Application of SAN DIEGO GAS & ELECTRIC COMPANY For Authority to Update Marginal Costs, Cost Allocation, And Electric Rate Design (U 902-E)	)

Application No. 07-01-__
Exhibit No.: (SDGE-13) _____

PREPARED DIRECT TESTIMONY
OF LESLIE WILLOUGHBY
ON BEHALF OF SAN DIEGO GAS & ELECTRIC COMPANY

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

JANUARY 31, 2007

TABLE OF CONTENTS

PREPARED DIRECT TESTIMONY

OF

LESLIE WILLOUGHBY

CHAPTER 13

I. INTRODUCTION

The purpose of this testimony is to provide the California Public Utilities Commission (CPUC or Commission) with San Diego Gas & Electric Company's (SDG&E's) plan to conduct measurement and evaluation (M&E) activities for its default Critical Peak Pricing (CPP) rates, the small commercial time-of-use rate, and Peak Time Rebate (PTR) option. This chapter also includes SDG&E's proposal for the customer reference level (CRL), and the rebate level that is to be used in the calculation of customer rebates for SDG&E's PTR program. Additionally, this chapter contains the updated AMI demand response benefits based on the dynamic pricing rate design.

The first section of this testimony will cover the measurement and evaluation (M&E) activities that will encompass the demand response achieved with the dynamic pricing associated with the implementation of default CPP, small commercial TOU rates, and SDG&E's proposed PTR program. The overall objective of the Demand Response (DR) M&E effort is to provide the Commission and other interested parties with a systematic evaluation of SDG&E's demand response implementation activities and customer response to those activities. Specifically, M&E described in this section quantifies the amount of demand response achieved from customers served by SDG&E and to provide information that will improve existing rate options. SDG&E plans to:

- Report monthly estimates of its demand response impact by each major rate class,
- Conduct M&E annually and evaluate the effectiveness of the demand response achieved,
- Conduct annual evaluation of customer reference level for PTR program,
- Evaluate the CPP/PTR website that provides the on-line presentation of customer load profile data, and
- Estimate customer awareness of CPP and PTR events.

II. M&E PLAN FOR CPP AND PTR

A. Monthly CPUC Reporting

SDG&E proposes to provide monthly statistics for all CPP and PTR events – to be incorporated into the monthly CPUC report as required by Decision (D.) 01-04-006. SDG&E proposes to include number of customers that participated (estimated), amount of demand response achieved (estimated). SDG&E proposes to include econometric Model estimates for peak days (system load forecast, Dynamic Load Profiles) and to utilize population and large meter sample for megawatt (MW) load reduction estimates compare to forecasted system load shape with no demand response (incorporates historical data, current population, historical load research data, weather data, day of the week, and other relevant factors such as customer growth…etc).

B. Annual M&E Evaluation of CPP and PTR Demand Impacts

Conduct formal M&E evaluation of the CPP and PTR events. This analysis will:

(1) Derive load impacts over an adequate time frame utilizing individual interval metered load data.

(2) Show the distribution of customer demand response within each major rate class by applying statistical modeling techniques if appropriate, based on participant population size and characteristics, to the extent possible..

(3) Assess impacts by business segments, end-uses, and technologies to the extent possible.

The impact evaluation analysis and scope will need to be determined as these programs develop and mature. The overall evaluation approach will be one that leverages research results and focuses on new program features adopted in 2006-2008, thereby reducing total study costs.

C. Annual Evaluation of Customer Reference Level for PTR

SDG&E proposes to develop an annual process that will evaluate the accuracy of the customer reference levels (CRLs) used to calculate the PTR credit. The goal is minimize any bias in the CRLs, ensuring accuracy and minimizing gaming opportunities. The CRL is described in detail in Section III below.

D. Assess Effectiveness of SDG&E's CPP and PTR Website

DRA estimates approximately $2.6 million in annual benefits[1] attributed to daily website access and information display technologies with load information in SDG&E's Advanced Metering Initiative (AMI) proceeding (Application (A.) 05-03-015). SDG&E plans to monitor and evaluate the effectiveness of the website (and other potential customer information display technologies) and make enhancements as needed.

[1] This annual benefit is derived from the Division of Ratepayer Advocates' (DRA's) estimate of $18.9 million in present value from customer information feedback website.

E. Conduct Post Event Surveys.

Post event surveys will be utilized to estimate effectiveness of SDG&E's event notification efforts (e.g., electronic customer notification, broadcast media, public service announcement, etc.). This will accomplished by conducting telephone surveys immediately after PTR events. This process will allow SDG&E to assess awareness levels and to determine which type of notification channel is most effective.

III. CUSTOMER REFERENCE LEVEL (CRL)

A. Background

In SDG&E's AMI application (A).05-03-015, SDG&E witness Mr. Gaines (Exhibit 25) presented the Peak Time Rebate (PTR) option for SDG&E's residential and small commercial classes.[2]. The PTR option will pay customers an amount per kWh for the energy reduced between 11 a.m. and 6 p.m. on event days. The energy reduced during these events will be measured using a customer specific reference level[3]. This testimony presents the recommended reference levels and rebate amounts for the residential and small commercial classes that will be used to calculate PTR credits when AMI is implemented.[4]

SDG&E proposes to call event days as needed according to the "soft" triggers, as described in witness Stephen Jack's testimony (Chapter 12). The rebates are designed on an average of nine events per year.[5] All residential and small commercial customers will be automatically enrolled in the PTR option. The load reduction for each customer will

[2] Small commercial customers were defined as generally being less than 20 kW, A.05-03-015, Exhibit 24, Chapter 5 MFG -15 at 6-8.
[3] "reference level" is the term SDG&E will use in this proceeding in place of the term "baseline", so that the term is not confused with the CPUC Code 739 "baseline" which is also discussed in this proceeding.
[4] *See* A.05-03-015, Exhibit 45, Mark Gaines Rebuttal Testimony, Ch 24, p. MFG-18, 5-17.
[5] See Magill (Chapter 10)

be calculated by comparing the customer's 11 a.m. to 6 p.m. load on the day of the event with the customer's reference level. Each customer will be paid a monthly credit according to the kWh reduced below their specific reference level.

The purpose of the reference level is to establish a reasonable customer specific benchmark during PTR events. It is important that the reference level is easy for customers to understand, minimizes payments to customers based on natural variation in electricity usage, and ensures that customers who provide demand response are accurately compensated for their effort. In order to achieve this result, the reference level must be a good predictor of each customer's actual event period usage had the event not been called or triggered. However, it must be emphasized that a reference level does not exactly predict a customer's actual usage. For example, if a customer who normally does not run their room air-conditioner during the day leaves the house one morning and forgets to turn off the air-conditioner, the customer's actual usage on that day will be significantly higher than the customer's reference level. Conversely, if a customer who is normally at home during the day decides to take an extended trip, the customer's actual usage will be lower than the customer's reference level. These deviations of actual usage from the reference level do not indicate that the reference level is unreasonable; rather, they indicate that the customer did something out of the ordinary on that PTR event day. The reference levels proposed in this testimony are explainable to customers, and are strong predictors of actual usage, which enables demand response.

B. Proposed Reference Level for the Residential Class "High 3 of 5"

For weekday PTR events, SDG&E is proposing the reference level for the residential class to be the average of the 11 a.m. to 6 p.m. usage[6] for the highest three out of the past five eligible days. For a weekday event, the eligible days are the five previous weekdays, excluding PTR event days, air conditioning saver or other demand response program event days, and holidays. For weekend PTR events, the recommended reference level is the highest one out of the past three eligible weekend days. The event period for a weekend event is assumed to be 11 a.m. to 6 p.m., which is the same time period as the weekday event period. Although each event has its own reference level, the rebates will be paid based on the average reduction in event usage from the entire bill cycle. For example, if four events occur within a bill cycle, all four reference levels will be summed, the event period usage for each of the four events will be summed, and the total rebate will be paid out based on the difference of these two totals. If a customer's total usage is higher than the customer's reference level for that bill cycle, no rebate is issued and no penalty is assessed.

C. Proposed Reference Level Small Commercial "High 3 of 10"

For the small commercial customer class, SDG&E recommends that the reference level be the average 11 a.m. to 6 p.m. usage during the highest three out of the past ten eligible weekdays. As in the residential case, eligible weekdays exclude PTR event days, other demand response program event days, and holidays. For weekend events the recommended reference level is the highest weekend day out of the past three eligible

[6] SDG&E defines the PTR event period to be from 11am to 6pm during the summer months regardless of weekday or weekend. May through October comprise the summer months for the residential class, whereas the small commercial summer months are May-September

weekend days.[7] As with residential customers, rebates are paid in each bill cycle based on the average event period reduction over the entire bill cycle.

D. Accuracy of Reference Levels

The performance of the proposed reference levels was analyzed using interval data from SDG&E's load research samples. Load data for 338 residential customers and 145 small commercial customers was used in the analysis. In order to assess the accuracy of the proposed reference levels, the reference levels were compared to the actual usage on the nine highest system load days from the years 2004, 2005, and 2006 for these samples of customers. Since 2004 was a normal weather year, 2005 was a cooler than average year, and 2006 was an extremely hot year, all three were reflective of a variety of weather conditions. The results of the residential reference level analysis are contained in Table LW-1.

Table LW-1
Residential Reference Level Statistics

Year	Reference Level	Average Error	Median Error	Total Rebates Paid no DR ($ millions)	Total Rebates Paid with DR ($ millions)
2004	High 3 of 5	2%	-1%	-$10	-$15
2005	High 3 of 5	6%	-1%	-$11	-$15
2006	High 3 of 5	-1%	-1%	-$12	-$17

The average and median errors displayed in this table represent the difference between the actual event period usage and the proposed reference level with a positive error indicating that the actual event period usage is higher than the baseline and a

[7] SDG&E believes that the need for weekend PTR days will be rare, but the possibility does exist that weekend events will be called. All PTR events will be from 11AM to 6PM regardless of weekend or weekday. When weekend PTR events are called, the customers' reference level will be calculated by using the highest 11AM-6PM period from the last 3 weekend days. Holidays are excluded from all reference level calculations.

negative error indicating that the actual event period usage is lower than the reference level.[8] Table LW-1 shows that the reference level has a low average error in all three years, and that the median error is even lower. The baseline study conducted for the CEC recommended that the median be used to evaluate the reference levels rather than the mean.[9] The column "Total Rebates Paid no DR" (i.e., no demand response) indicates the total estimated payout to customers if no demand response actions are taken. The column "Total Rebates Paid with DR" indicates the total amount of rebates that would be paid out if 70 percent of residential customers each contribute the average 14 percent load reduction predicted by the PRISM model using the elasticities from the Statewide Pricing Pilot (SPP). Total rebates paid without demand response are less than 1% of SDG&E's 1.2 billion dollar revenue requirement for the residential class.

Table LW-2 addresses the concern that some customers would have to reduce more than 15 percent from their actual usage in order to achieve a rebate due to baseline errors. This table contains the percentage of customers whose average annual error is greater than 15 percent.

Table LW-2
Residential Customer Percentages

Reference Level	Year	Disadvantage Error > 15%	Able to earn rebate
High 3 of 5	2004	19%	81%
High 3 of 5	2005	23%	77%
High 3 of 5	2006	18%	82%

[8] The median error is the 50th percentile, in other words 50% of the errors are higher than the median and 50% of the errors are lower than the median. The mean error is the average error. Both statistics are appropriately weighted.

[9] Protocol Development for Demand Response Calculation – Findings and Recommendations , Prepared by KEMA- XENERGY, February 2003 p 5-2

The data shows that for all years, this number reasonably low, 19 percent in 2004 and 18 percent in 2006. Although this statistic is calculated to give a sense of the variance of the reference level errors, SDG&E contends that many of these customers who are at a disadvantage may still be able to receive a rebate. Since the reference level consists of the highest three of the previous five days, the customer clearly has the ability to use less than the reference level because they actually did so on two of the previous five days. In addition the average load reduction from the high responders who provided 80 percent of the residential load reduction in the Statewide Pricing Pilot was 29 percent. Customers with this type of large load reduction would still be able to receive a rebate.

The small commercial analysis of the "high three of ten" proposed reference level is shown in Table LW-3. As in the residential case, the average and median errors are generally small: the average error for 2004 is 0 percent and the average error for 2005 is -1 percent. The average error for 2006 is somewhat larger, at -9 percent, but the median error is only -3%. The temperatures in 2006 represent a 1 in 23 weather scenario therefore it is likely that the unusually high average error in 2006 is caused by the unusually hot weather.

Table LW-3

Small Commercial Reference Level Statistics

Year	Reference Level	Average Error	Median Error	Total Rebates No DR (millions)	Total Rebates with DR (millions)
2004	High 3 of 10	0%	0%	-2.3	-3.2
2005	High 3 of 10	-1%	-1%	-2.4	-3.3
2006	High 3 of 10	-9%	-3%	-3.9	-5.3

Table LW-4 addresses the issue of the percentage of small commercial customers who would have to reduce more than 15 percent from their actual usage in order to achieve a rebate. This table contains the percentage of customers whose average annual error is greater than 15 percent.

Table LW-4

Small Commercial customer percentages

Reference Level	Year	Disadvantage (Error > 15%)	Able to earn rebate
High 3 of 5	2004	9%	91%
High 3 of 5	2005	4%	96%
High 3 of 5	2006	5%	95%

E. Setting of the Rebate Level

In the AMI application, SDG&E's proposed rebate level for the PTR program was $0.65 per kWh. The Anaheim Pilot Program had a rebate level that was approximately three times the average residential rate per kWh. Since SDG&E's average rates are approximately $.17/kWh for its residential customers, the $.65 per kWh rate was deemed a reasonable rebate level. The $.65 per kWh rebate level was also in line with the price levels that were used in the Statewide Pricing Pilot (SPP). The $.65 per kWh was based on thirteen CPP days. In this filing, SDG&E proposes a PTR credit of $1.00 per kWh, which provides nearly the same bill savings over nine event days as the $.65 per kWh rebate over 13 event days[10]. Witness James Magill's testimony (Chapter 10) on

[10] The rebate used in the AMI proceeding was: $.65 rebate amount per kWh * 13 design days * 7 hours each event day = $59.15. $.94 per kWh * 9 design days * 7 hours each event day = $59.15. SDG&E proposes that the $.94 / kWh is rounded to $1.00 / kWh for simplicity

CPP rate design provides a discussion on why SDG&E proposes to use nine CPP design days. The available experimental evidence indicates that the $1.00 per kWh rebate level is sufficient to encourage demand response. This rebate level is within the fully cost based rebate level of $1.12/kWh.[11] SDG&E proposes that flexibility be provided in setting the rebate levels for PTR. SDG&E must have the ability to adjust the rates upward or downward depending on the demand response it achieves after the program has been implemented.

IV. UPDATED DEMAND RESPONSE BENEFITS

There have been some changes between the rates proposed in the Test Year 2008 General Rate Case (GRC) Phase II proceeding and the illustrative rates proposed in the AMI proceeding. The purpose of this section is to show that the new rates support the demand response estimates claimed in the AMI business case. The net result of the new cost based rate designs is to increase the present value of demand response benefits from $262 million previously filed[12] to $344 million. The higher results demonstrate that the demand response benefits claimed in the AMI business case will still be achieved with the current rate design. Only two assumptions have been changed from the AMI business case in this analysis: (1) the PTR credits and CPP rates have been updated to reflect those proposed in this filing, and (2) the load for all customer classes has been updated to reflect year 2005 data. All other assumptions, including the avoided capacity value, analysis period, and growth rates for the number of customers, remain the same as in the AMI application (A.).05-03-015. For reference, the nominal avoided capacity value is $85 per kW, the analysis horizon is 2009-2038, the residential awareness rate is 70

[11] See Magill (Chapter 10)
[12] In A.05-03-015, Exhibit 26E, Chapter 6, SG-11, Table SSG-6-3

percent, the small commercial participation rate ramps up to 33 percent over five years and also includes small commercial customers with Title 24 thermostats, and the medium and large commercial participation rate is 100 percent. These assumptions are consistent with the assumptions used in SDG&E's AMI application (A).05-03-015 which estimated demand response benefits as a result of implementing illustrative dynamic rates that would be enabled with AMI technology.

Table LW-5
Present Value of Demand Response Benefits
(Millions of 2006 $)

Customer Segment	Capacity	Energy	Total	2011 MW
Residential	163.1	10.9	174.0	160
Small C&I (<20 kW)	15.5	1.1	16.6	9
Medium C&I (20- 200 kW)	78.9	2.5	81.5	69
Large C&I (> 200 kW)	75.7	2.3	78.0	64
Total	333.3	10.9	344.2	302

Although the main purpose of this testimony is to show the effects of the dynamic pricing design, there is one additional change that has an effect on the results. The load underlying the avoided capacity benefits has been changed to the annual peak day load from 11 a.m. to 6 p.m. instead of the average of the top 9 days. Using the annual peak load for calculating the avoided capacity benefits is a more accurate measure as shown by the following example: Suppose SDG&E's annual peak for the year would be 4,500 MWs and the modeled reduction for that day is 300 MWs of load reduction for a total system peak of 4,200 MWs. Next suppose the 9th highest load day would be 4,250 MWs and the modeled load reduction for this day is 275 MWs, reducing the load to 3,975 MWs. The new annual peak load in this example is 4,200 MWs a full 300 MWs below

what it would have otherwise been. If the 300 MWs had been averaged with the 275 MWs, the reduction of peak would have been underestimated. Since it is the reduction in the system peak which drives the avoided capacity benefits, the use of the annual peak day load is more appropriate than the average. The average usage for the top 9 days is still used to calculate the avoided energy benefits.

V. UCAN STUDY

Attached to my testimony in Appendix LW-A is a study regarding the correlation of the customer's average and peak demand during peak hours with peak and other high load hours on the system, pursuant to Ordering Paragraph #5 contained in D.05-12-003, which was issued as part of SDG&E's most recent Rate Design Window settlement agreement (A.05-02-019). The decision also directs SDG&E to provide detailed work papers for that study to UCAN at the time the application is filed. Please see attached detailed work papers.

This concludes my prepared direct testimony.

VI. QUALIFICATIONS OF LESLIE WILLOUGHBY

My name is Leslie Willoughby. My business address is 8306 Century Park Court, Suite CP42F, San Diego, California 92123. I am employed by San Diego Gas & Electric Company (SDG&E) as a Load Analysis Manager in the Regulatory Strategy Department. In my current position, I am responsible for managing and conducting load and energy research analysis.

I attended San Diego State University in San Diego, California, where I graduated with a Bachelor of Science degree in Business Administration in 1983. I continued to attend San Diego State University where I graduated with an MA in Economics in 1989. In 1990, I was employed by SDG&E to work in the Load Research Section of the Marketing Department as an Associate Economic Analyst. Over the past 17 years I have held positions of increasing responsibility within Load Analysis that have included Load and Energy Research.

APPENDIX LW-A

Study regarding the correlation of large commercial customers' demand during peak periods with average billing demands and consumption

This study is prepared in conformance with ordering paragraph five of the California Public Utilities Commission Opinion Adopting an All-party Settlement for the 2006 San Diego Gas & Electric Company Electric Rate Design, D.05-12-003.

SDG&E presents the results of a study of how certain explanatory variables relate to both electric demand at the time of the single system peak and the average demand for the top 100 hours of system peak. SDG&E used 2004 customer data for the analysis.

For AY-TOU and AL-TOU customers, SDG&E and specified the variables for analysis as follows:

Table A-1

Dependent Variables	
y_1	Electric demand at the time of the single system peak[1]
y_2	Average electric demand for the top 100 hours of system peak

Independent Variables	
x_1	Summer[2] average load occurring during the daily on-peak[3] period
x_2	Summer average maximum demand occurring during the daily on-peak period
x_3	Summer average maximum demand (occurring during any daily period)
x_4	Indicator = 1 if September kilowatt-hours (kWh) < 17,500 kWh, otherwise = 0
x_5	Indicator = 1 if September kWh >= 17,500 kWh and < 67,000 kWh, otherwise = 0
x_6	Indicator = 1 if September kWh >= 67,000, otherwise = 0

[1] 2004 system peak occurred during the hour of 2:00 PM PST on September 10.
[2] Summer is defined as May 1 through September 30.
[3] On-peak is defined as 11:00 AM – 6:00 PM.

Any customer for whom x_4, x_5, and x_6 are set to zero has an annual maximum demand greater than or equal to 500 kW. All other customers have annual maximum demands less than 500 kW.

For AL-TOU-CP customers, SDG&E specified the variables for analysis as follows:

Table A-2	
Dependent Variables	
y_1	Electric demand at the time of the single system peak
y_2	Average electric demand for the top 100 hours of system peak

Independent Variables	
x_1	Summer average load occurring during the daily on-peak period
x_2	Summer average maximum demand occurring during the daily on-peak period
x_3	Summer average maximum demand (occurring during any period)
x_4	Indicator = 1 if maximum demand > 500 kW (maximum over entire summer), otherwise = 0

Data was used for 80 AL-TOU-CP customers, 174 AY-/AL-TOU customers with annual maximum demand less than 500 kilowatts (kW), and 507 AY-/AL-TOU customers with maximum demand greater than or equal to 500 kW. Preliminarily, SDG&E examined Pearson correlation coefficients for these dependent and independent variables, and notes the following results:

Table A-3

AL-/AY-TOU

	x_1	x_2	x_3	y_1
x_1	1	0.99378	0.98999	0.98815
x_2	0.99378	1	0.99555	0.97902
x_3	0.98999	0.99555	1	0.97543
y_1	0.98815	0.97902	0.97543	1

	x_1	x_2	x_3	y_2
x_1	1	0.99378	0.98999	0.99649
x_2	0.99378	1	0.99555	0.99168
x_3	0.98999	0.99555	1	0.98863
y_2	0.99649	0.99168	0.98863	1

AL-TOU-CP

	x_1	x_2	x_3	y_1
x_1	1	0.97151	0.90355	0.71164
x_2	0.97151	1	0.90143	0.67859
x_3	0.90355	0.90143	1	0.63991
y_1	0.71164	0.67859	0.63991	1

	x_1	x_2	x_3	y_2
x_1	1	0.97151	0.90355	0.96714
x_2	0.97151	1	0.90143	0.93862
x_3	0.90355	0.90143	1	0.89882
y_2	0.96714	0.93862	0.89882	1

Correlation between the independent variables x_1, x_2, and x_3 is very high, and nearly as high (in some cases, higher than) as the correlation of those variables with the dependent variables y_1 and y_2. This result gives a strong indication that regression analysis used for the purpose of describing the explanatory power of these independent variables on either of the two dependent variables would suffer from multicollinearity. SDG&E presents the statistical analysis of the variables specified above for the AY-/AL-TOU and AL-TOU-CP customer groups based on a linear regression model:

Table A-4

AL-/AY-TOU Customers

Dependent variable:					y_1
Adjusted R-squared:					0.9773
Variable	**Parameter Estimate**	**SE**	**t-value**	**Pr > t**	**VIF**
Intercept	47.25940	10.78807	4.38	< 0.0001	0
x_1	0.20162	0.00893	22.58	< 0.0001	81.30795
x_2	-0.24636	0.08587	-2.87	0.0043	184.38930
x_3	-0.01755	0.07179	-0.24	0.8069	115.68885
x_4	-46.07444	28.64554	-1.61	0.1083	1.07192
x_5	-35.20291	20.64123	-1.71	0.0886	1.11360
x_6	-42.88824	56.44727	-0.76	0.4477	1.01513
Dependent variable:					y_2
Adjusted R-squared:					0.9932
Variable	**Parameter Estimate**	**SE**	**t-value**	**Pr > t**	**VIF**
Intercept	21.09584	5.15640	4.09	< 0.0001	0
x_1	0.13722	0.00443	30.98	< 0.0001	80.98676
x_2	0.02543	0.04239	0.6	0.5488	181.72370
x_3	0.09217	0.03534	2.61	0.0093	113.38466
x_4	-20.0459	13.97850	-1.43	0.1520	1.06884
x_5	-15.84859	10.05751	-1.58	0.1155	1.10961
x_6	-14.10754	25.97740	-0.54	0.5873	1.01602

Table A-5					
AL-TOU-CP Customers					
Dependent variable:					y_1
Adjusted R-squared:					0.5137
Variable	**Parameter Estimate**	**SE**	**t-value**	**Pr > t**	**VIF**
Intercept	60.77943	51.94796	1.17	0.2460	0
x_1	0.17812	0.06294	2.83	0.0061	20.17722
x_2	-0.34325	0.36932	-0.93	0.3559	20.04932
x_3	-0.17372	0.24030	-0.72	0.4722	6.80666
x_4	186.52106	87.30410	2.14	0.0362	1.86351
Dependent variable:					y_2
Adjusted R-squared:					0.9376
Variable	**Parameter Estimate**	**SE**	**t-value**	**Pr > t**	**VIF**
Intercept	13.55519	15.91818	0.85	0.3972	0
x_1	0.15149	0.02028	7.47	< 0.0001	21.02862
x_2	-0.12763	0.11795	-1.08	0.2827	20.47714
x_3	0.11116	0.07298	1.52	0.1320	6.57416
x_4	37.57813	27.26014	1.38	0.1722	1.88097

These models (as specified by the Settlement Agreement) are found to be highly significant for the AY-/AL-TOU customers. However, the earlier suspicion of multicollinearity appears to be warranted here: only two of six regression coefficients (x_1 and x_2 for y_1; x_1 and x_3 for y_2) are found to be significant at the 0.05 level. Indeed, the variance inflation factors (VIF) for variables x_1, x_2, and x_3 are all quite high (and are also similar for the y_1 and y_2 regressions). The working papers will also show that the condition indices for these regressions are near 30, and analysis of structure indicates two sets of near-linear relationships involving these three variables.

Considering the model for y_1, it would be reasonable to conclude that x_3 may be statistically nonsignificant due to the presence of multicollinearity and not due to the fact

that they are not related to y_1. Similarly for y_2 - it would be reasonable to attribute x_2's non-significance to multicollinearity.

The models for the AL-TOU-CP customers have differing overall results with respect to y_1 and y_2. The model for y_1 does not enjoy a very large F-statistic – the adjusted R-squared is only 0.5137. On the other hand, the model for y_2 is highly significant. This regression, similar to the previous models for non-CPP customers, only reveals one coefficient as significant at the 0.05 level. The condition index here is a modest 11, and a strong relationship between x_1 and x_2 is indicated in the analysis of structure. As above, the AL-TOU-CP model for y_1 may be returning a statistically nonsignficant result for x_2 because of its relationship with x_1.

While the existence of multicollinearity is not a violation of the assumptions underlying the use of regression analysis, we see an illustration above of the fact that it can inhibit the usefulness of results – multicollinearity can produce estimates of coefficient estimates that are not statistically significant or have incorrect signs or magnitudes. This is a problem when the goal is to discover the relationship of the dependent variable to the various independent variables.

Data-driven variable selection processes can be used to provide an optimum subset of these variables whose estimated equation provides a best fit. P-values of the estimated coefficients of these models may not be taken literally; however, they can be indicators of relative importance of those variables for 2004 AL-/AY-TOU and AL-TOU-CP data set. Results of variable selection procedures for the four regressions above are included in the work papers.