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August 12, 1998

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Ms. Blanca S. Bayo, Director
Division of Records and Reporting
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850

980005

Re: Load Research Report - Tampa Electric Company

Dear Ms. Bayo:

In compliance with Rule 25-6.0437 enclosed are five copies of Tampa Electric Company's Load Research Sampling Plan.

Please acknowledge receipt and filing of the above by stamping the duplicate copy of this letter and returning same to this writer.

Thank you for your assistance in connection with this matter.

Sincerely,

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James D. Beasley

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cc: Angela Llewellyn

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TAMPA ELECTRIC COMPANY

LOAD RESEARCH SAMPLING PLAN

AUGUST 1998

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APPLICABLE RATE CLASSES

Table 1 lists the major rates which Tampa Electric Company has in effect. The third column shows the percent of total annual sales for each rate and indicates the rates for which monitoring is required by the load research rule. The annual sales reported are for the twelve month period ending December 31, 1997.

TABLE 1

PERCENT OF ANNUAL MWH SALES BY RATE

RATE	ANNUAL SALES (MWH)	PERCENT OF TOTAL SALES
Residential (RS & RST)	6,481,556	43.0
General Service Non-Demand (GS, GST, TS)	868,777	5.8
General Service Demand (GSD & GSDT)	3,997,489	26.5
General Service Large Demand (GSLD, GSLDT, SBFT)	1,666,173	11.0
Interruptible Service (IS-1, IST-1, IS-3, IST-3, SBIT-1, SBIT-3)	1,928,978	12.8
All Other Rates	147,218	1.0
Total for All Rates	14,599,954	100.0

Each of the rates listed in Table 1 was monitored during 1997 as part of Tampa Electric Company's ongoing load research program. Samples for the RS, GS and GSD classes were selected and installed in late 1996. Samples for the GSLD and IS classes are not necessary since all of the Customers on these rates have recorders installed on their meters for billing purposes. The data collected by these recorders is used for load research purposes as well. Under this plan the collection of load data for the GSLD and IS classes in this manner will continue.

EXISTING SAMPLE DESIGN

The residential sample was pre-stratified by housing type. The three housing type categories are single family detached, multi-family, and mobile home. The primary reasons for using this stratification was that the load patterns for the three housing types are dissimilar and the percentage of mobile homes in the population changes significantly with the seasons. The percentage ranged from a high of 13.3% in the winter to a low of 12.4% in the summer. The housing type stratification allows corresponding changes to be made in stratum weights (since inter-strata migration is not a concern) on a month by month basis when estimating class demands. The estimated demands thus reflect the seasonal changes in the housing type mix.

The sample points were allocated to the strata using Neyman allocation with stratum variances estimated from previous sample results. A minimum sample size of 50 was used in the multi-family and mobile home categories to allow generating more accurate data for these sub-populations. The resulting allocation is shown in Table 2.

TABLE 2

RESIDENTIAL SAMPLE

STRATUM	SAMPLE SIZE
Single Family Detached	175
Multi-Family	50
Mobile Home	50
TOTAL	275

The general service non-demand class was stratified on the basis of annual kilowatt-hour consumption at the time of sample selection. Two strata were used with the boundary being 15,000 KWH. The sample points were allocated to the strata using Neyman allocation with stratum variances estimated from the previous sample results. The allocation is shown in Table 3.

TABLE 3

GENERAL SERVICE NON-DEMAND SAMPLE

STRATUM	SAMPLE SIZE
0 - 14,999 KWH	257
15,000 - Infinity	243
TOTAL	500

The general service demand class was stratified by several different variables. The first variable was service voltage level; the GSD class contains Customers served at either primary voltage or secondary voltage. Voltage level stratification was used to facilitate analysis required for performing cost of service studies. All Customers served and/or metered at primary voltage were included in the sample. Among secondary Customers an additional 100% sampled stratum was included in the sample design; Customers having demands over 700 KW are included in this stratum. During the course of the data collection for this sample, new Customers meeting the criteria of these 100% sampled strata were added to the sample. The remaining GSD Customers were stratified into two strata on the basis of their highest demand in the twelve month period prior to sample selection. The stratum boundary used was 200 KW. Sample points were allocated to these two strata using Neyman allocation with variances being estimated from the preceding sample. The allocation shown in Table 4 reflects the sample as of December 1997.

TABLE 4

GENERAL SERVICE DEMAND SAMPLE

STRATUM	SAMPLE SIZE
Secondary 0 - 199 KW	70
Secondary 200 - 699 KW	70
Secondary over 699 KW	149 (100%)
Primary Metered/Primary Served	73 (100%)
Primary Metered/Secondary Served	37 (100%)
TOTAL	399

EXISTING SAMPLE ACCURACY

As a first step in rmulating a sampling plan for Tampa Electric Company the accuracy achieved for the three sampled c' sses was calculated for each month's coincident peak for 1997 and for the average of the twelve monthly coincident peaks as well. The class accuracies were calculated in the conventional manner for combined ratio analysis. The resulting accuracies are shown in Table 5.

TABLE 5

1997 COINCIDENT PEAK PERCENTAGE ACCURACIES AT 90% CONFIDENCE LEVEL USING COMBINED RATIO ESTIMATION

Month	RS	GS	GSD
January	6.6	9.1	10.0
February	7.6	9.3	9.8
March	6.2	8.1	4.8
April	7.2	6.3	4.1
May	5.7	6.3	4.9
June	5.3	5.0	4.7
July	4.1	4.7	3.9
August	4.3	5.1	3.9
September	4.5	4.7	4.6
October	5.1	4.8	4.2
November	7.0	7.5	5.3
December	7.8	8.1	3.7
12 Coincident Peak Average	2.4	3.3	6.4

The 1997 annual system winter peak occurred in January, and the summer peak occurred in May. All three samples achieved at least the target 10% accuracy at the 90% confidence limit for the winter coincident peak, the summer coincident peak and for the 12 coincident peak average.

PROPOSED SAMPLING PLAN

No changes are proposed for the RS or GS sample designs for 1999. Both samples met the target accuracies and can reasonably be expected to do so again in 1999.

The GSD sample also met the target accuracies for 1997, but the sample design for this class is being modified somewhat. As of the end of 1997 the threshold for 100% sampling was lowered to 500 kW, and our plan is to further reduce the threshold to 400 kW prior to the start of data collection in January of 1999.

Based on current GSD Customer usage levels, the resulting proposed sample design is as follows:

STRATUM	1999 PROPOSED SAMPLE SIZES
1. Secondary 0 - 199 KW	70
2. Secondary 200 - 400 KW	70
3. Secondary Over 400 KW	513
4. Primary Metered/Primary Served	75
5. Primary Metered/Secondary Served	38
Total	766

CONTINUOUS OVERLAPPING SAMPLES

As outlined in the 1996 Tampa Electric Company Load Research Sampling Plan, we are proposing to continue the continuous overlapping sampling methodology for all three of the sampled rate classes, RS, GS and GSD.

Prior to the end of 1997 Tampa Electric Company randomly selected and installed recorders on half-sized samples in each of the strata for RS, GS and GSD. In 1998, following the completion of 1997 data collection, half of the prior sample Customers in each stratum were randomly selected to be dropped from the sample. Data collection from the remaining prior sample Customers will continue throughout 1998. Prior to the end of 1998, new half-sized samples will be installed -- in time for data collection to begin in 1999 and continue for two years.

For subsequent years, new independent, approximately half-sized samples will be selected and installed every year; data will be collected from these samples for twenty-four months. Once the new, independent sample is fully installed and data collection has begun, the oldest previously selected sample will be retired and removed. Thus, for any given month, two independent samples will be available to produce population estimates. For computing annual statistics, in particular the twelve coincident peak average, estimates from two or three independent, overlapping samples will be combined. The sample size for each new sample will be computed such that it is sufficiently large, when used in combination with the existing sample(s), to be expected to achieve an accuracy of $\pm 10\%$ at the 90% confidence level for the summer and winter coincident peaks as well as for the average of the twelve monthly coincident peaks.

FORMULAS AND DEFINITIONS

Combined Ratio Estimate

$$\hat{R}_c = \frac{\sum_h W_h \bar{y}_h}{\sum_h W_h \bar{x}_h}$$

Where

$\hat{R}_c$ = combined ratio estimate
W_h = stratum weight for stratum h
$\bar{Y}_h$ = mean coincident demand for stratum h
$\bar{X}_h$ = mean billed energy for stratum h

Coincident Peak Estimate

$$\hat{Y}_{rc} = \hat{R}_c X$$

Where

$\hat{R}_c$ = combined ratio estimate
$\hat{Y}_{rc}$ = estimated class total coincident peak
X = class total billed energy

Standard Deviation of Sample Residuals

$$s_{dh}^2 = \frac{\sum_{i=1}^{n_h} (y_{hi} - \hat{R}_c x_{hi})^2}{n_h - 1}$$

Where

$\hat{R}_c$ = combined ratio estimate
n_h = sample size for stratum h
s_{dh} = standard deviation of sample residuals
y_{hi} = coincident demand for sample Customer i of stratum h
x_{hi} = billed energy for Customer i of stratum h

Variance of Coincident Peak Estimate

$$\hat{V}(\hat{Y}_{rc}) = \sum_{h} \frac{N_h^2\left(1 - \frac{n_h}{N_h}\right)}{n_h} s_{dh}^2$$

Where

$\hat{V}(\hat{Y}_{rc})$ = variance of coincident estimate
N_h = population size for stratum h
n_h = sample size for stratum h
s_{dh} = standard deviation of sample residuals

Accuracy at 90% Confidence Level

$$A = \frac{1.645\sqrt{\hat{V}(\hat{Y}_{rc})}}{\hat{Y}_{rc}}$$

Where

$\hat{Y}_{rc}$ = estimated class total coincident peak
$\hat{V}(\hat{Y}_{rc})$ = variance of coincident estimate
A = accuracy at 90% confidence level

Sample Size

$$n = \frac{(\sum_{h} W_h s_{dh})^2}{\left(\frac{d}{1.645}\right)^2 \left(\frac{\hat{Y}_{rc}}{N}\right)^2}$$

Where

W_h = stratum weight for stratum h
$\hat{Y}_{rc}$ = estimated class total coincident peak
N = population size
s_{dh} = standard deviation of sample residuals
n = total sample size
d = desired relative accuracy

Sample Allocation (Neyman)

$$n_h = n \frac{W_h s_{dh}}{\sum_h W_h s_{dh}}$$

Where

W_h = stratum weight for stratum h
n_h = sample size for stratum h
s_{dh} = standard deviation of sample residuals
n = total sample size

TWELVE COINCIDENT PEAK ESTIMATE

$$12\hat{CP} = \frac{1}{12} \sum_{m=1}^{12} \hat{Y}_{rcm}$$

WHERE

$\hat{Y}_{rcm}$ = Coincident Peak Estimate for Month M

VARIANCE OF TWELVE COINCIDENT PEAK

$$VAR(12\hat{CP}) = \left(\frac{1}{12} \right)^2 \left(\sum_{m=1}^{12} \hat{V}(\hat{Y}_{rcm}) + 2 \sum_{m=1}^{12} \sum_{k<m} \hat{C}(\hat{Y}_{rcm}, \hat{Y}_{rck}) \right)$$

WHERE

$\hat{V}(\hat{Y}_{rcm})$ = Variance of Coincident Peak Estimate Month m
$\hat{C}(\hat{Y}_{rcm}, \hat{Y}_{rck})$ = Covariance of Month m and Month k Estimates

MONTH TO MONTH COVARIANCE

$$\hat{C}(\hat{Y}_{rcm}, \hat{Y}_{rck}) = \sum_{h=1}^{L} \frac{N_{hm} N_{hk}}{n_{hmk}} (fpc_{mk})\, s_{hd_m d_k}$$

WHERE

N_{hm} = Population Size in Month m
N_{hk} = Population Size in Month k
n_{hmk} = Sample Size with good data in Month m and k

$$fpc_{mk} = 1 - \min\left(\frac{n_m}{N_m}, \frac{n_k}{N_k}\right)$$

$$s_{hd_m d_k} = \sum_{i=1}^{n_{hmk}} \frac{(y_{hmi} - \hat{R}_m x_{hmi})(y_{hki} - \hat{R}_k x_{hki})}{n_{hmk} - 1}$$

COMBINING ESTIMATES FROM TWO SAMPLES

$$\hat{Y}_{rc} = \alpha \hat{Y}_{rcA} + (1 - \alpha)\hat{Y}_{rcB}$$

WHERE

$\hat{Y}_{rcA}$ = Sample A Estimate
$\hat{Y}_{rcB}$ = Sample B Estimate
α = Weighting factor

COMBINING VARIANCES FROM TWO SAMPLES

$$\hat{V}(\hat{Y}_{rc}) = \alpha^2 \hat{V}(\hat{Y}_{rcA}) + (1 - \alpha)^2 \hat{V}(\hat{Y}_{rcB})$$

WHERE

$\hat{V}(\hat{Y}_{rcA})$ = Variance of Sample A Estimate
$\hat{V}(\hat{Y}_{rcB})$ = Variance of Sample B Estimate
α = Weighting factor

WEIGHT TO OBTAIN MINIMUM VARIANCE

$$\alpha = \frac{\hat{V}(\hat{Y}_{rcA})}{\hat{V}(\hat{Y}_{rcA}) + \hat{V}(\hat{Y}_{rcB})}$$

$\hat{V}(\hat{Y}_{rcA})$ = Variance of Sample A Estimate
$\hat{V}(\hat{Y}_{rcB})$ = Variance of Sample B Estimate
α = Weighting factor

TWELVE COINCIDENT PEAK -- THREE SAMPLES EQUAL / WEIGHTING

$$12\hat{CP} = \left(\frac{1}{24}\right)\left(\sum_{m=1}^{l}\hat{Y}_{mA} + \sum_{m=1}^{12}\hat{Y}_{mB} + \sum_{m=l+1}^{12}\hat{Y}_{mC}\right)$$

WHERE

Sample A is in place for the first *l* months, sample B is in place for all 12 months and sample C is in place for the last 12 - *l* months and

$\hat{Y}_{mA}$ = Sample A Estimate for Month m
$\hat{Y}_{mB}$ = Sample B Estimate for Month m
$\hat{Y}_{mC}$ = Sample C Estimate for Month m

VARIANCE OF TWELVE COINCIDENT PEAK

$$\begin{aligned}VAR(12\hat{CP}) = &\left(\frac{1}{24}\right)^2\left(\sum_{m=1}^{l}\hat{V}(\hat{Y}_{rcmA}) + 2\sum_{m=1}^{l}\sum_{k<m}\hat{C}(\hat{Y}_{rcmA},\hat{Y}_{rckA})\right)\\ &+\left(\frac{1}{24}\right)^2\left(\sum_{m=1}^{12}\hat{V}(\hat{Y}_{rcmB}) + 2\left(\sum_{m=1}^{12}\sum_{k<m}\hat{C}(\hat{Y}_{rcmB},\hat{Y}_{rckB})\right)\right.\\ &+\left(\frac{1}{24}\right)^2\left(\sum_{m=l+1}^{12}\hat{V}(\hat{Y}_{rcmC}) + 2\sum_{m=l+1}^{12}\sum_{k<m}\hat{C}(\hat{Y}_{rcmC},\hat{Y}_{rckC})\right)\end{aligned}$$