,117	140	937,234	6001794596	21,118
141	940,490	6000536948	21,432	141	940,489	6001176665	21,431	141	940,491	6001311083	21,432
142	943,746	6000744275	21,772	142	943,745	6001342687	21,772	142	943,747	6001302641	21,773
143	947,002	6001869085	22,124	143	947,001	6000463355	22,123	143	947,003	6000401187	22,124
144	950,258	6001763150	22,498	144	950,257	6001354954	22,498	144	950,259	6001867539	22,498
145	953,514	6000932422	22,905	145	953,513	6001109983	22,905	145	953,515	6001024573	22,905
146	956,770	6002040257	23,346	146	956,769	6001208199	23,346	146	956,771	6001454549	23,346
147	960,027	6001659363	23,835	147	960,026	6001009227	23,835	147	960,028	6000326111	23,835
148	963,283	6000608222	24,375	148	963,282	6001819958	24,375	148	963,284	6001889693	24,376
149	966,539	6001520252	24,956	149	966,538	6001013679	24,956	149	966,540	6000723722	24,957
150	969,795	6000112729	25,586	150	969,794	6001703609	25,586	150	969,796	6000534229	25,586
151	973,051	6001799826	26,321	151	973,050	6001509983	26,321	151	973,052	6001122693	26,321
152	976,307	6000726978	27,172	152	976,306	6001372642	27,171	152	976,308	6000645822	27,172
153	979,564	6000603582	28,155	153	979,563	6000545347	28,155	153	979,565	6000936383	28,156
154	982,820	6001234794	29,328	154	982,819	6001827396	29,328	154	982,821	6000004473	29,328
155	984,589	6000326601	30,069	155	984,588	6001060492	30,067	155	984,590	6001475141	30,069
156	984,870	6001043596	30,190	156	984,869	6000380928	30,189	156	984,871	6000261610	30,190
157	985,152	6001491937	30,304	157	985,151	6000148033	30,304	157	985,153	6000956895	30,305
158	985,433	6001098618	30,444	158	985,432	6001235872	30,443	158	985,434	6000364116	30,444
159	985,715	6000440051	30,592	159	985,714	6001425693	30,592	159	985,716	6000389078	30,592
160	985,996	6000983154	30,724	160	985,995	6000671094	30,723	160	985,997	6001969557	30,724
161	986,278	6000035055	30,860	161	986,277	6001390577	30,860	161	986,279	6000103157	30,860
162	986,559	6000529936	30,985	162	986,558	6000100425	30,985	162	986,560	6000146589	30,985
163	986,841	6001852897	31,147	163	986,840	6001513793	31,146	163	986,842	6000290021	31,147
164	987,122	6000186507	31,284	164	987,121	6001554903	31,284	164	987,123	6000132819	31,284
165	987,403	6000064776	31,449	165	987,402	6000490510	31,449	165	987,404	6000571801	31,450
166	987,685	6000024298	31,622	166	987,684	6001594343	31,621	166	987,686	6001211487	31,623
167	987,966	6000194343	31,775	167	987,965	6000942618	31,775	167	987,967	6001258302	31,775
168	988,248	6001504834	31,948	168	988,247	6000346962	31,948	168	988,249	6001238712	31,949
169	988,529	6000913361	32,110	169	988,528	6001053468	32,108	169	988,530	6000479238	32,111
170	988,811	6000946578	32,270	170	988,810	6000243601	32,268	170	988,812	6001240387	32,272

Primary Sample for RC 07 (P)				First Backup Sample for RC07 (FB)				Second Backup Sample for RC07 (SB)			
Sample #	Obs.	Device Location	Annualized KWH	Sample #	Obs.	Device Location	Annualized KWH	Sample #	Obs.	Device Location	Annualized KWH
171	989,092	6001791199	32,447	171	989,091	6001256927	32,446	171	989,093	6001294953	32,448
172	989,374	6001317832	32,644	172	989,373	6000162897	32,643	172	989,375	6001072751	32,645
173	989,655	6000100901	32,844	173	989,654	6001780870	32,844	173	989,656	6000466197	32,847
174	989,936	6001407252	33,055	174	989,935	6001632926	33,055	174	989,937	6001774656	33,055
175	990,218	6001696468	33,296	175	990,217	6000890144	33,294	175	990,219	6001477203	33,296
176	990,499	6001299277	33,520	176	990,498	6001996073	33,518	176	990,500	6001467411	33,520
177	990,781	6001767992	33,735	177	990,780	6001072054	33,735	177	990,782	6001185903	33,735
178	991,062	6000132854	33,971	178	991,061	6001898804	33,971	178	991,063	6001328136	33,972
179	991,344	6000779443	34,217	179	991,343	6000064856	34,217	179	991,345	6001471855	34,217
180	991,625	6001531238	34,488	180	991,624	6000447050	34,488	180	991,626	6000886683	34,488
181	991,907	6000946534	34,775	181	991,906	6001115788	34,773	181	991,908	6000106805	34,775
182	992,188	6001211593	35,089	182	992,187	6000728773	35,088	182	992,189	6000273700	35,089
183	992,469	6001784313	35,373	183	992,468	6001818932	35,373	183	992,470	6001816812	35,375
184	992,751	6001644291	35,692	184	992,750	6000964622	35,691	184	992,752	6000800116	35,695
185	993,032	6000482949	36,000	185	993,031	6001582501	36,000	185	993,033	6001346843	36,001
186	993,314	6001766336	36,362	186	993,313	6001649915	36,361	186	993,315	6001536058	36,363
187	993,595	6000500151	36,738	187	993,594	6000555865	36,738	187	993,596	6001254290	36,739
188	993,877	6000016899	37,106	188	993,876	6000176250	37,104	188	993,878	6000815150	37,106
189	994,158	6000788745	37,537	189	994,157	6001557052	37,535	189	994,159	6000519377	37,538
190	994,439	6000031211	37,983	190	994,438	6001804773	37,982	190	994,440	6001733879	37,983
191	994,721	6000663669	38,431	191	994,720	6001675625	38,428	191	994,722	6000362759	38,431
192	995,002	6000242577	38,909	192	995,001	6001108076	38,908	192	995,003	6000318270	38,910
193	995,284	6000048839	39,451	193	995,283	6001238213	39,450	193	995,285	6000294805	39,456
194	995,565	6001085365	39,988	194	995,564	6001051334	39,984	194	995,566	6000588391	39,988
195	995,847	6000215850	40,609	195	995,846	6000609015	40,608	195	995,848	6001756967	40,611
196	996,128	6000804143	41,205	196	996,127	6000275881	41,204	196	996,129	6001429184	41,205
197	996,410	6000944138	41,878	197	996,409	6000828140	41,877	197	996,411	6001841503	41,883
198	996,691	6000245258	42,578	198	996,690	6000144807	42,577	198	996,692	6001016958	42,582
199	996,972	6000268583	43,431	199	996,971	6000604417	43,430	199	996,973	6001328859	43,433
200	997,254	6000304826	44,345	200	997,253	6000940497	44,341	200	997,255	6000854982	44,347
201	997,535	6001138244	45,270	201	997,534	6000720849	45,266	201	997,536	6001481660	45,272
202	997,817	6001375948	46,398	202	997,816	6001536942	46,398	202	997,818	6001664394	46,398
203	998,098	6000733428	47,683	203	998,097	6000739766	47,679	203	998,099	6001230689	47,691
204	998,380	6001371810	49,130	204	998,379	6000643418	49,129	204	998,381	6001454821	49,130
205	998,661	6000005542	50,880	205	998,660	6000761894	50,873	205	998,662	6000240025	50,888
206	998,943	6001315850	52,804	206	998,942	6001801646	52,799	206	998,944	6001415689	52,808
207	999,224	6000122971	55,211	207	999,223	6001012562	55,193	207	999,225	6000325917	55,219
208	999,505	6000588958	57,781	208	999,504	6000872212	57,777	208	999,506	6000985685	57,781
209	999,787	6001219324	61,708	209	999,786	6000389048	61,697	209	999,788	6000622841	61,716
210	1,000,068	6001664677	65,953	210	1,000,067	6001774893	65,923	210	1,000,069	6000944606	65,966
211	1,000,350	6001485851	71,743	211	1,000,349	6001798484	71,733	211	1,000,351	6000723309	71,759
212	1,000,631	6002049626	79,751	212	1,000,630	6000394744	79,704	212	1,000,632	6000408583	79,770
213	1,000,913	6002017180	92,159	213	1,000,912	6001585194	92,124	213	1,000,914	6000444254	92,166
214	1,001,194	6001067513	113,963	214	1,001,193	6001905902	113,927	214	1,001,195	6000974443	114,007
215	1,001,476	6000882908	160,428	215	1,001,475	6000091994	160,033	215	1,001,477	6000845957	160,734

Reuse of the Existing Sample Meters with High Performance Records

In order to improve the performance of the sampled meters, other existing sampled metered data were evaluated. This include existing load research sample meters, which were deployed in March 2011 and the 15-minute interval meter readings maintained by the Energy Efficiency Group for their program impact study. These existing meter data were evaluated for availability and quality of their interval load readings from September 2016 to February 2017. In total, 543 existing residential sample meters and 5,188 existing non-residential sample meters were examined. Through the meter reading performance evaluation, it was discovered that 329 residential meters and 3,757 non-residential meters have been producing accurate interval load readings for 99 or higher percent of time.

Since these meters have been verified for their high performance, we would save a good amount of time and efforts spent previously for verifying, editing and estimating (VEE) the interval load readings, if we reuse those existing sample meters in place of the newly drawn samples whenever they are compatible with the new samples drawn. For each rate class, those high performing meters were checked against the new samples for their compatibility in annual energy usage. Whenever the difference between the annual energy usage of an existing high-performance sample and a newly-drawn sample is within 5 percent, the existing sample replaced the new sample. This process resulted in a final list of primary samples made of 477 from the existing load research sample meters, 792 from the interval load meters being maintained by the Energy Efficiency Group, and 405 from the new samples drawn in accordance with 2017 Load Research Sample Design. Since the number of interval load reading meters is limited by a budget constraint, the secondary backup samples were selected from only the existing sample meters. Table 4 below lists sources and sizes of the final primary, first backup and second backup samples by rate class:

Table 4

2017 Load Research Samples by Rate Schedule and Source

	Schedule 07				Schedule 24			
	Sources of Samples				Sources of Samples			
	Existing Samples				Existing Samples			
	L.R.	Other	New	Total	L.R.	Other	New	Total
Primary Samples	119	44	51	214	172	290	127	589
First Backup Samples	66	37	111	214	92	264	196	552
Second Backup Samples	30	15	0	45	62	218	0	280
Total	215	96	162	473	326	772	323	1421

	Schedule 25				Schedule 26			
	Sources of Samples				Sources of Samples			
	Existing Samples				Existing Samples			
	L.R.	Other	New	Total	L.R.	Other	New	Total
Primary Samples	46	102	38	186	19	107	21	147
First Backup Samples	23	96	46	165	8	75	46	129
Second Backup Samples	21	75	0	96	2	62	0	64
Total	90	273	84	447	29	244	67	340

	Schedule 29				Schedule 31			
	Sources of Samples				Sources of Samples			
	Existing Samples				Existing Samples			
	L.R.	Other	New	Total	L.R.	Other	New	Total
Primary Samples	50	137	106	293	50	79	51	180
First Backup Samples	10	66	115	191	11	42	34	87
Second Backup Samples	2	21	0	23	4	29	0	33
Total	62	224	221	507	65	150	85	300

	Schedule 43				Total			
	Sources of Samples				Sources of Samples			
	Existing Samples				Existing Samples			
	L.R.	Other	New	Total	L.R.	Other	New	Total
Primary Samples	21	33	11	65	477	792	405	1,674
First Backup Samples	8	23	5	36	218	603	553	1,374
Second Backup Samples	4	12	0	16	125	432	0	557
Total	33	68	16	117	820	1,827	958	3,605

Validation of the Final Samples

The main goal of sample design is to obtain unbiased samples to represent statistical properties of the target population within a pre-determined level of error tolerance. The maximum level of error tolerance with a 95 percent confidence limit set for the sample design was 3 percent for the residential rate class and 5 percent for all other rate classes. Validity of the samples selected for each usage bracket was evaluated comparing the mean value of the selected sample customers' annual energy usage with the population mean calculated for the rate-class usage brackets involved. There were 37 usage brackets to evaluate. As shown in Table 5 below, all the usage bracket samples selected for the "Primary" sample group perform significantly better than the pre-set error margin criteria, except the highest usage bracket samples selected for Rate Class 25I. Difference between the sample mean and the population mean for this rate class usage bracket is 5.1 percent, slightly over the 5 percent criteria. This usage bracket has only 30 large industrial

customers with a high usage variance. Out of 24 samples required to meet the sample design criteria, 4 samples were selected from the existing Load Research Program samples and 3 samples were recruited from the current Energy Efficiency Program samples. Considering the benefit of reusing the existing samples with proven records, an error margin slightly above the 5 percent limit was deemed reasonable.

Future Plan

The interval load data to be collected from the new samples will be examined regularly for service changes and metering performance. The interval load readings will be verified, estimated and edited, and be post-stratified and expanded to develop class hourly load profiles as needed for electric cost of service study. Through the continuous monitoring and verification process, the load research meters with missing or erroneous readings for more than 5% of times will be sorted out. If a sub-performing meter is a primary sample, performance of its first backup meter will be evaluated. If the backup meter's performance rate is 95% or above, it will replace the primary meter for interval load data processing and hourly load profiling for the current and future months. If both the primary and the first backup meters fail the performance test, the second backup will be evaluated as a substitute. The large C&I customers whose interval loads are being read and stored in the MV-90 system will be also evaluated as a replacement for the failing samples. PSE plans to update its class load research sample design and selection every five years.

Table 5

Validity Test Results of the Final Primary Samples by Rate Class

RC 7

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 6,000*	0.2657	4,094	4,102	0.20%
6,001 -10,000	0.3295	7,892	7,946	0.68%
11,001 - 17,000	0.2771	12,864	12,857	-0.05%
17,001 - 30,000	0.1105	21,218	21,218	0.00%
> 30,000	0.0171	44,129	43,514	-1.40%
Total	1.0000	10,355	10,362	0.07%

Where W(h) = Usage bracket weight; Y(h) = Population Mean; y(h) = Sample Mean

RC 24C

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 16,000*	0.6816	4,666	4,664	-0.04%
16,001 -60,000	0.2272	30,999	30,921	-0.25%
60,001 - 180,000	0.0811	96,188	95,822	-0.38%
> 180,000	0.0100	303,750	297,478	-2.06%
Total	1.0000	21,075	20,963	-0.53%

RC 24I

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 16,000*	0.5247	6,433	6,441	0.13%
16,001 -60,000	0.3319	31,130	31,546	1.34%
60,001 - 180,000	0.1327	95,842	95,497	-0.36%
> 180,000	0.0106	397,576	397,576	0.00%
Total	1.0000	30,662	30,759	0.31%

RC 25C

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 220,000*	0.4134	130,478	130,368	-0.08%
220,001 - 450,000	0.3130	315,447	315,311	-0.04%
450,001 - 1,000,000	0.2146	644,594	644,371	-0.03%
> 1,000,000	0.0591	1,377,211	1,356,396	-1.51%
Total	1.0000	372,310	370,945	-0.37%

RC 25I

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 220,000*	0.4134	126,733	127,262	0.42%
220,001 - 450,000	0.3130	307,881	303,510	-1.42%
450,001 - 1,000,000	0.2146	667,491	662,662	-0.72%
> 1,000,000	0.0591	1,436,845	1,363,165	-5.13%
Total	1.0000	376,829	370,292	-1.73%

RC 26C

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 2,000,000*	0.4933	1,242,556	1,237,622	-0.40%
2,000,001 -4,000,000	0.4051	2,775,802	2,800,977	0.91%
> 4,000,000	0.1016	5,391,478	5,287,760	-1.92%
Total	1.0000	2,285,192	2,282,418	-0.12%

RC 26I

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 2,000,000*	0.5859	1,213,976	1,177,192	-3.03%
2,000,001 -4,000,000	0.2727	2,783,103	2,720,446	-2.25%
> 4,000,000	0.1414	5,340,681	5,166,295	-3.27%
Total	1.0000	2,268,889	2,207,644	-2.70%

RC 29

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 50,000*	0.8589	13,692	13,643	-0.35%
> 50,000	0.1411	91,757	91,757	0.00%
Total	1.0000	24,709	24,667	-0.17%

RC 31C

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 2,000,000*	0.6757	593,843	584,823	-1.52%
2,000,001 - 8,000,000	0.2725	3,984,168	3,939,590	-1.12%
> 8,000,000	0.0518	13,371,056	13,371,056	0.00%
Total	1.0000	2,179,128	2,160,886	-0.84%

RC 31I

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 2,000,000*	0.5462	636,363	605,158	-4.90%
2,000,001 - 8,000,000	0.3231	4,846,963	4,747,255	-2.06%
> 8,000,000	0.1308	13,829,097	13,829,097	0.00%
Total	1.0000	2,466,668	2,418,413	-1.96%

RC 43

Annual kWh Range	W(h)	Y(h)	y(h)	% Diff.
0 - 1,000,000*	0.8261	506,784	501,626	-1.02%
> 1,000,000	0.1739	1,734,804	1,734,804	0.00%
Total	1.0000	720,353	716,092	-0.59%