IMPACT EVALUATION OF PACIFIC GAS & ELECTRIC COMPANY'S 1994 AGRICULTURAL PROGRAMS:

PUMPING AND RELATED MEASURES (STUDY ID #315)
ENERGY MANAGEMENT SERVICES (STUDY ID #318)
MISCELLANEOUS MEASURES (STUDY ID #321)

APPENDICES

Submitted to

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In Association With

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LIST OF APPENDICES

Appendix A

SAMPLE DESIGN

Appendix A

SAMPLE DESIGN

This appendix presents the existing data sources and the sample design approach used for the evaluation of Pacific Gas and Electric Company's (PG&E's) 1994 Agricultural (Agricultural) Programs. It starts with a discussion of the program tracking database and the PG&E billing database used in this evaluation, followed by a description of the steps undertaken to design the telephone survey and on-site audit samples for the impact and process evaluations.

Program Participant Tracking System

The participant tracking system for the Retrofit Express (RE), Customized Incentives (Customized), and Energy Management Services (EMS) programs was maintained as part of the PG&E Management Decision Support System (MDSS). It contains program application, rebate and technical information about installed measures, including measure descriptions, quantities, rebate amounts, and ex ante demand, energy and therm saving estimates. The MDSS extract used in this evaluation is consistent with the data used in the PG&E March 31 AEAP report.

For the RE/Customized Programs, the program participation was tracked at both application and measure levels and they are physically stored in two separate databases, linked by application code and program year. Each application can cover multiple measures and each measure is linked to a PG&E electrical or gas service location where the measures were supposedly installed. The account location can be identified either by the account number or a unique 7-digit identification number called PG&E control number. The control numbers were used to identify customer service locations and serve as the key fields to link different datasets because they are not subject to reassignment or change in the way that customer account numbers may be. The following exhibit presents the participation and the ex ante impact estimates by end use and measure for the 1994 PG&E Agricultural Retrofit Program.

Exhibit A-1
PG&E Agricultural Programs Participation and Ex Ante Impact Estimates

End Use	Action Code	Control	# Installed	Ex Ante Gross Program Impact kWh	kW	Therm
Agricultural - Pumping						
Agricultural Pumps Other	609	2	2	18,605	37	0
Agricultural Water System Equipment Change - ISS	610	3	3	130,736	93	0
Agricultural Water System Changes	629	8	8	5,172,445	800	0
Agricultural Change/Add Equipment	670	7	7	252,219	832	0
Pump Retrofit	A1	807	807	27,382,752	4,716	0
Time Clock with Battery Backup (AG)	A11	52	55	484,770	0	0
Pump Adjustment	A4	1,380	1,433	13,892,935	0	0
Well Water Measurement Device	A5	118	44,747	1,879,374	0	0
Sprinkler Nozzle : Low Pressure	A6	69	352,469	4,441,109	1,057	0
Surge Valve	A7	3	7	108,528	0	0
Motors: Energy Efficient	M13-M38	102	151	395,093	62	0
Motors: Energy Efficient	M7-M8	4	5	3,999	1	0
Agricultural Pumping Total		2,555		54,162,566	7,597	0
Agricultural - Miscellaneous						
Agricultural Other	689	5	5	470,446	286	0
Greenhouse : Heat Curtain	A10	17	1,211,065	0	0	666,086
Milk Pre-Cooler	A2	15	67,488	506,163	0	0
Refrig : Desuperheater (AG)	A3	4	2,005	71,178	0	0
Greenhouse : Rigid Double-Walled Plastic	A8	16	616,688	0	0	339,178
Greenhouse : Double-Walled Polyethylene	A9	16	1,799,516	0	0	647,826
Refrigeration		25	19,707	7,129,150	686	0
Food Service		1	1	1,681	0	0
Process		2	2	270,400	55	19,136
HVAC		14	30	161,897	94	0
Lighting Indoor		259	30,194	14,679,366	2,450	0
Lighting Outdoor		45	264	391,540	0	0
Agricultural Miscellaneous Total		419		23,681,821	3,571	1,672,226
Agricultural Energy Efficiency Incentives Total		2,974	4,146,659	77,844,386	11,168	1,672,226
Agricultural EMS Program Total		5,380	0	NA	NA	NA

The EMS program provides end use surveys for customers with agricultural accounts. Services categories included Irrigation System Surveys, Pumping System Analysis, Agricultural Facility Analysis, and Pump Tests. This evaluation only targets the Pump Test component of the EMS Program because it accounted for more than 98% of the overall EMS Program participation in 1994.

The structure of the Pump Test Program database is similar to the RE/Customized Programs. It also consists of two separate databases, linked by a variable called pump test code. The Pump Test Database has the customer level information (such as the test dates and the customer control numbers) and the Pump Run Database contains the technical information on each tested pump. For the 1994 EMS Pump Test Program, 5,854 records representing 5,300 unique PG&E control numbers were identified as program participants based on the test date for each pump.

PG&E Billing Data

Two billing data installments were received for the Evaluation. The first billing dataset, received in March 1995, covers the period between January 1992 and February 1995. The second billing dataset was received in late November 1995 covering the period from September 1994 through September 1995. Depending on the time period, the number of unique control numbers in the billing dataset ranges from 723k in 1992 to 758k in 1995 and it contains monthly energy-consumption information for all nonresidential electric accounts in the PG&E service territory. It also contains other billing related information such as customer name, service location, rate schedule, and SIC code. The final integrated multi-year billing dataset contains a total of 761,669 unique control numbers.

For the 1994 Agricultural program evaluation, analysis datasets of Agricultural Incentive participant data, EMS Pump Test participant data, and nonparticipant billing data were created and stored separately. Nonparticipant agricultural pump accounts were preliminarily identified and subsetted from the nonresidential population of 761,669 accounts by the following criteria:

- PG&E defined SIC Two Code: Customers with a PG&E defined SIC Code Two variable value between 1 and 999 were considered agricultural accounts and were considered for inclusion in the final analysis dataset. There were 649,283 accounts removed from eligibility for the final analysis dataset for having SIC codes that were either missing or not within the set of values that were considered agricultural classifications.

- Accounts for which the service address did not begin with a number: because it was necessary to draw a distinction between pump accounts and other agricultural service accounts for the purpose of drawing the comparison group sample, it was first necessary to identify some aspect of the billing data that would indicate that the account as a pump account. It was decided that since service addresses on pumps were typically a series of instructions, rather than a physical address, pumps could be preliminarily identified as those accounts for which the service address did not begin with a street number. There were 44,738 customers eliminated from eligibility for the final sample for this reason.

- Electrical Rate Schedule: Customers were required to have an electrical billing rate tariff that could be classified as agricultural in nature. Rate schedules that were considered eligible were the AG 1, AG 2, AG 4, AG 5, AG 6, AG R, and AG V rate schedules. There were 7,828 customers who were eliminated from eligibility for failure to meet the rate schedule criteria.

The final billing dataset created using these methods consisted of 59,820 accounts and was used in the generation of the comparison group telephone survey and onsite survey sample frames. The generation of these sample frames is described in the comparison group sample section below.

In the creation of the Agricultural Incentives and EMS Pump Test 1994 participant database, all customers identified as participants were retained in the final analysis dataset. Data attrition and screening were performed downstream during the creation of participant sample frames. For the 1994 Agricultural Incentives Program, 3,085 customers were identified as participants based on the nature of their installed measures and the corresponding paid year for the installation. For the EMS Pump Test Program, 5,854 records representing 5300 unique PG&E control numbers were identified as 1994 Pump Test Program participants based on the test date for each pump. Creation of the 1994 Agricultural Incentives and 1994 EMS Pump Test Program sample frames and the aspects of data attrition performed during the construction of these sample frames are detailed in the following section.

Sample Design and Participant Population

The sampling plan for the PG&E Agricultural Evaluation was based upon analysis of 1994 program participation data and the PG&E billing data as discussed above. The nested sample design approach was used to achieve the most efficient utilization of project resources in order to meet the following objectives:

- Determine least-cost optimal sample allocation for the first-year gross impact analysis based upon sample size and evaluation accuracy requirements according to California Measurement and Evaluation Protocols (the Protocols).

- Allocate sufficient sample points to meet the net-to-gross and process evaluation objectives.

- Reallocate available resources, wherever feasible, to focus on the measures and/or program features deemed most important by PG&E staff for future program re-design.

Defining the participant population was an important step in setting up the stage for all subsequent data collection. For this evaluation, a key issue is to define the participant population for EMS Program because there were many EMS participants who also participated in the RE/Customized Programs. All agricultural customers who received a pump energy audit in 1994, independent of whether or not they installed the recommended measures or took the recommended actions, were classified as EMS Program participants. But the gross program savings accomplished by the programs will be allocated as follows:

- Customers who receive a rebate under RE or Customized Programs will be allocated to the RE/Customized Programs.

- Customers who installed measures outside the RE/Customized Program and indicate as part of the survey that they did so as a result of participating in the EMS program will be credited to the EMS program.

Both gross estimates will be adjusted for free-riders (participants who would have undertaken the same actions in the absence of the program and who thus took advantage of the program) and free-drivers (non-participants who installed measures covered by the program and who would not have taken the same action in the absence of the program) as part of the net-to-gross adjustments.

Participant Sample Frame

Sample frame screening for Agricultural Program and EMS Pump Test Program participants was performed separately, and was based on different criteria for each group due to requirements of the sample frame and the number of accounts of each type available for inclusion into the sample frame.

The participant sample frame for the Agricultural Incentives programs was restricted to customers who installed targeted measures as indicated by the PG&E defined Action Code variable from the MDSS database. Accounts that were considered eligible for the sample frame included those that had made agricultural water system changes or additions (action codes 610, 629, and 670), installed low-pressure sprinkler nozzles (action code A6), had pumps retrofitted (action code A1), or had pumps adjusted (action code A4). Consequently, the first stage in the data attrition process for the Incentive Program participants was to eliminate from eligibility any accounts installing measures of types other than those targeted. During this stage of data attrition, 739 control numbers were eliminated for having PG&E defined MDSS action code values that were not for targeted measures. An additional 55 customers were eliminated because they had more than 4 accounts per Corporation ID/Premise ID combination participate under the program. This screening step was taken to avoid the necessity of conducting very lengthy surveys with customers who had many accounts that participated in the program, and because it was felt that doing so would in no way bias the sample. Customers of this type comprised less than 4 percent of the participant population. After this screening, a total of 1,815 accounts representing 1477 unique PG&E defined Corporation ID/Premise ID combinations remained eligible for the final sample frame. Because data collection was to be done at the Corporation ID/Premise ID level to avoid multiple contact of customers with several participating pumps, it was necessary to retain all 1,477 eligible customers, in order to meet the achieve the sampling goal of 450 completed telephone surveys.

Due to their greater availability, it was possible for the screening process for 1994 EMS Pump Test program participants to be more rigorous than that for Incentive program participants. This allowed for the selection of customers with quality program database and billing data that would prove useful in later analysis. The criteria considered in the assessment of pump test and account billing data quality for Pump Test participants were the following:

- Missing or bad values for key aspects of billing data: Accounts were rejected for having missing or miscoded values for key variables in their billing records.

Accounts that had changes in their service addresses, service cities, or divisions between 1993 and 1995, and accounts with missing electrical rate schedules or poor cohesion of read dates between 1993, 1994, and 1995 data tapes were considered to have flawed billing data and were rejected from eligibility for the sample frame. The number of customers rejected for flawed billing data was 352.

- Changes in key billing data variables across years: Accounts for which there were changes in certain key billing data variables across years were rejected for eligibility for the sample frame. The variables considered in this assessment were the account's PG&E defined Corporation ID, Date on Premises, Date on System, Meter Number, Rate Schedule, Premise ID, and SIC Code Two variables. There were 1,676 customers rejected for failing to satisfy these criteria.

- Overlap with Agricultural Incentives sample: customers who participated in the Agricultural Incentives program in addition to the Pump Test program were removed from eligibility for the Pump Test sample frame. There were 1,316 account records removed for this reason.

- Removal of multiple pump test records: if more than one test record was present in the database for a given account and pump, the record with the latest test date for each pump was retained and the others deleted. There were 358 records deleted for this reason.

- Customers having more than 4 participating accounts per Corporation ID/Premise ID combination were eliminated from eligibility for the sample frame. This screening step was taken to avoid the necessity of conducting prolonged surveys with customers who had many accounts that participated in the program. It was felt that doing this would in no way bias the sample. There were 318 accounts eliminated for this reason.

For the final sample frame, records were collapsed to the Corporation ID/Premise ID level to avoid multiple contact of customers with several participating pumps. This resulted in a final sample frame of 1497 unique records representing 1,814 1994 Pump Test program participant accounts.

Comparison Group Sample Frame

The comparison group sample frame was drawn from the nonparticipant billing data analysis dataset of 59,820 potential agricultural pumping accounts. The data attrition process and method of sample frame generation for the nonparticipant sample is detailed below:

- The first stage in the data attrition process was the removal of control numbers for which agricultural measure installation records appeared in the 1994 MDSS database, thus indicating Agricultural Incentives Program participation in 1994.

There were 1,940 Agricultural Program participants removed from eligibility for this reason.

- Accounts that were participants in the 1994 EMS Pump Test Program were next eliminated from eligibility for the sample frame. This process removed 3,845 accounts from the set of eligible customers.

- To avoid the possibility of contacting the same customer multiple times for different surveys on different accounts (i.e. one participant account and one nonparticipant account), all accounts that shared a PG&E defined Corporation ID with any account in the MDSS or EMS database were removed from eligibility. This resulted in the ineligibility of an additional 11,942 accounts.

- Missing or bad values for key aspects of billing data: Accounts were rejected for having missing or miscoded values for key variables in their billing records. Accounts that had changes in their service addresses, service cities, or divisions between 1993 and 1995, and accounts with missing electrical rate schedules or poor cohesion of read dates between 1993, 1994, and 1995 data tapes were considered to have flawed billing data and were rejected from eligibility for the sample frame. The number of customers rejected for flawed billing data was 5,338.

- Changes in key billing data variables across years: Accounts for which there were changes in certain key billing data variables across years were rejected for eligibility for the sample frame. The variables considered in this assessment were the account's PG&E defined Corporation ID, Date on Premises, Date on System, Meter Number, Rate Schedule, Premise ID, and SIC Code Two variables. There were 6,554 customers rejected for failing to satisfy these criteria.

From the 30,201 available accounts that remained after the screening described above, a random sample was drawn of 2,500 customers who were unique by Corporation ID, Premise ID, and division. A list of the selected customers within each division was generated and distributed to the appropriate PG&E division representative for approval. Following the receipt of approval decisions, the sample of 2,500 customers was passed through a final screen to eliminate any customers for whom more than 4 accounts were present for a given Corporation ID, Premise ID combination or for whom approval was denied by PG&E account representatives. Customers eliminated from eligibility for having more than 4 participating accounts were removed to avoid the necessity of conducting telephone surveys that would be very lengthy as a result of the number of customer accounts. There were 105 customers removed from the sample for exceeding the number of allowable accounts on one premise. It was felt that adding this screening criterion would in no way bias the sample since customers fitting this profile constituted less than 4.5 percent of the sample. An additional 27 customers were removed from sample eligibility because PG&E account representatives requested that they not be contacted for data collection purposes. After these final screens, a final sample frame of 2,367 unique customers, representing a total of 3020 unique accounts, remained.

Sample Selection and Sample Sizes

Select Target End Use and Technology

PG&E Agricultural Evaluation sample allocation begins by calculating the end use and technology level avoided cost, which will identify which end use and technology represents the largest share of program anticipated impacts. This information will then be used as the key factor to prioritize evaluation activities and allocate program resources.

Another consideration in designing the sample is to comply with the Protocols. The Protocols require a telephone survey sample of 450 points each for the RE/CUSTOMIZED Program participants, EMS participants, and a common comparison group. It also requires a relative precision of 10% at the 90% confidence level in terms of annual energy consumption.

Finally, the sample allocation reflects feedback from PG&E program staff regarding the future design of the program and the uncertainty of the current program estimates. For example, according to the PG&E project manager, only four agricultural measures in the 1994 RE/CUSTOMIZED Programs will be incorporated into the 1995 RE/CUSTOMIZED Programs, and the proposed sample design recognizes the importance of these four measures.[1]

For each program, Exhibit A-2 presents the percentage of shareholder values by end use and key technology. It also defines level of analysis, which will serve as the basis for the final telephone and on-site sample allocation.

[1]They are pump retrofits, pump adjustments, greenhouses, and low pressure sprinkler nozzles.

Exhibit A-2
PG&E Agricultural Program Avoided Cost by End Use and Technology

Program	End-Use	Action Code	Avoided Cost	% of Avoided Cost	Analysis Level
RE/CI	**Ag - Pumping**		**$19,922,337**	**50.1%**	
	Ag Pumps Other	609	$38,846	0.1%	○
	Ag Water System Equip Chg.	610	$182,480	0.5%	○
	Ag Water System Chg.	629	$3,248,742	8.2%	●○
	Ag Change/Add Equip	670	$1,133,977	2.8%	○
	Pump Retrofit	A1	$11,339,641	28.5%	●●
	Time Clock w/ Batt Backup (Ag)	A11	$77,903	0.2%	○
	Pump Adjustment	A4	$1,395,840	3.5%	●
	Well Water Measurement Dev	A5	$544,138	1.4%	○
	Sprinkler Nozzle:Low Pressure	A6	$1,689,583	4.2%	●●
	Surge Valve	A7	$34,510	0.1%	○
	Motor: Energy Efficient	M7-M8	$2,347	0.0%	○
	Motor: Energy Efficient	M13-M38	$234,331	0.6%	○
	Ag - Other		**$7,015,551**	**17.6%**	
	Ag Other	686	$612,869	1.5%	○
	Milk Pre-Cooler	A2	$191,443	0.5%	○
	Refrig: Desuperheater (Ag)	A3	$22,633	0.1%	○
	Greenhouse	A8-A10	$6,188,606	15.6%	●◒
	Food Service		**$460**	**0.0%**	○
	HVAC		**$151,050**	**0.4%**	○
	Light - Indoor		**$9,018,506**	**22.7%**	○
	Light - Outdoor		**$197,510**	**0.5%**	○
	Process		**$326,665**	**0.8%**	○
	Refrigeration		**$3,156,670**	**7.9%**	○
	RE/CI PROGRAM TOTAL		**$39,788,749**	**100.0%**	
EMS	**Pump Test**		**NA**	**100.0%**	●◒

* Data Source: 1994 Frozen MDSS Database.

KEY

- ● SAE Analysis
- ◒ Engineering Analysis Only
- ◍ Retention Study
- ○ Database Estimate/Transfer

Sample Sizes and Sample Allocation

As shown in Table B-3, the PG&E Agricultural Evaluation sampling plan consists of a telephone sample of 1,350 customers and an on-site audit sample of 250 customers. The sample design complies with the Protocols and meets the program evaluation objectives described in Section 2 of this plan.

Exhibit A-3
Sample Allocation by Program and Technology

Program	End Use	Expected Population	On-Site Audit	Telephone Survey	Analysis Level
RE/CI	**Pumping**				
	Ag Water System Change	8	5	5	●○
	Pump Retrofit	850	150	300	●●
	Pump Adjustment	1,417	35	115	●
	Sprinkler Nozzle:Low Pressure	69	30	30	●●
	Miscellaneous				
	Greenhouse	74	30	0	●◒
	RE/CI PROGRAM TOTAL		**250**	**450**	
EMS	**Pump Test**	6,539	**0**	**450**	●◒
NP		99,500*	**0**	**450**	●◒
PROJECT TOTAL			**250**	**1,350**	●◒

* There are approximately 99,500 unique Ag sect control numbers in the billing dataset, representing approximately 70,000 unique premises and 42,000 unique Ag customers.

KEY

- ● SAE Analysis
- ◒ Engineering Analysis Only
- ◍ Retention Study
- ○ Database Estimate/Transfer

Sample Sizes and Sample Allocation

For the Evaluation, a final telephone survey sample of 1374 customers was collected. Of these customers, 466 were Incentives Program participants, 455 were EMS program participants, and the remaining 453 were Agricultural program nonparticipants. In addition to the telephone survey sample, a total of 261 onsite surveys were collected for customers who participated in the Agricultural Incentives program. The final sample distributions by sample type, program , and measure type are presented in Exhibit A-4 below.

Exhibit A-4
Final Survey Sample Sizes by Program and Key Measures

Sample		Telephone Survey Sample	Onsite Survey Sample
RE/CI Participant	Pump Retrofit	286	111
	Pump Adjustment	151	54
	Sprink/Nozzles	29	54
	CI Water System	9	0
	Greenhouse	0	42
	EMS Participant	114	0
	TOTAL *	466	261
EMS Only Participant		455	0
Comparison Group		453	0
TOTAL		1,374	261

* Sum may exceed the total number of customers due to multiple measure participation.

Relative Precision

Given a sample design, the relative precision, based on total annual energy use, reflects the uncertainty regarding the extent to which the allocated sample sizes are large enough to control for the population variance in terms of annual energy usage. The final achieved telephone survey samples for the Agricultural Incentives participants, EMS participants, and program comparison group samples yielded relative precisions of 6.9 percent, 9.9 percent and 5.5 percent respectively at the 90 percent confidence level in terms of annual energy usage.

The precisions for the telephone samples were calculated using the following procedure.

- First, the 1994 annual energy consumption was computed for all customers in each of the three samples.

- Next, four strata were constructed based on customers' annual usage. Customers with annual usage in 0-40, 40-70, 70-90, and 90+ percentiles of the sample population are grouped into different strata. Exhibit A-13 presents the stratum level sample size, sample weight, sample mean, and estimated standard errors for the Agricultural Incentives program participants.

- Then, the program level mean and standard error for each program were calculated using the classic stratified sample techniques. The functional relation can be best described in the following equation, which uses values obtained in the Incentives program calculations:

$$\overline{m} = \Sigma_i w_i * \overline{m}_i = 118{,}925 \text{ kWh} \quad \text{with } w_i = \frac{n_i}{n}$$

$$StdErr = \Sigma_i (w_i)^2 * \frac{StdErr_i}{n_i} = 4{,}964 \text{ kWh}$$

- Finally, the relative precision at 90% confidence level was calculated as

$$RP = \frac{1.645 * StdErr}{\overline{m}} = 6.9\%$$

Exhibit A-5
Agricultural Incentives Telephone Sample Relative Precision Levels

Stratum	Sample Size	Segment Weight	Mean 1994 Usage	Sample Est. Std. Err
1	168	0.40	1,976	122
2	126	0.30	9,508	235
3	84	0.20	26,946	1,084
4	42	0.10	121,834	6,729
Total	420	1.00	21,412	712

The relative precisions for all survey samples meet the requirement of a 10% relative precision established in the Protocols. However, it is important to mention that this expected precision is based on the *annual energy usage* and it does not imply the same level of precision for the final *end-use impact* evaluation results.

Appendix B

ENGINEERING TECHNICAL ANALYSIS

Appendix B

ENGINEERING TECHNICAL ANALYSIS

This appendix presents the engineering technical approach used for the evaluation of Pacific Gas and Electric Company's (PG&E's) 1994 Agricultural (Ag) Programs. It starts with an overview of the analysis followed by a description of the steps undertaken to design the telephone survey and on-site audit samples for the impact and process evaluation.

Engineering for the 1994 Agricultural Program Evaluation - Overview

The engineering effort within the 1994 Agricultural program evaluation was multi-faceted. The work can be divided into two broad categories: review of existing work and creation of pumping impacts based upon an engineering algorithm. The review category will be discussed first.

There were three reviews performed in which the assumptions and algorithms were assessed. The first review was of the Agricultural Custom Rebates. Thirty separate Custom Rebate forms were thoroughly reviewed and the results written up in a memo to the program manager on October 9, 1995. That memo and the attachments to it are included in Appendix J.

The second review was of the EMS Program. Report number CEQ-93-A01 ("Impact Evaluation of 1990-1992 Nonresidential Energy Management Services Programs") was reviewed for the gross impact value. The results of that review are presented in Appendix J following the Custom Rebate review.

The last review was of the Retrofit Express Program. Each of the eleven Agricultural measures within the program were reviewed based upon the 1994 ex-ante document. The results follow the EMS review in Appendix J.

The second broad category of work performed by the engineering team consisted of creating engineering estimates of energy impacts for pump retrofit, pump adjustment and greenhouse measures. These measures were focused upon due to the combined level of avoided costs for these three measures being close to 50% of the Agricultural program. The pump retrofit and pump adjustment engineering estimates used an algorithm based upon information gathered through telephone surveys and on-site audits. The greenhouse measure used a computer simulation

(DOE-2) to determine savings with information gathered during on-site audits. The pump retrofit and pump adjustment estimates will be discussed first.

Engineering Detailed Computational Methods for Pump Retrofit and Pump Adjustment Measures

Data Sources

Information was pulled from multiple sources for the engineering estimates. Listed below are the sources used along with a number. This number will be referenced throughout the remainder of the engineering technical appendix as needed.

1. *Low Pressure Sprinkler Nozzles,* Peter Canessa, P.E., San Luis Obispo, CA, November, 1994.

2. *Effective Precipitation, A Field Study to Assess Consumptive Use of Winter Rains by Spring and Summer Crops,* Department of Water Resources, February, 1989.

3. California Irrigation Management Information System Bulletin, 1992.

4. Western Regional Climate Center, Atmospheric Sciences Center, Desert Research Institute, Reno, Nevada.

5. *Water Conservation & Management Handbook,* January 1985.

6. PG&E MDSS Pump Test Applications User's Manual, Draft Report, 9/5/95.

7. PG&E Pump Test Database, 1993-1994.

8. U.C. Cooperative Extension, Division of Agriculture and Natural Resource, Leaflets 21427 and 21428, July, 1987.

9. "Vegetative Water Use in California", California Department of Water Resources, 1974.

10. Technical memorandum, "Ag Water Calibration for the Kings River Service Area", February, 1994.

11. "Water Conservation Plan", Westlands Water District, July, 1992.

12. ASHRAE 1993 Handbook of Fundamentals, pp. 22.2.

13. ASHRAE 1995 HVAC Applications Handbook, pp. 20.9.

14. DOE-2 Reference Manual, May 1981.

Pumping kWh Algorithm

The information gathered for the engineering estimate was driven by the algorithm used. The engineering pumping algorithm is shown below.

$$kWh_{impact} = kWh_{pre\ year} - kWh_{post\ year}$$

$$kWh_{yr} = AF/yr * kWh/AF = \sum_{m=1}^{12} \left(\frac{\frac{ETc_m - Rain_m}{IE} - Surf}{1 - LR} / 12 * Acres * \frac{1.0241 * TDH}{OPE} \right)$$

Where:

ETc = seasonal crop water requirement (inches)
Rain = effective rainfall (inches)
IE = seasonal irrigation efficiency (unitless)
Surf = delivered surface water
LR = leaching requirement (unitless)
TDH = total dynamic head (feet)
OPE = operating efficiency

The engineering estimates provided for the statistical analysis covered the years of 1993, 1994 and through September of 1995. An engineering estimate was also created based upon a 30 year average of rainfall, to determine a "weather-normalized" estimate. Each portion of the algorithm will now be presented.

Segmentation

The agricultural population is quite diverse. By mapping each customer in the analysis to a specific region which would make sense and could be easily identified, mean values could be assessed and used in the case of missing data. For the engineering analysis, the PG&E service territory was segmented into 6 distinct regions based upon similar rainfall (1). Since this mapping is also somewhat geographical, when pump total dynamic head and OPE were missing (in the case of a participant not having a pump test performed) the average TDH and OPE from the pump test database could be substituted. The mapping of these regions is shown below. The Division/Local office characters are found in the second and third spot in the customers account number.

Region	Name	Counties	PG&E Division/Local Office
1	Southern San Joaquin Valley	Kern, Kings, Tulare, Fresno, Madera	TC, TD, TF, TG, TH, TJ, TK, TL, TN, TP, TQ, TT, TV, TX
2	Northern San Joaquin Valley	Merced, San Joaquin, Stanislaus, Solano, Sacramento	TM, TR, TS, XF, XH, XL, XT, XV, XX, PV, PJ, PK, PP, PS
3	Sacramento Valley	Tehama, Glenn, Butte, Colusa, Amador, Sutter, Yolo, Yuba	PT, PX, PY, PZ, SB, XB, XD, XJ, XN, XR, D*, F*, H*, W*
4	North Coast	Humboldt, Del Norte, Trinity, Mendocino	L*, NB, NF, NP, NX, NY, NZ
5	Marin	Marin, Sonoma, Napa, Lake	NC, ND, NG, NH, NJ, NK, NL, NM, NN, NQ, NR, NV, NW
6	South Coast	Contra Costa, Alameda, San Mateo, Santa Clara, Santa Cruz, San Benito, Monterey, San Luis Obispo, Santa Barbara	J*, R*, V*, B*

Precipitation - Rain

Precipitation changes radically from year to year and month to month. In California, the months during which most crops are grown, there is little to no rainfall. This meant that engineering estimates needed to be sensitive to these patterns, not only on a yearly level, but on a monthly level. If the post-installation year happened to be wetter than the pre-installation year, there would be negative kWh values shown in the impact which would not be a function of the measure, but of the weather. At the same time, the overall estimates for the program could not be assessed on just two or three years, since those years could occur in the middle of a drought. To work with these parameters, it became clear that detailed precipitation data was needed. Precipitation data was gathered from the Western Regional Climate Center (WRCC) for as many sites within each region as possible to determine an average rainfall by regional segmentation. If there was no data for the designated PG&E division office, a nearby site was utilized. Once the data was received from WRCC, a cleaning was required since not all original sites had data which was considered good. If the site had more than 10 missing days of precipitation, it was automatically deleted from the averaging. Also, certain sites were not used in determining the average monthly precipitation by region because they were not high in agricultural use. For region 2, Fairfield and Exchequer were deleted and for region 3, Oroville, Paradise, Grass Valley, Nevada City, Placerville, Hat Creek, Angel's Camp and Sonora were deleted from the monthly averages. Monthly precipitation for 1993, 1994 and through September 1995 as well as a 30 year

average for each site was gathered. The table below shows the number of sites which went into the monthly average precipitation by region.

	REGION						
YEAR	1	2	3	4	5	6	**TOTAL**
1993	8	7	10	7	6	11	49
1994	7	7	12	8	5	11	50
1995	10	8	12	7	6	10	53
30 Yr Avg	10	9	14	8	7	12	60

The following table has the monthly gross precipitation for each year and region. For 1995, only the rainfall from January through September was used. At the time of this analysis, August and September 1995 rainfall data was not available from WRCC. However, the climatologist at WRCC stated that no precipitation fell in either of these months in California. Zero precipitation for August and September was used for the analysis.

PG&E Service Territory Gross Precipitation (inches)														
		Month												
Region	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	1993	4.80	3.32	2.06	0.13	0.26	0.60	0.00	0.00	0.00	0.29	0.75	0.89	13.10
	1994	1.12	2.05	0.62	1.20	1.21	0.00	0.00	0.00	0.24	0.82	1.51	1.18	9.96
	1995	5.33	0.78	5.33	0.96	0.83	0.27	0.01	0.00	0.00	-	-	-	13.49
	30 Yr. Avg	2.06	1.78	2.19	0.79	0.31	0.08	0.04	0.07	0.25	0.43	1.19	1.36	10.55
2	1993	6.73	4.19	2.73	0.28	1.05	0.49	0.00	0.00	0.00	0.38	1.62	1.37	18.85
	1994	1.81	2.93	0.25	0.96	1.28	0.00	0.00	0.00	0.13	0.41	1.55	1.26	10.59
	1995	8.01	0.39	5.80	1.05	0.82	0.29	0.01	0.00	0.00	-	-	-	16.37
	30 Yr. Avg	2.90	2.32	2.27	0.96	0.32	0 10	0.04	0.06	0.29	0.78	1.99	2.07	14.11
3	1993	10.61	7.10	3.14	1.32	2.13	1.14	0.00	0.10	0.00	1.06	2.34	2.70	31.65
	1994	2.62	4.74	0.54	1.36	1.44	0.02	0.00	0.00	0.10	0.69	4.80	4.44	20.73
	1995	16.58	0.76	11.95	2.57	2.18	1.30	0.02	0.00	0.00	-	-	-	35.37
	30 Yr. Avg	5.23	3.93	4.11	1.68	0.84	0.42	0.09	0.18	0.53	1.66	3.76	4.20	26.63
4	1993	12.01	6.73	4.57	4.59	4.27	1.28	0.06	0.14	0.01	0.79	2.15	7.22	43.82
	1994	6.09	7.59	1.34	2.96	1.58	0.27	0.02	0.00	0.03	0.52	8.56	6.28	35.24
	1995	23.14	1.66	16.85	5.69	1.93	1.28	0.17	0.00	0.00	-	-	-	50.71
	30 Yr. Avg	8.17	6.32	6.53	2.98	1.28	0.42	0.10	0.34	0.81	2.76	6.78	7.74	44.22
5	1993	12.53	7.10	2.61	1.43	1.59	0.85	0.00	0.00	0.00	1.56	3.46	3.97	35.09
	1994	3.21	5.18	0.35	1.57	1.20	0.03	0.00	0.00	0.00	1.02	7.32	3.94	23.83
	1995	20.23	0.87	13.69	2.24	1.96	0.72	0.00	0.00	0.00	-	-	-	39.70
	30 Yr. Avg	6.80	4.93	4.52	1.73	0.49	0.23	0.05	0.11	0.38	1.90	4.66	5.16	30.98
6	1993	8.53	5.28	2.64	0.45	0.63	0.45	0.00	0.00	0.00	0.28	1.43	1.83	21.53
	1994	2.05	4.05	0.73	1.15	1.09	0.01	0.00	0.00	0.37	0.50	2.93	1.65	14.54
	1995	10.96	0.90	8.81	1.67	0.75	0.72	0.01	0.00	0.00	-	-	-	23.81
	30 Yr. Avg	3.58	3.08	3.18	1.24	0.29	0.12	0.05	0.07	0.31	0.83	2.35	2.69	17.81

The monthly precipitation does not show how effective that rainfall is in the growing cycle of a crop, and ultimately in decreasing the pumping needs. The effective rainfall is a function of when the rain falls (time of year) and the state of the crop (just planted or full canopy). The crops were divided up into three categories, spring & summer crops, winter crops, and perennial crops. The table below shows the categorization of each crop used for this analysis.

Crop	Crop Type	Crop	Crop Type	Crop	Crop Type
Alfalfa (hay)	3	Grapes	1	Prunes	1
Alfalfa (seed)	3	Kiwi	1	Pumpkins	1
Almonds	1	Lettuce	1	Rice	1

Apples	1	Milo	2	Safflower	1
Apricots	1	Nectarines	1	Spinach	2
Barley	2	Oats	2	Sudan	1
Beans	1	Olive	3	Sunflower	1
Beets (sugar)	1	Onions	1	Tomatoes	1
Broccoli	2	Oranges	3	Walnuts	1
Cabbage	2	Pasture	3	Wheat	2
Cantaloupe	1	Peaches	1		
Carrots	1	Pears	1		
Celery	2	Pecans	1		
Corn	1	Peppers	1		
Cotton	1	Pistachios	1		
Figs	1	Plums	1		
Flowers	1	Pomegranate	1		
Garlic	1	Potato	1		

1= Summer & Spring Crop

2=Winter Crop

3=Perennial Crop

Taking each of these crops from a monthly precipitation to an effective precipitation was a multi-step process. The first was to determine a soil moisture change, or the effective rain during the non-growing season. Winter rain was partitioned for summer & spring crops by months using the following algorithms (2):

For November, December, January & February

Non - growing se ason effec tive rain = 0.940 * rainfall a mount - 0.54

For October

Non - growing se ason effec tive rain = 0.635 * rainfall a mount - 0.06

For March

Non - growing se ason effec tive rain = 0.837 * rainfall a mount - 1.07

Winter crops had the algorithm applied for October, November and December only. Since perennial have no non-growing season, these crops had no changes applied (i.e. they were all zero). The next step was to determine the effectiveness of the growing season rainfall and the crop ground cover. Spring and summer crops had 50% effective rainfall during April and 100% effective rainfall from May through September. Winter crops had 100% effective rainfall from January through June. Perennial crops had 100% effective rainfall throughout the year. A monthly potential evapotranspiration (ETo) by region was gathered from CIMIS (3). The last step was to pull all the data together using the algorithm below.

Effective Rainfall = Non - growing se ason effec tive rain + Growing season effective Rain

or

$$\text{Effective Rainfall} = \text{Non - growing season effective rain} + \text{Smaller of} \left(\begin{array}{l} \text{Monthly ETo, Rainfall} * \\ \text{\% effective rainfall due to crop ground cover} \end{array} \right)$$

Because a large amount of rainfall would saturate the soil and actually move through the soil profile to an inaccessible depth below the crop root zone, non-growing rainfall was limited to less than 8 inches. The tables below shows the ETo, crop percentages and effective rainfall by year and region used in the analysis.

Region	ETo, in./Month												Total
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1	3.42	1.32	0.73	0.94	1.83	3.19	5.13	6.59	7.68	8.30	6.97	5.61	51.71
2	3.42	1.32	0.73	0.83	1.71	2.95	4.88	6.35	7.68	8.06	6.73	5.49	50.15
3	3.66	1.54	1.04	1.18	1.95	2.95	4.88	6.10	7.68	8.30	6.85	5.49	51.63
4	2.44	0.77	0.73	0.59	1.34	2.13	3.42	4.27	5.31	6.10	5.31	4.27	36.70
5	2.93	1.32	0.85	1.18	1.71	2.60	3.91	4.88	5.91	6.71	5.91	4.88	42.79
6	3.42	1.98	1.34	1.65	2.32	3.07	4.27	5.49	5.91	6.10	5.91	4.88	46.35

Spring and Summer Crops													Non-Growing Limited to < 8"
Region	Oct 92	Nov	Dec	Jan 93	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	0.17	0.35	0.52	3.97	2.58	0.65	0.07	0.26	0.60	0.00	0.00	0.00	8.92
2	0.24	1.38	1.07	5.79	3.40	1.21	0.14	1.05	0.49	0.00	0.00	0.00	9.69
3	0.79	2.23	2.65	9.43	6.13	1.56	0.66	2.13	1.14	0.00	0.10	0.00	12.03
4	0.57	2.00	7.99	10.75	5.78	2.75	2.30	4.27	1.28	0.06	0.14	0.01	16.06
5	1.19	3.54	4.15	11.24	6.13	1.11	0.71	1.59	0.85	0.00	0.00	0.00	11.15
6	0.16	1.14	1.62	7.48	4.42	1.14	0.23	0.63	0.45	0.00	0.00	0.00	9.32
Region	Oct 93	Nov	Dec	Jan 94	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	0.12	0.17	0.30	0.52	1.39	0.00	0.60	1.21	0.00	0.00	0.00	0.24	4.54
2	0.18	0.99	0.75	1.17	2.22	0.00	0.48	1.28	0.00	0.00	0.00	0.13	7.19
3	0.61	1.66	2.00	1.92	3.91	0.00	0.68	1.44	0.02	0.00	0.00	0.10	10.24
4	0.44	1.48	6.25	5.18	6.59	0.05	1.48	1.58	0.27	0.02	0.00	0.03	11.39
5	0.93	2.71	3.19	2.48	4.33	0.00	0.79	1.20	0.03	0.00	0.00	0.00	10.02
6	0.12	0.80	1.18	1.39	3.26	0.00	0.57	1.09	0.01	0.00	0.00	0.37	8.80

Crops planted or that emerge in Feb through May. Includes Trees, Vines, Spring and Summer Crops

Winter Annual Crops													Non-Growing Limited to < 8"
Region	Oct 92	Nov	Dec	Jan 93	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	0.17	0.35	0.52	0.94	1.83	2.06	0.13	0.26	0.60	0.00	0.00	0.00	2.84
2	0.24	1.38	1.07	0.83	1.71	2.73	0.28	1.05	0.49	0.00	0.00	0.00	5.07
3	0.79	2.23	2.65	1.18	1.95	2.95	1.32	2.13	1.14	0.00	0.00	0.00	13.07
4	0.57	2.00	7.99	0.59	1.34	2.13	3.42	4.27	1.28	0.00	0.00	0.00	19.68
5	1.19	3.54	4.15	1.18	1.71	2.60	1.43	1.59	0.85	0.00	0.00	0.00	14.21
6	0.16	1.14	1.62	1.65	2.32	2.64	0.45	0.63	0.45	0.00	0.00	0.00	8.41
Region	Oct 93	Nov	Dec	Jan 94	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	0.12	0.17	0.30	0.94	1.83	0.62	1.20	1.21	0.00	0.00	0.00	0.00	3.89
2	0.18	0.99	0.75	0.83	1.71	0.25	0.96	1.28	0.00	0.00	0.00	0.00	4.02
3	0.61	1.66	2.00	1.18	1.95	0.54	1.36	1.44	0.02	0.00	0.00	0.00	6.92
4	0.44	1.48	6.25	0.59	1.34	1.34	2.96	1.58	0.27	0.00	0.00	0.00	10.45
5	0.93	2.71	3.19	1.18	1.71	0.35	1.57	1.20	0.03	0.00	0.00	0.00	9.24
6	0.12	0.80	1.18	1.65	2.32	0.73	1.15	1.09	0.01	0.00	0.00	0.00	4.90

Crops planted in Oct, Nov, and Dec. Harvested Jun, Jul, or Aug. Grain, Garlic, Onions

Perennial Crops													Non-Growing Limited to < 8"
Region	Oct 92	Nov	Dec	Jan 93	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	0.36	0.94	0.73	0.94	1.83	2.06	0.13	0.26	0.60	0.00	0.00	0.00	6.03
2	0.48	1.32	0.73	0.83	1.71	2.73	0.28	1.05	0.49	0.00	0.00	0.00	7.91
3	1.33	1.54	1.04	1.18	1.95	2.95	1.32	2.13	1.14	0.00	0.10	0.00	12.74
4	0.99	0.77	0.73	0.59	1.34	2.13	3.42	4.27	1.28	0.06	0.14	0.01	14.39
5	1.96	1.32	0.85	1.18	1.71	2.60	1.43	1.59	0.85	0.00	0.00	0.00	11.78
6	0.35	1.79	1.34	1.65	2.32	2.64	0.45	0.63	0.45	0.00	0.00	0.00	9.32
Region	Oct 93	Nov	Dec	Jan 94	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	0.29	0.75	0.73	0.94	1.83	0.62	1.20	1.21	0.00	0.00	0.00	0.24	5.98
2	0.38	1.32	0.73	0.83	1.71	0.25	0.96	1.28	0.00	0.00	0.00	0.13	5.89
3	1.06	1.54	1.04	1.18	1.95	0.54	1.36	1.44	0.02	0.00	0.00	0.10	8.28
4	0.79	0.77	0.73	0.59	1.34	1.34	2.96	1.58	0.27	0.02	0.00	0.03	9.10
5	1.56	1.32	0.85	1.18	1.71	0.35	1.57	1.20	0.03	0.00	0.00	0.00	8.08
6	0.28	1.43	1.34	1.65	2.32	0.73	1.15	1.09	0.01	0.00	0.00	0.37	8.05

Crops that grow all year. Includes Alfalfa, Pasture, Citrus, and Olives.

Spring and Summer Crops													Non-Growing Limited to < 8"
Region	Oct 94	Nov	Dec	Jan 95	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	0.46	0.88	0.57	4.47	0.20	3.39	0.48	0.83	0.27	0.01	0.00	0.00	9.58
2	0.20	0.91	0.65	6.99	0.00	3.79	0.52	0.82	0.29	0.01	0.00	0.00	9.64
3	0.38	3.97	3.63	15.05	0.18	8.93	1.29	2.18	1.30	0.02	0.00	0.00	12.79
4	0.27	7.50	5.36	21.21	1.02	13.03	2.85	1.93	1.28	0.17	0.00	0.00	14.21
5	0.59	6.34	3.16	18.47	0.28	10.39	1.12	1.96	0.72	0.00	0.00	0.00	11.79
6	0.26	2.22	1.02	9.77	0.30	6.30	0.84	0.75	0.72	0.01	0.00	0.00	10.31
Region	Oct TMY	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	1.25	1.14	1.52	0.20	0.00	0.00	0.02	0.07	0.25	0.43	1.19	1.36	7.42
2	1.78	1.64	1.59	0.37	0.00	0.00	0.02	0.06	0.29	0.78	1.99	2.07	10.60
3	3.26	3.15	3.33	1.04	0.25	0.00	0.04	0.18	0.53	1.66	3.76	4.20	18.37
4	5.13	5.40	5.60	2.26	0.66	0.00	0.05	0.34	0.81	2.76	5.31	4.27	21.54
5	4.26	4.10	3.71	1.09	0.00	0.00	0.03	0.11	0.38	1.90	4.66	4.88	19.96
6	2.21	2.35	2.45	0.63	0.00	0.00	0.03	0.07	0.31	0.83	2.35	2.69	13.93

Crops planted or that emerge in Feb through May. Includes Trees, Vines, Spring and Summer Crops

Winter Annual Crops													Non-Growing Limited to < 8"
Region	Oct 94	Nov	Dec	Jan 95	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	0.46	0.88	0.57	0.94	0.78	3.19	0.96	0.83	0.27	0.00	0.00	0.00	7.15
2	0.20	0.91	0.65	0.83	0.39	2.95	1.05	0.82	0.29	0.00	0.00	0.00	6.64
3	0.38	3.97	3.63	1.18	0.76	2.95	2.57	2.18	1.30	0.00	0.00	0.00	15.59
4	0.27	7.50	5.36	0.59	1.34	2.13	3.42	1.93	1.28	0.00	0.00	0.00	17.34
5	0.59	6.34	3.16	1.18	0.87	2.60	2.24	1.96	0.72	0.00	0.00	0.00	14.45
6	0.26	2.22	1.02	1.65	0.90	3.07	1.67	0.75	0.72	0.00	0.00	0.00	9.69
Region	Oct TMY	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	1.25	1.14	1.52	0.79	0.31	0.08	0.04	0.07	0.25	0.00	0.00	0.00	10.72
2	1.78	1.64	1.59	0.83	0.32	0.10	0.04	0.06	0.29	0.00	0.00	0.00	6.20
3	3.26	3.15	3.33	1.18	0.84	0.42	0.09	0.18	0.53	0.00	0.00	0.00	9.89
4	5.13	5.40	5.60	0.59	1.28	0.42	0.10	0.34	0.81	0.00	0.00	0.00	9.73
5	4.26	4.10	3.71	1.18	0.49	0.23	0.05	0.11	0.38	0.00	0.00	0.00	9.67
6	2.21	2.35	2.45	1.24	0.29	0.12	0.05	0.07	0.31	0.00	0.00	0.00	8.03

Crops planted in Oct, Nov, and Dec. Harvested Jun, Jul, or Aug. Grain, Garlic, Onions

Perennial Crops													Non-Growing Limited to < 8"
Region	Oct 94	Nov	Dec	Jan 95	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	0.82	1.32	0.73	0.94	0.78	3.19	0.96	0.83	0.27	0.01	0.00	0.00	9.07
2	0.41	1.32	0.73	0.83	0.39	2.95	1.05	0.82	0.29	0.01	0.00	0.00	8.41
3	0.69	1.54	1.04	1 18	0.76	2.95	2.57	2.18	1.30	0.02	0.00	0.00	13.48
4	0.52	0.77	0.73	0.59	1.34	2.13	3.42	1.93	1.28	0.17	0.00	0.00	11.52
5	1.02	1.32	0.85	1.18	0.87	2.60	2.24	1.96	0.72	0.00	0.00	0.00	11.89
6	0.50	1.98	1.34	1.65	0.90	3.07	1.67	0.75	0.72	0.01	0.00	0.00	11.70
Region	Oct TMY	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1	2.06	1.32	0.73	0.79	0.31	0.08	0.04	0.07	0.25	0.43	1.19	1.36	8.32
2	2.90	1.32	0.73	0.83	0.32	0.10	0.04	0.06	0.29	0.78	1.99	2.07	11.12
3	3.66	1.54	1.04	1.18	0.84	0.42	0.09	0.18	0.53	1.66	3.76	4.20	18.26
4	2.44	0.77	0.73	0.59	1.28	0.42	0.10	0.34	0.81	2.76	5.31	4.27	18.55
5	2.93	1.32	0.85	1.18	0.49	0.23	0.05	0.11	0.38	1.90	4.66	4.88	18.51
6	3.42	1.98	1.34	1.24	0.29	0.12	0.05	0.07	0.31	0.83	2.35	2.69	14.42

Crops that grow all year. Includes Alfalfa, Pasture, Citrus, and Olives.

Crop Values - ETc

After the monthly effective rainfall was determined, the monthly crop water requirements (ETc) values were needed. The crop value of ETc is a function of potential evapotranspiration (ETo) and the crop coefficient (Kc). The ETo and Kc values were determined using data sources 8 through 12. These crop coefficient values are shown in the following table by region and crop. The ETo values used were the same as shown in the previous table.

Monthly Kc Values for Specific California Crops

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alfalfa (Hay)	1.15	1.15	1.15	1.15	1.09	1.09	1.09	1.09	1.09	1.09	1.15	1.15
Alfalfa (Seed)	1.00	1.00	1.00	0.60	1.15	1.15	1.10	0.30	0.10	0.35	1.00	1.00
Almonds	0.00	0.00	0.37	0.58	0.70	0.90	0.85	0.85	0.65	0.55	0.10	0.00
Apples	0.00	0.00	0.45	0.63	0.75	0.92	1.00	0.90	0.74	0.77	0.10	0.00
Apricots	0.00	0.00	0.45	0.63	0.75	0.92	1.00	0.90	0.74	0.77	0.10	0.00
Barley	0.15	0.25	0.50	0.85	0.85	0.25	0.00	0.00	0.00	0.00	0.00	0.10
Beans	0.00	0.00	0.00	0.00	0.20	0.38	0.95	0.40	0.23	0.00	0.00	0.00
Beets (Sugar)	0.36	0.62	1.03	1.09	1.09	1.09	0.83	0.35	0.00	0.00	0.00	0.00
Broccoli	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.35	0.88	1.00	0.82	0.00
Cabbage	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.35	0.88	1.00	0.82	0.00
Cantaloupe	0.00	0.00	0.00	0.00	0.00	0.15	0.32	0.86	0.38	0.00	0.00	0.00
Carrots	1.06	1.06	0.96	0.85	0.55	0.35	0.00	0.00	0.00	0.25	0.78	0.98
Celery	1.02	1.02	1.02	0.55	0.00	0.00	0.00	0.00	0.00	0.45	0.75	1.02
Corn	0.00	0.00	0.00	0.08	0.20	0.65	1.00	1.00	0.40	0.00	0.00	0.00
Cotton	0.00	0.00	0.00	0.10	0.35	0.85	1.10	0.92	0.60	0.00	0.00	0.00
DF Trees (1)	0.00	0.00	0.45	0.63	0.75	0.92	1.00	0.90	0.74	0.77	0.10	0.00
Figs	0.00	0.00	0.00	0.20	0.33	0.57	0.63	0.63	0.23	0.00	0.00	0.00
Flowers	0.00	0.00	0.00	0.22	0.46	0.78	0.95	0.95	0.00	0.00	0.00	0.00
Garlic	0.05	0.15	0.15	0.47	0.72	0.65	0.35	0.03	0.00	0.00	0.00	0.00
Grapes	0.00	0.00	0.17	0.33	0.53	0.65	0.70	0.65	0.54	0.33	0.00	0.00
Kiwi	0.00	0.00	0.15	0.35	0.73	0.82	0.91	0.91	0.81	0.73	0.00	0.00
Lettuce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.50	0.85	0.95	0.95
Milo	0.00	0.00	0.00	0.00	0.00	0.07	0.45	1.03	0.91	0.47	0.00	0.00
Nectarines	0.00	0.00	0.45	0.63	0.75	0.92	1.00	0.90	0.74	0.77	0.10	0.00
Oats	0.15	0.25	0.50	0.85	0.85	0.25	0.00	0.00	0.00	0.00	0.00	0.10
Olive	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Onions	0.05	0.15	0.15	0.47	0.72	0.65	0.35	0.03	0.00	0.00	0.00	0.00
Oranges	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Pasture	0.70	0.70	0.75	0.75	0.95	0.95	0.95	0.95	0.75	0.75	0.70	0.70
Peaches	0.00	0.00	0.45	0.63	0.75	0.92	1.00	0.90	0.74	0.77	0.10	0.00
Pears	0.00	0.00	0.48	0.58	0.73	0.89	0.95	0.95	0.92	0.78	0.00	0.00
Pecans	0.00	0.00	0.60	0.85	0.95	1.05	1.05	1.05	0.95	0.75	0.00	0.00
Peppers	0.00	0.00	0.00	0.20	0.45	0.75	0.98	0.98	0.00	0.00	0.00	0.00
Pistachios	0.00	0.00	0.00	0.26	0.75	1.09	1.00	0.33	0.33	0.33	0.00	0.00
Plums	0.00	0.00	0.45	0.63	0.75	0.92	1.00	0.90	0.74	0.77	0.10	0.00
Pomogranate	0.00	0.00	0.35	0.53	0.65	0.85	0.90	0.78	0.54	0.25	0.00	0.00
Potato	0.00	0.43	0.88	1.10	1.10	0.52	0.00	0.00	0.00	0.00	0.00	0.00
Prunes	0.00	0.00	0.50	0.65	0.85	0.95	0.95	0.95	0.80	0.30	0.00	0.00
Pumpkins	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.95	0.75	0.00	0.00	0.00
Rice	0.00	0.00	0.00	0.00	1.24	1.24	1.24	1.24	1.24	0.50	0.00	0.00
Safflower	0.00	0.00	0.33	0.45	1.30	1.40	1.01	0.00	0.00	0.00	0.00	0.00
Spinach	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.35	0.88	1.00	0.82	0.00
Sudan	0.00	0.00	0.00	0.28	0.65	0.98	0.98	0.98	0.45	0.22	0.00	0.00
Tomatoes	0.00	0.00	0.20	0.30	0.72	1.05	0.52	0.00	0.00	0.00	0.00	0.00
Walnut	0.00	0.00	0.40	0.72	0.90	1.08	1.15	1.15	1.02	0.70	0.20	0.00
Wheat	0.26	0.38	0.77	1.02	1.02	0.22	0.00	0.00	0.00	0.00	0.00	0.10
Fallow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1. DF Trees (Deciduous Fruit Trees) are a general classification and include apples, pears, plums, prunes, apricots, peaches, pomegranites, and nectarines.

Monthly Etc Values follow this page.

Leaching - LR

It was assumed that any leaching value gathered by self-report would be unreliable. The on-site auditors were experts at determining this values and therefore, the leaching values were based upon the on-site audits. The leaching requirement is a function of the crop and water salinity. The assumption was made that both of these variables were sufficiently homogeneous to maintain a static leaching requirement across a region. Each audit had at most 3 crops audited and with leaching values determined for each crop (shown by LR1-LR3). These values were weighted by the number of observations (N1-N3).

Region	N1	LR1	N2	LR2	N3	LR3	Total N	Weighted Average - LR	LR Used in Analysis
1	66	12.7	29	19.1	11	21.7	106	15.4	15.4
2	32	8.3	10	7.8	4	3.3	46	7.8	7.8
3	49	7.2	16	8.9	6	4.3	71	7.4	7.4
4	0	0.0	0	0.0	0	0.0	0		15.0
5	1	5.0	0	0.0	0	0.0	1	5.0	7.0
6	12	17.1	7	14.7	4	12.0	23	15.5	15.5

Irrigation Efficiency - IE

For the same reasons that the leaching requirements were not gathered via self-report, the irrigation efficiency values were determined based on on-site audits. In addition to information gathered on three crops, there were three types of irrigation - flood, sprinkler and low volume. One IE was used across all regions based upon the irrigation type.

Region	Irrigation Type	N1	IE1	N2	IE2	N3	IE3	Total N	Average IE
1	1	52	64.5	22	63.2	8	63.1	82	64.0
1	2	6	70.0	5	73.0	3	73.3	14	71.8
1	3	8	89.4	2	87.5	0	0.0	10	89.0
2	1	23	62.4	6	60.0	3	56.7	32	61.4
2	2	4	80.0	3	76.7	1	80.0	8	78.8
2	3	4	78.8	1	90.0	0		5	81.0
3	1	24	63.8	11	65.5	4	63.8	39	64.2
3	2	18	70.6	4	71.3	2	72.5	24	70.8
3	3	7	89.3	1	60.0	0		8	85.6
4	1	0		0		0		0	
4	2	0		0		0		0	
4	3	0		0		0		0	
5	1	0		0		0		0	
5	2	1	90.0	0		0		1	90.0
5	3	0		0		0		0	
6	1	1	65.0	1	80.0	0		2	72.5
6	2	6	74.2	6	77.5	4	78.8	16	76.6
6	3	5	84.0	0		0		5	84.0

Where irrigation type 1=Flood, 2=Sprinkler and 3=Low Volume (drip & microsprinkler).

The weighted average across all regions is shown below

Type	Weighted Average for IE
1	63.6
2	73.8
3	85.7

Surface Water - Surf

Surface water varies from year to year and within regions. This piece of data was gathered by self-report from the telephone surveys. The grower was asked what percent of the water required by the crop was supplied through surface water. This value was implemented by multiplying the ETc value with the self-reported surface water percent (if present), which provided the inches of water which the pump was not required to provide. If the grower did not know if surface water was used for the year, a value of zero was used. The table below shows the results, when a response was provided, from the surveys fielded. Participants are those growers who participated in either the Retrofit Express or EMS program.

Surface Water Used?	Frequency - Participants	Percent - Participants	Frequency - Non-participants	Percent - Non-parts
Yes	232	33	142	39
No	470	67	224	61
Total	702	-	366	-

Of those growers who stated that they used surface water, the table below shows the percent of surface water used in 1993 by quartiles.

Percent of Surface Water Used	Frequency - Participants	Percent - Participants	Frequency - Non-parts	Percent - Non-parts
Missing	33	-	34	-
>0 to 25	53	26.6	19	17.6
> 25 to 50	52	26.1	29	26.9
> 50 to 75	29	14.6	20	18.5
> 75 to 99	28	14.1	21	19.4
100	37	18.6	19	17.6

Acres

The crop acres were collected from both the participant and non-participant telephone surveyed growers. Since the acres of crop was quite variable, if the value was not present, an engineering estimate was not created. The table below shows the frequency of acres as reported for those surveyed with a pumping measure. Since some of the acreage responses were noticeably high, a cut off point was required to determine which responses to keep for the engineering estimates. Any responses which provided less than a 9 gallons per minute per acre from the pump caused the observation to be deleted from the engineering estimates.

Acres	Frequency - Participants	Percent - Participants	Frequency - Non-parts	Percent - Non-parts
0 - 500	574	91.9	283	98.4
500 - 1000	33	5.4	2	.8
> 1000	16	2.7	2	.8
missing	22	-	23	-
Total	645	-	300	-

Pump Specific Values - OPE, TDH

If the overall plant efficiency (OPE) and total dynamic head (TDH) were present in the pump test database (7) for the specific account, that value was used. The horsepower of the pump determined the post retrofit efficiency in the algorithm, therefore the horsepower value was also needed. However, only about 36% of the surveyed growers had values in the pump test database. The other growers used the mean OPE, TDH and HP for the region as shown below. The mean values used were segmented into the type of pump and type of irrigation system to better represent the average efficiency of the site. The irrigation system would require greater lift for a nozzle system than a flood system, as the averages indicate. Averages from the pump test database for turbine motors were used to represent the deep well pumps. Averages from centrifugal motors were used to represent the surface and booster pumps. There were no participants in region 5, so the low sample sizes were disregarded for the determination of mean values.

Region	Pump Type	Irrigation	N	Mean OPE	Mean TDH	Mean HP
1	Turbine	Nozzle, High or Low PSI	321	64.1	312.8	100.8
1	Turbine	Drip	94	59.1	297.6	101.2
1	Turbine	Furrow or flood	3349	57.6	191.4	75.5
1	Centrifugal	Nozzle, High or Low PSI	23	45.0	200.0	31.6
1	Centrifugal	Drip	7	46.0	86.8	21.4
1	Centrifugal	Furrow or flood	12	38.0	72.6	27.3
2	Turbine	Nozzle, High or Low PSI	192	62.7	255.0	91.3
2	Turbine	Drip	47	60.5	212.0	61.9
2	Turbine	Furrow or flood	1540	55.7	123.4	50.5
2	Centrifugal	Nozzle, High or Low PSI	26	60.8	132.5	36.5
2	Centrifugal	Drip	8	56.7	108.7	29.4
2	Centrifugal	Furrow or flood	36	50.0	38.9	30.3
3	Turbine	Nozzle, High or Low PSI	393	64.0	220.4	78.1
3	Turbine	Drip	203	61.0	170.5	68.0
3	Turbine	Furrow or flood	1459	54.8	81.3	46.6
3	Centrifugal	Nozzle, High or Low PSI	85	57.8	131.7	53.8
3	Centrifugal	Drip	28	51.9	95.1	36.4
3	Centrifugal	Furrow or flood	30	48.7	44.6	32.5
4	Turbine	Nozzle, High or Low PSI	34	62.4	224.4	93.3
4	Turbine	Drip	8	52.6	137.9	20.6
4	Turbine	Furrow or flood	10	37.0	99.9	30.5
4	Centrifugal	Nozzle, High or Low PSI	52	53.4	142.9	46.3
4	Centrifugal	Drip	11	48.8	109.4	33.2
4	Centrifugal	Furrow or flood	4	39.5	61.0	10.0
5	Turbine	Nozzle, High or Low PSI	95	58.4	259.0	138.8
5	Turbine	Drip	2	58.5	119.5	15.0
5	Turbine	Furrow or flood	29	40.1	95.4	26.5
5	Centrifugal	Nozzle, High or Low PSI	116	45.3	201.0	40.5
5	Centrifugal	Drip	6	29.2	95.2	11.3
5	Centrifugal	Furrow or flood	1	49.0	76.2	5.0
6	Turbine	Nozzle, High or Low PSI	339	60.9	270.5	120.6
6	Turbine	Drip	43	51.9	219.6	70.2
6	Turbine	Furrow or flood	652	53.7	154.2	59.6
6	Centrifugal	Nozzle, High or Low PSI	119	49.2	160.0	92.0
6	Centrifugal	Drip	8	39.8	101.3	25.0
6	Centrifugal	Furrow or flood	16	46.6	47.7	69.1

Engineering kWh Estimate Results

The table below shows the annual impact by region calculated from the engineering estimates. The values are for the survey participants with available data. The impacts are from the normalized weather data (30 year average precipitation). The savings from the pump adjustment measure was determined by using the impact percent of 1.5%. (Based on empirical expertise with pump adjustment measures.)

Region	N	Mean kWh Impact - Pump Retrofit	N	Mean kWh Impact - Pump Adjustment
1	80	52,021	45	1,300
2	41	19,234	22	2,084
3	35	10,892	47	1,354
4	2	2,731	0	0
5	0	0	0	0
6	23	9,567	0	0
Average	181	30,702	114	1,474

Engineering kW Estimate

The engineering demand savings estimate were based upon the ex-ante algorithm with a few refinements. The algorithm used is shown below.

kW Savings = HP * 0.746 * CDF * OPE Ratio

Where the OPE ratio and HP is a function of the horsepower bins. The bins and values used in the 1994 ex-ante algorithm are:

Bin Category	OPE Ratio	HP Used for kW Savings
5 - 15 HP	1-(42/52.3) = 0.20	10.33
15-75 HP	1-(46.7/59) = 0.21	44.16
75-400 HP	1-(51.4/63.7) = 0.19	156.27

The average pre-repair and estimated post-repair OPE for the bins from the 93-94 pump test database required some cleaning before determination. The estimated new efficiency within a pump test is determined based upon the horsepower and type of the pump (7). In some of the pump tests, the old efficiency was higher than estimated new efficiency. To determine the new efficiency of the plant if the old efficiency was higher than the estimated efficiency, a conservative 5% was added to the old efficiency and called the new efficiency. All efficiencies greater than 95% were not used in the determination of average pre and post efficiency.

Bin Category	N - Pre OPE	Pre-Retrofit OPE	N - Post OPE	Post-Retrofit Estimated OPE
5 - 15 HP	1823	43.75	2138	58.22
15-75 HP	5455	54.75	6427	63.31
75-400 HP	3717	60.78	4506	68.02

These values were substituted for the ex-ante values and the new OPE ratios became:

Bin Category	OPE Ratio	HP Used for kW Savings
5 - 15 HP	1-(43.75/58.22) = 0.25	10.33
15-75 HP	1-(54.75/63.31) = 0.14	44.16
75-400 HP	1-(60.78/68.02) = 0.11	156.27

The coincident diversity factor (CDF) used was 0.53.

Although the horsepower was not known directly from the MDSS, the hp bin could be determined based upon the ex-ante kW savings estimate and the new values implemented. The results for the demand analysis are shown below.

Bin Category	N in 1994 MDSS	Ex-ante OPE Ratio	Ex-ante Mean kW Impact	Ex-ante Summed MW Impact	New OPE Ratio	Mean kW Impact	Summed MW Impact
5 - 15 HP	132	0.20	0.82	0.11	0.25	1.36	0.18
15-75 HP	410	0.21	3.67	1.50	0.14	3.16	1.29
75-400 HP	265	0.19	11.74	3.11	0.11	8.82	2.34
Total	807	-	-	4.72	-	-	3.81

Greenhouse Engineering Estimates

Greenhouse measures were the only measures with therm impacts. The engineering estimates for these measures consisted of using the on-site audits to create a "typical" greenhouse and then changing the construction to the post-retrofit construction. The greenhouse model was then implemented in DOE-2 and run with CEC climate zone weather files. There are two important items regarding this analysis:

1) the DOE-2 files were not calibrated with the actual therm use of the customers and

2) the pre-installation construction assumption used were from the ex-ante program.

There were 53 greenhouse audits performed, representing 19 different accounts. Multiple audits were done at the same site if a grower had multiple retrofits on one account. There were 34 audits which were used to create the "typical" greenhouse variables, representing 12 different accounts. Multiple peaks (a peak can mean one greenhouse or one roof peak within a greenhouse, depending on the grower) were on one account. The on-site audit was targeted toward providing information about the specific peaks which were retrofit. Although a census of greenhouses was performed, there could be no mapping of peaks to accounts for a calibration of DOE-2 (as originally planned) since information was not gathered about the non-retrofit peaks or about which peaks were on which meter.

An interesting piece of information which came from the audits and should be explored further in the 1995 evaluation regards the implementation of the heat curtain measure. According to the PG&E program of ex-ante assumptions, "In

greenhouses, the addition of thermal blankets [heat curtains] to the greenhouse interior decreases heat losses resulting from radiation, convection and infiltration. Thermal blankets also reduce air stratification and the amount of space to be heated.". What the auditors found in the field was that thermal blankets such as described here were not rebated by PG&E (according to the growers self-report), but what was rebated was the implementation of a single piece of clear poly film to create a flat ceiling and decrease the volume of space to be heated. Since this is what the auditors found in the field, this is what was simulated in DOE-2 for the heat curtain measure.

The hardcopy of the greenhouse audits were provided to PG&E in a separate binder. Also in this binder is an electronic spreadsheet with the audit information.

DOE-2 Specifications

DOE-2 is a model which does not allow light through a construction unless it is specified as a window. Because of this and because DOE-2 requires windows to go with a wall, the walls within this model are only 0.05 feet larger that the windows. The windows represent the characteristics of the various measures. The construction of the heat curtain measure was built up from the known elements based on data source 12. This estimate of resistance is conservative since that average air space created by the poly film is 36 inches and 7 inches is used here. This estimate does not take into account lack of good sealing between the ceiling and the walls although there will be air exchange between the spaces. The resistances used in the construction of the heat curtain are shown below.

Construction of HC Ceiling	R-value	U-value
Single Pane Glass	0.885	-
7" Air Space	1.860	-
Single Poly Film	0.833	-
Total	3.578	0.28

The U-values for the simulated measures came from data source 13 and are shown next.

Construction	Base U-value	U-value Multiplier	U-Value
Fiberglass with metal frame	1.2	1.03	1.236
Single Poly with metal frame	1.2	1.02	1.224
Single Glass with metal frame	1.13	1.05	1.187
Rigid Double Wall with metal frame	0.65	1.03	0.67
Double Wall Poly with metal frame	0.70	1.02	0.71
Single Pane Glass with Heat Curtain	-	-	0.28

Once the U-values for each construction were determined, they needed to be turned into the DOE-2 glass conductance values. Data source 14, pp. III.89 shows the formulas used. The glass conductances used in the DOE-2 simulations are for winter wind conditions (15 mph) are shown below.

Construction	U-value	Glass Conductance
Fiberglass with metal frame	1.24	1.63
Single Poly with metal frame	1.22	1.61
Single Glass with metal frame	1.19	1.55
Rigid Double Wall with metal frame	0.67	0.77
Double Wall Poly with metal frame	0.71	0.83
Single Pane Glass with Heat	0.28	0.30

The specifications used for the models are shown below. The infiltration value is based on an older greenhouse with good maintenance.

	For Rigid Double Wall and Double Wall Poly	For Heat Curtain
Azimuth	10	10
Length	230	230
Width	25.8	25.8
Height	13.8	10
Area	5,934	5,934
Volume	81,889	59,340
Heater Type	Forced Air Furnace	Forced Air Furnace
Heater Capacity	511,559	511,559
Heating Schedule	7 pm to 7 am year round	7 pm to 7 am year round
Thermostat Setpoint	65	65
Baseline Wall Construction	100% Fiberglass on Metal Frame OR 100% Single Poly Film on Metal Frame	100% Single Pane Glass with Metal Framing
Base Roof Construction	100% Fiberglass on Metal Frame OR 100% Single Poly Film on Metal Frame	100% Single Pane Glass with Metal Framing
Floor Construction	Dirt	Dirt
Infiltration	1.5 ACH	1.5 ACH
8 Mil Rigid Double Wall U-value	0.67	-
Double Wall Poly U-value	0.71	-
Single Pane with HC U-value*	-	0.28

* On ceiling only

Results of DOE-2 Simulations

The DOE-2 files were simulated with three weather files corresponding the areas with the most greenhouse growing, CTZ03 (Oakland), CTZ04 (Sunnyvale) and CTZ12 (Sacramento). The results from each run were averaged together by construction and the impact was determined by subtracting the new therms from the old therms. The results, shown below, map well with the updated ex-ante estimates of 0.36 therms/ft^2 for double poly and 0.40 therms/ft^2 for rigid double wall

measure. The heat curtain measure, however, is substantially different at 0.67 therms/ft^2 for the updated ex-ante estimate. The main reason for this difference is the decrease in volume required for heating as implemented in the DOE-2 simulations and that this is not accounted for in the algorithm. However, because of the uncertainties in the modeling of the heat curtain measure in DOE-2, the updated ex-ante algorithms will be used in determining the ex-post savings for the greenhouse measures.

Old Construction	New Construction	Installed Sq Ft	Therms / Installed Sq Ft Savings
Single Poly	Double Poly	12,994	0.34
Single Poly	Rigid Double Wall	12,994	0.37
Fiberglass	Rigid Double Wall	12,994	0.37
Single Glass	Heat Curtain	5,934	0.98

The hardcopy of the DOE-2 files used for this analysis are located on the following pages.

Put greenhouse DOE-2 model hardcopy and results pages here

Appendix C

BILLING REGRESSION ANALYSIS

Appendix C

BILLING REGRESSION ANALYSIS

This appendix documents the detailed analytical steps undertaken in the billing regression of Pacific Gas and Electric Company's (PG&E's) 1994 Agricultural (Agricultural) Programs. The appendix starts with a discussion of the data sources used in the regression analysis, followed by a detailed description of statistical model specification and refinement process and a presentation of the final model results. It also presents some alternative models that are not used in the final calculation of impacts.

Overview

The objectives of the billing regression analysis are (1) to determine the first-year gross impacts of high impact pumping measures, and (2) to provide information and feedback to improve engineering estimates on measures that are not suitable for a deterministic statistical estimation.

Modeling customers' energy usage pattern in the agricultural sector is a challenging task due to often large year-to-year and customer-to-customer usage changes associated with weather variation, crop rotation, irrigation system reconfiguration, and other agricultural economy factors. These factors have an even more significant impact on this evaluation because of the large difference between the pre-participation period (i.e., 1992, a dry year) and the post-participation period (i.e., 1995, a record wet year in a decade). The data used in this analysis had a higher noise to signal ratio resulting in insignificant or low-significance parameter estimates.

The pump retrofit measure group is the only case where a statistically significant impact can be detected from a billing regression analysis. For other measures, impacts cannot be reliably determined in a statistical model for one of two reasons:

- Low Expected Impacts. Agricultural measures with low impacts (less than 5% of usage) are difficult to model because their expected impacts are mixed with modeling errors of the same or even greater magnitude. Measures in this category include pump adjustment (RE), pump testing (EMS), low cost/no cost pumping measures (EMS).

- Low Participation Level. Impacts for measures with low participation are hard to determine with insufficiently small sample sizes. Measures in this category include

Customized water system upgrade measures (9 accounts) and low pressure sprinkler nozzles (29 accounts).

For the measures for which a statistically significant estimates are not available, the billing regression analysis can still serve as a reality check or provide some indication for the range of the expected impacts and corroborate the engineering estimates.

Data and Sample

The billing regression analysis for the 1994 Agricultural Programs Evaluation uses data from three primary data sources: the MDSS tracking database, the CIS billing database, and the telephone survey data specifically collected for this evaluation.

- *Program Participant Tracking System.* The participant tracking system for the RE and Customized programs was maintained as part of the PG&E MDSS. It contains program application, rebate, and technical information about installed measures, including measure descriptions, quantities, rebate amounts, and ex ante demand, energy, and therm saving estimates. The MDSS database is linked to the billing database and other program databases through the PG&E's customer control numbers.

- *PG&E Billing Data.* For this evaluation, the PG&E billing data were obtained from two PG&E data sources. The original nonresidential billing dataset contains monthly energy usage for all nonresidential accounts in the PG&E service territory, and was used in the sample design as described in *Appendix A.* The second billing dataset, which consists only of customer accounts in the surveyed dataset, was later obtained from PG&E's Load Data Services.[1] Since the second billing dataset has many useful fields not included in the first dataset, a decision was made to use the second billing dataset to conduct the statistical analysis. The billing series used in the analysis is the PG&E prorated monthly usage data, a series calculated by PG&E for each calendar month, from January 1991 to September 1995.

- *Telephone Survey Data.* The three telephone survey samples (466 RE/Customized participants, 455 EMS only participants and 453 comparison group customers) were collected as part of this Evaluation. They were designed to be representative of the participant population for each program. The telephone survey supplies information on energy-related changes at each site for the billing period covered by the billing regression analysis. The final telephone sample distribution is presented in Exhibit C-1.

[1] A preliminary analysis has concluded that the monthly usage and bill read date information in these two datasets is consistent.

All data elements mentioned above were linked to the final analysis database through the unique customer identifier -- PG&E's customer control number. For this Evaluation, the analysis database served as a centralized tracking system for customers' billing history, program participation, and sampling status and helped to reduce data problems such as account mis-matches and double counting. All participants in the survey sample were successfully merged with the MDSS database by control numbers and only two surveyed customers (both comparison group customers) failed to merge with the billing dataset due to disconnected services. Surveys collected for the evaluation were distributed across the following programs/measures:

Exhibit C-1
Agricultural Evaluation Telephone Survey Sample by Program and Measure

Telephone Survey Sample		Survey Completes	After Merge with Billing
Rebate Participant	Pump Retrofit (RE)	286	286
	Pump Adjustment (RE)	151	151
	Low Pressure Sprink Nozzles (RE)	29	29
	Water System Changeout (Customized)	5	5
	Custom Measures (Customized)	4	4
	EMS Participant	114	114
	Rebate Program Total *	466	466
EMS Only Participant		455	455
Nonparticipant		453	451
TOTAL		1,374	1,372

* The total is less than the sum of all the subcategories due to multi-measure participation.

In addition to the three data sources discussed below, the billing regression analysis also utilized the engineering analysis results. The original research plan also proposed to use the PG&E agricultural class load research data, however, the overlap of the load research sample with the program participant population only consisted of 28 accounts and this sample was judged to be too small to run a robust regression given the volatile nature of the agricultural sector.

Model Specification

Engineering Prior

To determine the gross energy impact that can be attributed to the pump measures of the RE and Customized Programs, a cross-sectional billing regression analysis model was used to estimate program impacts by fitting customer-specific post-installation usage to estimated impacts (impact priors) for each key pump measure and premise-specific variable obtained from the telephone surveys. Two different sets of impact priors were considered in the model specification stage - the engineering estimates of impact and the actual usage in the pre-installation period. When engineering estimates are used, the output of the model will be called SAE realization rates and they represent the fractions of engineering estimates that are "realized" or "detected" in a billing regression analysis. On the other hand, when the pre-installation usage is used in the model, the estimated impacts will be represented as a percentage of this value. If the original engineering estimates are calculated as a fraction of usage (such as the ex-ante estimates of pump retrofit impact in the MDSS database), these two priors will yield the same results. Actual pre-installation usage was used in the final billing regression analysis for two reasons:

- As discussed in the engineering analysis section, engineering estimates are calculated based on ideal watering behavior for specific crops and technologies and they do not depend on actual usage information. This approach provides a deterministic algorithm that can be transferred to any weather conditions, including TMY. These estimates track expected impacts for the participant population, however, on a specific customer basis, the engineering estimates have a weaker correlation with the year-to-year usage changes, than the actual pre-participation usage.

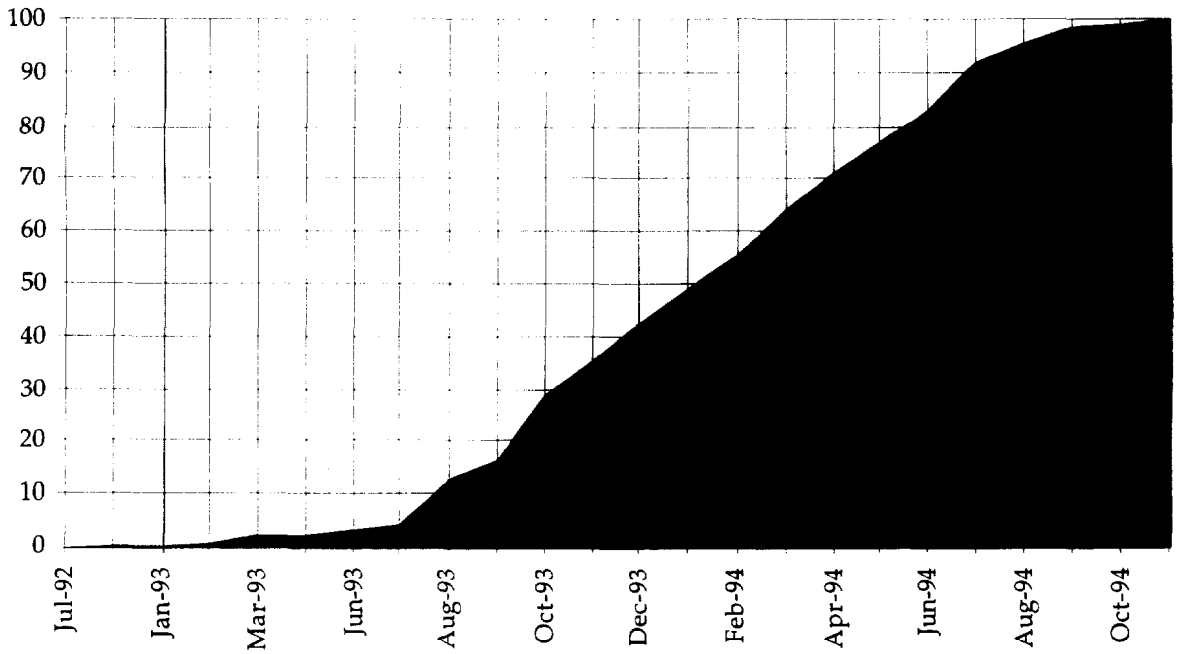
- The engineering analysis can only be reliably performed on 2/3 of the total sample due to lack of acreage and crop information. Therefore, an SAE model would immediately exclude one-third of the sample from the analysis.

Analysis Period

For the RE/Customized Programs, participants are defined as those PG&E agricultural customers who received PG&E rebates in the 1994 calendar year for installing at least one agricultural measure under the Nonresidential Retrofit Program. Although the accurate installation dates could not be determined due to inadequate data in the MDSS database, customers' installation dates can still be estimated based on the analysis of the inspection dates (when populated), rebate check issue dates, and the survey self-reported installation dates. Exhibit C-2 presents the estimated participation date for the RE/Customized participants paid in 1994.

Exhibit C-2
Agricultural Rebate Program Telephone Sample Distribution
by Estimated Installation Date

Cumulative % of Participation by Month
(Based on 466 Participants in the Analysis Dataset)



Determining the EMS audit date is relatively easy because the pump test date field is well populated in the 1994 Pump Test Database and all pump tests were conducted in 1994. However, the actual date that an EMS participant later implemented a recommended no cost/low cost measure or a capital-intensive measure outside of the Rebate Program was not collected.

The billing regression models were conducted on monthly, seasonal, and annual energy usage. The final model uses a fixed summer season comparison approach based on customer usage patterns in the agricultural sector. The summer season model resulted in the most stable results. The two summer seasons used in the final models are June 1992 - September 1992 as the pre-installation period and June 1995 - September 1995 as the post-installation period.

Sample Segmentation

Three basic segmentation schemes were used in the billing regression analysis: (1) usage segment which is defined based on customers' PG&E electric rate schedule and is consistent with the segments used in the net-to-gross analysis; (2) geographic segments based on weather regions which are the same segmentation defined and used in the engineering analysis; and (3) year-to-year usage changes based on their utilization

factors which are developed to capture the radical usage shifts among sample observations. The final model is a weighted Ordinary Least Square (OLS) model using usage segment weights. A detailed discussion on sample segmentation and sample distribution is presented below.

Usage Segment

For the impact analysis purpose, the telephone survey sample can be weighted using population distributions based upon rate class and regions.[2] This was done so that estimated results obtained from surveyed program participants and comparison group customers would more accurately reflect program population estimates. Region was chosen to ensure geographic representativeness of survey sample. Rate class was chosen so that comparison group sample results would adequately reflect participant account size.[3]

To develop the sample weights, population distributions were developed from the MDSS and CIS for the following two populations: 1994 RE/Customized participants and 1994 EMS only participants. This was done by using a three-level "usage" variable derived from rate class.

[2] Region was defined based on the engineering analysis of climate conditions as discussed in Appendix B.

[3] The actual annual usage was not a good weighting variable due to large year-to-year usage changes in the agricultural sector.

Exhibit C-3
Definition of Usage Segments [4]

Usage Segment	Rate Schedule	Definition
1	AG-1A	Agricultural Power
1	AG-RA	Split-Week TOU Agricultural Power
1	AG-VA	Short Peak TOU Agricultural Power
1	AG-4A	TOU Agricultural Power
2	AG-1B	Agricultural Power
2	AG-RB	Split-Week TOU Agricultural Power
2	AG-VB	Short Peak TOU Agricultural Power
2	AG-4B	TOU Agricultural Power
3	AG-5	Large TOU Agricultural Power
3	AG-6	Large Agricultural Power

Source: Revised CPUC Sheet No. 13358-E

First, all accounts were classified into a usage segment based upon rate class, as shown in Exhibit C-2. Smaller accounts (nondemand-billed) were grouped into one segment. Demand-billed accounts were grouped into a second segment, and accounts in the AG-5 and AG-6 rate classes were grouped into a third and final segment.

Population distributions were then used in combination with sample distributions developed for the analysis. The sample weights for each cell were calculated as p_{jk}/s_{jk}, where j is the jth usage segment, k is the kth region, p_{jk} is the percentage of the population represented by the cell p_{jk} and s_{jk} is the percentage of the survey sample represented by cell s_{jk}.

Once sample weights were constructed, they were applied in the calculation of statistics in the billing regression analysis when surveyed participants and comparison group customers were used. This method of sample weighting compensates for differences between the survey samples, and their respective populations, by assigning more importance to observations from usage categories and divisions that are under-represented in the survey sample, and less importance to observations that are over-represented.

The following exhibits presents the sample distribution by the usage segment. It also show the numbers of customers in the survey sample who were on PG&E TOU rates or demand rates. Only those customers who were on one of the demand rates during the

[4] This definition of "usage segment" is consistent with the survey analysis definition (Appendix E).

analysis period will have monthly demand data and can be included in a demand regression analysis.

Exhibit C-4
Telephone Sample Distribution by PG&E Rate Class

Rate Schedule Category		Rebate Participant	EMS Only Participant	Non-participant	Sample Total
Usage Segment *	1	178	197	345	720
	2	138	166	71	375
	3	150	92	35	277
Agricultural TOU Rate		393	316	202	911
Agricultural Demand Rate		269	230	95	594

* As defined in Exhibit C-3.

Region Segment

Another segment used in the billing regression analysis is region which is defined based on the engineering analysis of weather data (see *Appendix B*).

Exhibit C-5
Telephone Sample Distribution by Region

Agricultrual Region *	Rebate Participant	EMS Only Participant	Non-participant	Sample Total
1	182	149	204	535
2	105	133	81	319
3	126	123	118	367
4	3	9	5	17
5	3	3	0	6
6	47	38	43	128

* Regions are defined in *Appendix B* .

Given the low participation in regions 4, 5, and 6, they are combined into a new region 4 in the billing regression analysis.

Segment by Change in Usage

One key issue in modeling energy usage in the agricultural sector is to control for seemingly unexplainable radical usage changes over time for a given customer. This radical change of usage could be the results of number of reasons, including weather

impact, crop rotation, water system changes, switching from deep well water source to surface water source, and even leaving the land fallow for a year. In this evaluation, we isolate the impacts of different behavior on the model coefficients by segment customers into different groups according to their "utilization factors". For a given period of time, a pumping account's utilization factor is defined as the ratio between its current period usage and the maximum observed usage among all similar periods. For example, if a pump account has a summer usage of 80,000 kWh in 1992 and the maximum summer usage in a four year period (between 1992 and 1995) is 100,000 kWh, then the 1992 utilization factor for this account is 0.8 (=80,000/1000,000).

Using the utilization factor definition, a pumping account is said to have low utilization if the summer utilization factor in that year is less than 25%. Approximately 15% of the accounts in the analysis dataset are classified as "low utilization" accounts in 1992 and this percentage increased to around 35% in 1995. The account with low utilization factor should be considered non-operating and by isolating them from the operating accounts will reduce the noise in the data. Exhibit C-6 presents the distribution of samples by four possible combinations of customers when compared their utilization status between 1992 and 1995.

Exhibit C-6
Telephone Sample Distribution by Utilization Status

Utilization Status *	Rebate Participant	EMS Only Participant	Non-participant	Sample Total
Normal->Normal	304	312	291	907
Normal->Low	105	104	107	316
Low->Normal	44	27	27	98
Low->Low	13	12	26	51

* Between summer 1992 and summer 1995.

Change Variables

In this section, the sample distribution and the key change variables in the analysis dataset were examined. All the statistics presented below are based on the integrated analysis dataset of 1,372 observations.

Energy Efficient Measure Adoption Outside the Program

Customers in all three surveyed categories (Rebate participants, EMS participants, and comparison group customers) reported adoption of energy efficient measures outside the PG&E Rebate Programs. The following exhibit shows how each measure was adopted by different class of customers in the surveyed sample.

Exhibit C-7
Customers' Energy Efficient Measure Adoption Outside the Program

Measures Installed	Rebate Participant	EMS Only Participant	Non Participant
Pump Retrofit	73	57	51
Pump Adjustment	48	1	20
Low Pressure Sprinkler Nozzle	0	23	24
Time Clock w/ Batt. Backup	0	31	18
Well Water Measure Device	0	12	9
Double-Walled Polyethylene	0	1	0
Heat Curtain	0	1	0
Milk Pre-cooler	0	0	1
Refrig. Desuperheater	0	0	1
Rigid Double Wall Plastic	0	0	0

EMS Recommendations

Very few no-cost/low cost recommendations were made or adopted by the surveyed EMS participants. There were a total of 19 pumping related no cost/low cost recommendations that were adopted based on the self-report. Other adopted recommendations included 3 water/crop recommendations and 11 other miscellaneous recommendations.

Site-Specific Changes

For the pumping related changes, two key variables were collected from telephone survey - customers' water pumping changes and farm acreage changes. Among the Rebate Program participants, two reported water pump changes and 40 reported acreage changes. There are four water pump changes and 21 acreage changes among the EMS only program participants. For comparison group customers, no one reported water pump changes but 29 reported acreage changes.

In addition to pumping and other agricultural energy efficient changes discussed above, other site-specific end use changes can also affect the year-to-year energy consumption in a billing regression analysis if these end uses share the same pumping accounts. However, the survey response indicates that changes to other non agricultural end uses were negligible. Among four surveyed end uses (Lighting, Air Conditioning, Refrigeration, and Ventilation) and the non-farm square footage, only four customers among 1,372 surveyed reported any changes. Among them, one made air conditioning change (a Rebate Program participant) and three made square footage changes (one Rebate Program participant and two EMS only participants).

Billing Regression Model Specification

The basic billing regression model takes the following functional form:

$$kWh\_Post_{it} = \Sigma_j \alpha_j + \Sigma_k \beta_k kWh\_Pre_{it} + \Sigma_m \gamma_m \Delta Eng_{itm} + \Sigma_s \eta_s Chg_{its} + \varepsilon$$

Where

- kWh_Post_{it} is the energy consumption for account "i" in a post participation period "t"
- α_j are the regional specific intercepts for the model and are equal to 1 if customer I is in region j
- β_k*kWh_Pre_{it} is the pre-usage at a segment level based on the utilization factors mention above. For each customer in the analysis dataset, there are four segments as listed in Exhibit C-6.
- $\gamma_m \Delta Eng_{itm}$ is the engineering-estimated changes for participant "i" and measure "m" in period "t." Our approach used the pre-usage for this term to capture the customer specific variances and the coefficient estimates reflect the percentage of the pre-usage that is saved due to the measure installation.
- $\eta_s \Delta Chg_{its}$ represents customer-specific changes between the pre- and post-analysis periods.
- Finally, ε is the error term that captures both random errors and errors introduced from the omission of variables whose explicit inclusion in the model was not possible.

To calculate the impact estimates under the TMY weather condition, an engineering estimated weather adjustment factor was used in the following equation:

$$Impact_m = \gamma_m * Pre\text{-}kWh * (Eng\_TMY\ Impact / Eng\_95\ Impact)$$

Billing Regression Analysis Results

Rebate Program Model

The results of the billing regression analysis for the RE/Customized Programs are presented in Exhibit C-8. This model was estimated on a total 907 observations with 456 participants and 451 comparison group customers. A total of 10 observations were not included in the model due to their large usage (summer usage greater than 500 MWh).

Exhibit C-8
RE/Customized Programs Billing Regression Model Results

Parameter Description	Parameter Estimate	t-statistic
Region Specific Intercept		
Region 1	5,256	3.2
Region 2	7,235	3.3
Region 3	2,839	1.6
Region 4	2,709	1.0
Slopes on Pre-Usage by Utilization Segment		
Normal to Normal	1.00	39
Normal to Low	0.00	0.1
Low to Normal	4.46	6.9
Low to Low	0.52	1.7
Impacts as Percentage of Pre-Usage		
Pump Retrofit	-0.12	3.6
Pump Adjustment	-0.06	0.6
RE/CI with EMS	-0.03	0.9
Low Pressure Sprinkler and Nozzles	-0.07	0.6
CI Measures	-0.06	0.8
Change Variables (Multiplied by Pre-Usage)		
Outside Program Retrofit	0.026	0.7
Outside Program Adjustment	0.055	1.0
Outside Program Nozzles	-0.243	1.0
Other Outside Program Measures	-0.055	0.8
Implement EMS Recommendations	-0.055	0.8
Acreage Changes	-0.25	5.7
Other End Use Changes	0.283	0.6

Number of Observation:	907
R-squared:	0.83

As discussed in the overview, most of the impact coefficients in the model are not statistically significant with the exception of the pump retrofit measures, which show an impact of 12% on the pre-installation usage level. The 90% confidence interval around this estimate is ±5%. The model does provide indications of the expected impacts on EMS and pump adjustments as support for the engineering estimates.

EMS Program Model

Billing regression analysis conducted for EMS Program participants and the comparison group results in statistically insignificant impacts. However, the coefficient estimate of -2.3% is consistent with the program design estimates (1.7%) and the estimates shown in the previous RE/Customized model. The EMS model is estimated on a total sample of 450 EMS only participants and 450 comparison group customers with the largest usage customers removed (usage over 330 MWh). The output of the model is shown in Exhibit C-9 below.

Exhibit C-9
EMS Programs Billing Regression Model Results

Parameter Description	Parameter Estimate	t-statistic
Region Specific Intercept		
Region 1	2,122	2.2
Region 2	2,956	2.6
Region 3	1,660	1.6
Region 4	4,685	2.8
Slopes on Pre-Usage by Utilization Segment		
Normal to Normal	0.87	41
Normal to Low	0.04	1.3
Low to Normal	3.76	8.0
Low to Low	-0.18	0.3
Impacts as Percentage of Pre-Usage		
EMS	-0.023	1.0
Change Variables (Multiplied by Pre-Usage)		
Outside Program Retrofit	0.166	4.6
Outside Program Adjustment	0.016	0.1
Outside Program Nozzles	0.081	1.4
Other Outside Program Measures	-0.089	2.4
Implement EMS Recommendations	0.134	1.7
Acreage Changes	-0.119	2.4
Other End Use Changes	0.267	1.0
Number of Observation:	900	
R-squared:	0.86	

In order to determine the first year program impact for the EMS Program, an EMS spillover analysis was conducted based on the telephone survey data to determine the adoption rates for each energy efficient measure in the agricultural sector that can be attributed to the EMS Program. The impact estimates from the RE/Customized

Programs were then transferred to the same measures to calculate the total EMS program impact. The results of that analysis are also consistent with the billing regression results.

Appendix D

FINAL PARTICIPANTS TELEPHONE SURVEY

SCREEN 1

Name: &NAME_____ MS: &MS CUSTID: &QCCU Obs#: &OBC OF &TOT
Latest Interviewer: &LI Interviewer 1: &I1 Date: &IDATE1_ Time 1: &TIM1
PG&E Agricultural Part Interviewer 2: &I2 Date: &IDATE2_ Time 2: &TIM2
P725180 Interviewer 3: &I3 Date: &IDATE3_ Time 3: &TIM3
CATI_ID: &CATI_ID_ Interviewer 4: &I4 Date: &IDATE4_ Time 4: &TIM4
Account: &ACCOUNT_____ Interviewer 5: &I5 Date: &IDATE5_ Time 5: &TIM5
Interviewer 6: &I6 Date: &IDATE6_ Time 6: &TIM6
Business: &BUSINESS_____ Home Phone: (&HA) &HP - &HL_
Address: &ADDRESS_____ Corr Ph: (&CA) &CP - &CL_
City: &CITY_____ Zip: &ZIP_ Contact: &CONTACT_____
Callback Date: &CBD____ Callback Time: &CBT_____
Comment: &COMMENT1_____
&COMMENT2_____
Result1: &RESULT1_____ Res2: &RESULT2_____ Res3: &RESULT3_____
Result4: &RESULT4_____ Res5: &RESULT5_____ Res6: &RESULT6_____

1=Complete	6=Refusal	11=Wrong Number	16=No Phone or Zero
2=Partial	7=Answering Machine	12=Moved	17=T&T Non-Part.
3=Call Back	8=Busy Signal	13=Fax or Modem	18=Other
4=No Answer	9=Not Elig for Int	14=Language	19=Business
5=On Vacation	10=Disconnected No.	15=No Dir. Lst	20=Other T&T

SCREEN 2 Last updated: 08/11/95

CONTACT NAME: &CONTAT_____

Hello this is &LI__ calling from Quantum Consulting, on behalf of PG&E. Pacific Gas and Electric is very interested in hearing about your experiences with the
&PROGRAM_____ Program.
Do you have 10 minutes to answer some questions?
SHFT TAB AND ENTER CORRECTED CONTACT IF NEEDED:
NEW CONTACT: &CONTACT_____

SR001. Before we start, I would like to inform you that for quality control purposes, this call may be monitored by my supervisor. Would this be OK with you?
&SR001
1=Yes
0=No
8=(Refused)
9=(Don't Know)

SCREEN 5

DV002. Would you be the best person to answer questions about
&BUSINESS_____ 's decision to participate in this program?
&DV002
1=Yes -->SKIP TO DV001
0=No
8=(Refused)
9=(Don't Know)

SCREEN 6

DV003. **IF DV002=0**
Who would be the best person to talk about
&BUSINESS_____ 's decision to
participate in PG&E's
&PROGRAM_____ Program ?

Contact Name &CONTACT_____
New Phone (&DV3AC) &DV3PRE - &DV3LAST EXT. &DV3EXT

TO SKIP TO THANK AND TERMINATE ENTER 1: --> &SKIP
ELSE ENTER 2 IF NEW CONTACT AVAILABLE NOW:

SCREEN 3

DV001. According to our records you participated in PG&E's
&PROGRAM_____
under the account number &ACCOUNT_____ . Is this correct?
&DV001
1=Yes --> SKIP DV007
0=No
8=(Refused)
9=(Don't Know)

DV001A. What is the account number that covers the
&EQUIPMEN_____
worked on under the &PROGRAM2_____
(ENTER THE NEW ACCOUNT NUMBER)
&CORACCT_____
(IF DID NOT PARTICIPATE, OR IF REF/DK CODE FIELD BELOW)
&DV001A
(0 = Did not participate) --> THANK AND TERMINATE
(8 = Refused)
(9 = Don't Know)

SCREEN 11

DV007B. How many pumps does this account cover?
&DV007B
88 = (Refused)
99 = (Don't Know);

DV007. What other equipment is covered under this account?
ENTER 1 FOR ALL THOSE THAT APPLY
DV007K &DV007K None --> SKIP DV004/DV009
DV007C &DV007C Lighting
DV007D &DV007D Refrigeration
DV007E &DV007E HVAC
DV007F &DV007F Ventilation
DV007G &DV007G Other SPECIFY: &DV007H_____
DV007I &DV007I (Refused)
DV007J &DV007J (Don't Know)

SCREEN 7

DV004. **IF AG=1 ELSE SKIP TO DV006** AG= &AGPART

Our records show that you had (a)

&MEASURE1_____
&MEASURE2_____
&MEASURE3_____
&MEASURE4_____

Is this correct?
&DV004
1=Yes -->SKIP TO DV050
0=No
8=(Refused) [THANK AND TERMINATE]
9=(Don't Know) [THANK AND TERMINATE]

SCREEN 8

DV005. **IF DV004=0**
What work did you have done through the program?
ENTER '1' FOR ALL THOSE THAT APPLY

PUMPS/WATER
DV005A &DV005A Pump Retrofit
DV005B &DV005B Pump Adjustment
DV005E &DV005E Well-Water Measurement Device
DV005F &DV005F Low-Pressure Impact Sprinkler Nozzle

GREENHOUSE
DV005G &DV005G Rigid Double-Walled Plastic (Greenhouse)
DV005H &DV005H Double-Walled Polyethylene (Greenhouse)
DV005I &DV005I Heat Curtain (Greenhouse)

TIMECLOCK
DV005J &DV005J Time Clock with Battery Back-up

MILK
DV005C &DV005C Refrigeration Desuperheater
DV005D &DV005D Milk Pre-Cooler

DV005Y &DV005Y Refused
DV005Z &DV005Z Don't Know

SCREEN 9

DV050. **ASK ALL**
When did you have the
&MAXMEASU_____ done?
DV050 &DV050__ (MONYYY)
DV051 &DV051 (YEAR, REF, DK)
8=(Refused)
9=(Don't Know)

SCREEN 12

DV008. **IF AG=1 ELSE SKIP TO DV009** AG= &AGPART
Since participating (in 1994), have you installed any of the following energy-saving equipment outside of the program?
ENTER '1' FOR ALL THOSE THAT APPLY

PUMPS/WATER
DV008C &DV008C Well-Water Measurement Device
DV008D &DV008D Low-Pressure Impact Sprinkler Nozzle

GREENHOUSE
DV008F &DV008F Rigid Double-Walled Plastic (Greenhouse)
DV008G &DV008G Double-Walled Polyethylene (Greenhouse)
DV008H &DV008H Heat Curtain (Greenhouse)

TIMECLOCK
DV008I &DV008I Time Clock with Battery Back-up

MILK
DV008A &DV008A Refrigeration Desuperheater
DV008B &DV008B Milk Pre-Cooler

DV008W &DV008W Refused
DV008X &DV008X Don't Know

SCREEN 13

DV008J. Since participating (in 1994), have you had a pump retrofitted or adjusted outside of the program?
(ENTER 1 FOR ALL THAT APPLY)

DV008J &DV008J Pump Retrofit
DV008K &DV008K Pump Adjustment
DV008Y &DV008Y Refused
DV008Z &DV008Z Don't Know

SCREEN 14

DV009. **IF AG=0 ELSE SKIP TO FS001** AG= &AGPART

Since you had your pump test, have you installed any of the following energy saving equipment?
ENTER '1' FOR ALL THOSE THAT APPLY

PUMPS/WATER
DV009C &DV009C Well-Water Measurement Device
DV009D &DV009D Low-Pressure Impact Sprinkler Nozzle

GREENHOUSE
DV009F &DV009F Rigid Double-Walled Plastic (Greenhouse)
DV009G &DV009G Double-Walled Polyethylene (Greenhouse)
DV009H &DV009H Heat Curtain (Greenhouse)

TIMECLOCK
DV009I &DV009I Time Clock with Battery Back-up

MILK
DV009A &DV009A Refrigeration Desuperheater
DV009B &DV009B Milk Pre-Cooler

DV009W &DV009W Refused
DV009X &DV009X Don't Know

SCREEN 15

DV009J. Since you had your pump test, have you had the water pump retrofitted or adjusted?

DV009J	&DV009J	Pump Retrofit
DV009K	&DV009K	Pump Adjustment
DV009Y	&DV009Y	Refused
DV009Z	&DV009Z	Don't Know

SCREEN 16

DV010. **IF DV009a, b, c, d, e, f, or g =1: ELSE SKIP TO DV012**
Were you planning on installing this equipment BEFORE you had your pump test?
&DV010
1=Yes-->SKIP TO DV011 IF DV009K=1 ELSE SKIP TO FS001
0=No-->SKIP TO FS001
8=(Refused)-->SKIP TO FS001
9=(Don't Know)-->SKIP TO FS001

DV011. **IF PUMP ADJUSTED/RETROFIT**
Would you have had your pump adjusted if you had not had your pump tested?
&DV011
1=Yes
0=No
8=(Refused)
9=(Don't Know)

SCREEN 17

DV012. **IF NO MEASURES ELSE SKIP TO FS001**

Are you planning a pump retrofit or adjustment as a result of recommendations made during the pump test?
&DV012
1=Yes-->SKIP TO FS002
0=No-->SKIP TO FS002
2=Considering --> SKIP FS002
8=(Refused)-->SKIP TO FS002
9=(Don't Know)-->SKIP TO FS002

SCREEN 18

FS001. **IF EMS=0 ELSE SKIP TO FS002** EMS= &EMSPART

Have you heard of PG&E's Pump Test Program?
&FS001
1=Yes
0=No -->SKIP TO FS003
8=(Refused) -->SKIP TO FS003
9=(Don't Know) -->SKIP TO FS003

SCREEN 19

FS002. **IF FS001=1 OR EMS=1 ELSE SKIP TO FS003**

How did you first LEARN about PG&E's Pump Test Program?
DO NOT READ
&FS002
CUSTOMER APPROACHED SOMEONE:
1=Respondent approached vendor/contractor
2=Respondent approached PG&E concerning another matter and found out about program
SOMEONE APPROACHED THE CUSTOMER:
3=Contacted by PG&E account rep
4=Contacted by contractor
5=PG&E Brochure in mail
6=Bill Insert
7=Word of mouth
8=Television, Radio, Newspaper ad
10=Family tradition/recommendation
9=Other SPECIFY: &FS002B_____
88=(Refused)
99=(Don't Know)

SCREEN 20

FS003. **IF AG=0 OR (REPART=0 AND CUSTOMIZED PARTICIPANT) ELSE SKIP TO FS004**
AG= &AGPART REPART = &REPART

Have you heard of PG&E's Retrofit Express Agricultural program?
&FS003
1=Yes
0=No
8=(Refused)
9=(Don't Know)

SCREEN 21

FS004. **IF FS003=1 OR REPART=1 ELSE SKIP TO PR001**
How did you first LEARN about the Retrofit Express program?
DO NOT READ

&FS004
CUSTOMER APPROACHED SOMEONE:
1=Respondent approached vendor/contractor
2=Respondent approached PG&E concerning another matter and found out about program
SOMEONE APPROACHED THE CUSTOMER:
3=Contacted by PG&E account rep
4=Contacted by contractor
5=PG&E Brochure in mail
6=Bill Insert
7=Word of mouth
8=Television, Radio, Newspaper ad
9=From the PG&E pump tester
10=Other SPECIFY: &FS004B_____
88=(Refused)
99=(Don't Know)

SCREEN 22

FS004C. **IF DV012=1 AND FS003=1 AND AG=0 ELSE SKIP TO FS005**
Are you planning on having the work on your pump done under the Retrofit Express Program?
&FS004C
1=Yes -->SKIP TO FS005
0=No
8=(Refused) -->SKIP TO FS005
9=(Don't Know) -->SKIP TO FS005

FS004C. **IF FS004C=0**
Why not?
&FS004D_____
&FS004F_____

ENTER 1 TO SKIP FORWARD --> &SKIP

SCREEN 25

ASK IF EMS=1 ELSE SKIP TO PD001 EMS= &EMSPART
I'd now like to ask you some questions about your experience with the PG&E Pump Test Program.

PR001. On a scale of 1 to 7 where 1 is extremely DISsatisfied and 7 is extremely satisfied, how would you describe your experience with the PG&E Pump Test program?
&PR001
88=(Refused)
99=(Don't Know)

PR002. **IF PR001=1 or 2**
Why are you dissatisfied?
&PR002A_____
&PR002B_____

ENTER 1 TO SKIP FORWARD --> &SKIP

SCREEN 26

PR003. Do you have any suggestions for improving this program?
&PR003
1=Yes
0=No --> SKIP PD001/PD009
8=(Refused)--> SKIP PD001/PD009
9=(Don't Know)--> SKIP PD001/PD009

&PR003A_____
&PR003B_____

ENTER 1 TO SKIP FORWARD --> &SKIP

SCREEN 27

IF AG=1 ELSE SKIP TO PD009 AG= &AGPART
Now I would like to ask you some questions about your decision to participate in the &PROGRAM_____ Program.

PD001. What was the most important factor in deciding to participate?
&PD001
1=Acquiring the latest technology
2=Saving money on electric bills
3=Obtaining a rebate
4=Replacing old or broken equipment
5=Knowing that the program was sponsored by PG&E
6=Improving the quality of your equipment for employees and customers
7=Helping to protect the environment
8=Previous experience with other PG&E programs
9=Obtaining advice from other people in your field
10=Obtaining advice from PG&E account rep
11=Obtaining advice from contractors
12=Obtaining advice from the PG&E pump tester
13=Other SPECIFY: &PD001B_____
88 = (Refused)
99 = (Don't Know)

SCREEN 28

PD002. Would you have &MAXMEASU_____ if the &PROGRAM_____
Program did not exist?

&PD002
1=Yes
0=No -->SKIP TO PD004
8=(Refused) -->SKIP TO PD004
9=(Don't Know) -->SKIP TO PD004

PD003. How long would you have waited to &MAXMEAU1_____
without the program?
CODE IN MONTHS
&PD003 (MONTHS)
88=(Refused)
99=(Don't Know)

SCREEN 29

PD004. How long were you considering &MAXMEASU_____
before you heard about the
&PROGRAM_____ Program?
CODE IN MONTHS
&PD004 (MONTHS)
88=(Refused)
99=(Don't Know)

PD005. How long did you take to decide to participate after
becoming aware of the program?
CODE IN MONTHS
&PD005 (MONTHS)
88=(Refused)
99=(Don't Know)

SCREEN 31

PD007. Before you knew about the
&PROGRAM_____
Program, which of the following statements best describes
your company's plans to &MAXMEASU_____ ?

READ LIST
&PD007
1=You hadn't even considered &MAXMEAU1_____ .
2=You had considered &MAXMEAU2_____
but had not planned to do so at any given time.
3=You had decided to &MAXMEAU3_____ ,
but probably not within the year.
4=You had already decided to &MAXMEAU4_____
within the year.
8=(Refused)
9=(Don't Know)

SCREEN 32

IF SPRINKLERS = 1 SPRINKLERS = &SPRNKLR

PD008B. Did you consider purchasing standard-efficiency equipment?
&PD008B
1=Yes
0=No
8=(Refused)
9=(Don't Know)

SCREEN 33

IF EMS=1 ELSE SKIP TO AE001 EMS= &EMSPART

PD009. Did the pump tester recommend that you participate in PG&E's Retrofit Express or Customized Incentives Agricultural Program?
&PD009
1=Yes
0=No
8=(Refused)
9=(Don't Know)

SCREEN 34

PD010. What (other) recommendations did you get from the PG&E pump tester?
DO NOT READ LIST
ENTER '1' FOR ALL THOSE THAT APPLY
1 FOR STARTED AFTER EMS, 0 IF ALREADY DOING
&PD1Z (8 = Refused)
(9 = Don't Know) --> SKIP PD013

WATER/CROP AND PUMP RECOMMENDATIONS = SCREEN 35
COMMPRESSOR/HVAC/ELECTRIC/OTHER RECOMMENDATIONS = SCREEN 36

LIGHTING RECOMMENDATIONS (8 = Refused)
(9 = Don't Know)

RECOMMEND.	ADOPTED	EMS	
&PD10	None -->SKIP TO AE001		
&PD11	&PD111	&PD211	Replace fluorescent lights before burnout
&PD12	&PD112	&PD212	Set time clocks for security lighting
&PD13	&PD113	&PD213	Turn off lights when not needed
&PD14	&PD114	&PD214	Use skylights/windows for lighting

SCREEN 35

PUMP RECOMMENDATIONS (8 = Refused) (9 = Don't Know)

RECOMMEND.	ADOPTED	EMS	
&PD33	&PD133	&PD233	Adjust the impeller relative to the bowl assembly
&PD34	&PD134	&PD234	Adjust the bowl assembly
&PD35	&PD135	&PD235	Replace impeller and/or bowl

WATER/CROP RECOMMENDATIONS (8 = Refused) (9 = Don't Know)

RECOMMEND.	ADOPTED	EMS	
&PD15	&PD115	&PD215	Apply water for storage only in root zone
&PD16	&PD116	&PD216	Check depth of wetted zone
&PD17	&PD117	&PD217	Clean dryer air tunnels/adjust air fuel mix
&PD18	&PD118	&PD218	Keep crop drying fan belts tight or replace
&PD19	&PD119	&PD219	Limit high temperature batch drying
&PD20	&PD120	&PD220	Water at night or when wind velocity is low
&PD21	&PD121	&PD221	Water less frequently as crop matures

SCREEN 36

COMMPRESSOR/HVAC/ELECTRIC/OTHER RECOMMENDATIONS (8 = Refused)
(9 = Don't Know)

RECOMMEND.	ADOPTED	EMS	
&PD22	&PD122	&PD222	Check combustion efficiency on boiler/furnace
&PD23	&PD123	&PD223	Clean condenser coils yearly on refrig/HVAC
&PD24	&PD124	&PD224	Clean fuel tanks/boiler and change fuel filter
&PD25	&PD125	&PD225	Ensure adequate ventilation for compressor
&PD26	&PD126	&PD226	Inspect motor sheaves for end-use equipment
&PD27	&PD127	&PD227	Repair all leaks in water/steam pipes
&PD28	&PD128	&PD228	Repair damaged areas of greenhouse
&PD29	&PD129	&PD229	Sched. maintenance program on electric equipment
&PD30	&PD130	&PD230	Service compressor yearly
&PD31	&PD131	&PD231	Use precooler/desuperheater
&PD32	&PD132	&PD232	Other &PD32OTR_____

SCREEN 37

PD013. Were you planning on making the energy saving changes before you had the pump test?
&PD013
1=Yes
0=No
8=(Refused)
9=(Don't Know)

SCREEN 38

**ASK NEXT SERIES IF DV007C,D,E,F, OR G = 1
ELSE SKIP TO PP001**

I'd now like to ask you some questions about your general energy use on this PG&E account:

AE001. Since January 1993, have you changed any other equipment that makes up at least 10% of your annual electric bill?
&AE001
1=Yes
0=No -->SKIP TO AE003
8=(Refused) -->SKIP TO AE003
9=(Don't Know) -->SKIP TO AE003

SCREEN 39

AE002. **IF AE001=1**
Which end uses did you change?
ENTER '1' FOR ALL THOSE THAT APPLY
AE002A &AE002A Lighting
AE002B &AE002B Refrigeration
AE002C &AE002C HVAC
AE002D &AE002D Ventilation
AE002E &AE002E Water Pumping
AE002F &AE002F Other SPECIFY: &AE002G_____
AE002Y &AE002Y (Refused)
AE002Z &AE002Z (Don't Know)

SCREEN 40

AE003. Since January 1993, have you added or removed any other equipment that has significantly affected your electric bill?
&AE003
1=Yes
0=No -->SKIP TO BC001
8=(Refused) -->SKIP TO BC001
9=(Don't Know) -->SKIP TO BC001

AE004. What equipment did you add?
&AE004A_____
&AE004B_____

AE005. What fuel does the new equipment use?
&AE005
1=Electricity
2=Natural gas
3=Other SPECIFY: &AE005A_____
8=(Refused)
9=(Don't Know)

SCREEN 41

ASK NEXT SERIES IF DV007C,D,E,F or G = 1 ELSE SKIP TO PP001

BC001. In what year was your facility built?
&BC001
8=(Refused)
9=(Don't Know)

BC002. How many square feet is the facility?
&BC002___
8=(Refused)
9=(Don't Know)

SCREEN 42

BC003. How many square feet are conditioned?
(i.e., heat or cooled)
&BC003___
8=(Refused)
9=(Don't Know)

BC004. How many stories is the facility?
&BC004
88=(Refused)
99=(Don't Know)

SCREEN 43

BC005. Since January 1993, has the square footage increased,
decreased or remained the same?
&BC005
1=Increased
2=Decreased
3=Remained the Same -->SKIP TO PP001
8=(Refused) -->SKIP TO PP001
9=(Don't Know) -->SKIP TO PP001

BC006. How many square feet were &DELTA_____ ?
&BC006___ 8 = (Refused)
9=(Don't Know)

BC007. When did this change occur?
BC007A &BC007A__ (MONYYYY)
BC007B &BC007B
8=(Refused)
9=(Don't Know)

SCREEN 44

*ASK NEXT SERIES IF MEASURE=PUMP RETROFIT/ADJUST/TESTED ELSE SKIP TO AD001**
The next few questions pertain to the pump that was
&CHANGED_____ under the Program.
PP001. Is this a well pump, surface water lift pump or a pressure
booster pump?
&PP001
1=Well pump
2=Surface water lift pump
3=Pressure booster pump
8=(Refused)
9=(Don't Know)
PP002. In what season is this pump generally used?
&PP002
0=Not Used --> SKIP FM001
1=Summer (May 1 - Oct 31)
2=Winter (Nov 1 - Apr 31)
3=Year Round
4=Varies/Depends on weather
8=(Refused) --> SKIP AD001
9=(Don't Know)--> SKIP AD001

SCREEN 45

PP0031. Does this pump directly service fields, or does it feed into a reservoir?
&PP0031
1 = Services Fields
2 = Feeds into a reservoir --> SKIP AD001
3 = Other SPECIFY: &PP0032_____
8 = (Refused)
9 = (Don't Know)

SCREEN 46

PP005. What crops were grown in the acreage served by this pump during 1993?
ENTER '1' FOR ALL THOSE THAT APPLY
DO NOT READ LIST (88 = Ref 99 = DK)

			WHEN START H2O	WHEN END H2O	# ACRES
PP500	&PP500	Alfalfa Hay	&PP600	&PP700	&PP800__ (8888=REF)
PP501	&PP501	Alfalfa Seed	&PP601	&PP701	&PP801__ (9999=DK)
PP502	&PP502	Almond	&PP602	&PP702	&PP802__
PP503	&PP503	Barley	&PP603	&PP703	&PP803__
PP504	&PP504	Beans	&PP604	&PP704	&PP804__
PP505	&PP505	Carrots	&PP605	&PP705	&PP805__
PP506	&PP506	Citrus	&PP606	&PP706	&PP806__
PP507	&PP507	Corn, Field/Sweet	&PP607	&PP707	&PP807__
PP508	&PP508	Corn, Silage	&PP608	&PP708	&PP808__
PP509	&PP509	Cotton	&PP609	&PP709	&PP809__
PP510	&PP510	Garlic	&PP610	&PP710	&PP810__
PP511	&PP511	Grapes	&PP611	&PP711	&PP811__
PP512	&PP512	Lettuce	&PP612	&PP712	&PP812__
PP513	&PP513	Melons	&PP613	&PP713	&PP813__
PP514	&PP514	Olives	&PP614	&PP714	&PP814__

CONTINUED ON NEXT SCREEN ENTER 1 TO SKIP THERE, ELSE 2 TO SKIP OUT --> &SKIP

SCREEN 47

(88 = Refused) (99 = Don't Know)

			WHEN START H2O	WHEN END H2O	# ACRES (8888 = REF)
PP515	&PP515	Onions/Fresh	&PP615	&PP715	&PP815__ (9999 = DK)
PP516	&PP516	Onions/Dehydrator	&PP616	&PP716	&PP816__
PP517	&PP517	Peppers	&PP617	&PP717	&PP817__
PP518	&PP518	Pistachios	&PP618	&PP718	&PP818__
PP519	&PP519	Pomegranate	&PP619	&PP719	&PP819__
PP520	&PP520	Rice	&PP620	&PP720	&PP820__
PP521	&PP521	Safflower	&PP621	&PP721	&PP821__
PP522	&PP522	Sugar Beets	&PP622	&PP722	&PP822__
PP523	&PP523	Tomato, Fresh	&PP623	&PP723	&PP823__
PP524	&PP524	Tomato/Processing	&PP624	&PP724	&PP824__
PP525	&PP525	Wheat	&PP625	&PP725	&PP825__
PP526	&PP526	Gen. Veg.	&PP626	&PP726	&PP826__

(ARTICHOKE, ASPARAGUS, BASIL, CABBAGE, CAULIFLOWER, CELERY, CUCUMBER)
(PEA, PEPPER, POTATO, PUMPKIN, RADISH, SPINACH, SQUASH, TURNIP)

PP527	&PP527	Other:	&PP627	&PP727	&PP827__

SPECIFY &PP528_____
TO MOVE FORWARD ENTER 1 --> &SKIP

SCREEN 48

PP008. Did this pump supply the primary or supplementary water source for these crops in 1993?
&PP008
1=Primary -->SKIP TO PP010
2=Supplementary
8=(Refused) -->SKIP TO PP010
9=(Don't Know) -->SKIP TO PP010

PP009. What percent of the water did this pump provide in 1993?
&PP009
888=(Refused)
999=(Don't Know)

SCREEN 49

PP010. Did you have any surface water supplies for these crops in 1993?
&PP010
1=Yes
0=No -->SKIP TO PP012
8=(Refused) -->SKIP TO PP012
9=(Don't Know)-->SKIP TO PP012

PP011. On average, what was the percent of surface water allocation/irrigation district water/ditch water during 1993?
&PP011
888=(Refused)
999=(Don't Know)

SCREEN 50

PP012. **IF PP002=1,3,4 ELSE SKIP TO PP013**
In the Summer of 1993 (May 1 - Oct 31), what was the approximate flowrate during the hours of 11 am - 12 noon?
CODE AMOUNT UNITS FOR VOLUME AND TIME
&PP012 --> SKIP PP012E
8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS		DURATION	(888 = Refused)
PP012A	PP012B	PP012C		PP012D	(999 = Don't Know)
&PP012A__	&PP012B per 1=Gallons 2=Acre-feet 3=Cubic-feet	&PP012C 1=Hour 2=Minute 3=Second	for	&PP012D	(IN MINUTES)

SCREEN 51

PP012E. Between 4 pm and 5 pm?
CODE AMOUNT UNITS FOR VOLUME AND TIME
&PP012RD -> SKIP PP013
8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION	(888 = Refused)
PP012E	PP012F	PP012G	PP012H	(999 = Don't Know)

&PP012E__ &PP012F per &PP012G for &PP012H (IN MINUTES)

1=Gallons	1=Hour
2=Acre-feet	2=Minute
3=Cubic-feet	3=Second

SCREEN 52

PP013. **IF PP002=2,3,4 ELSE SKIP TO PP014**
In the Winter of 1993? (Starting Nov 1), what was the approximate flowrate during the hours of 11 am - 12 noon?
CODE AMOUNT UNITS FOR VOLUME AND TIME
&PP013 --> SKIP PP013E
8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION	(888 = Refused)
PP013A	PP013B	PP013C	PP013D	(999 = Don't Know)

&PP013A &PP013B per &PP013C for &PP013D (IN MINUTES)

1=Gallons	1=Hour
2=Acre-feet	2=Minute
3=Cubic-feet	3=Second

SCREEN 53

PP013E. Between 4 pm and 5 pm?
CODE AMOUNT UNITS FOR VOLUME AND TIME
&PP013RD --> SKIP PP014
8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION	(888 = Refused)
PP013E	PP013F	PP013G	PP013H	(999 = Don't Know)

&PP013E__ &PP013F per &PP013G for &PP013H (IN MINUTES)

1=Gallons	1=Hour
2=Acre-feet	2=Minute
3=Cubic-feet	3=Second

SCREEN 54

PP014. What type of irrigation was used on these fields in 1993?
(CODE FOR PRIMARY TYPE)
&PP014
1 = Drip
2 = Furrow
3 = Sprinkler
4 = Flood
8 = (Refused)
9 = (Don't Know)

DO NOT READ:
PP014a. Did the customer mention any secondary irrigation types?
&PP014A
1 = Yes
0 = No --> SKIP PP015a
DO NOT READ:
What other irrigation do they use, how much, and how often?
&PP014B_____
&PP014C_____
&PP014D_____
ENTER 1 TO SKIP FORWARD --> &SKIP

SCREEN 55

Now let's move to the 1994 season.

Are the approximate flowrates and crop information for this pump the same during 1994, as they were during 1993?

&PP015A
1 = Same
2 = Different
8 = (Refused)
9 = (Don't know)

SCREEN 56

PP15. What crops were grown in the acreage served by this pump during 1994?
ENTER '1' FOR ALL THOSE THAT APPLY
DO NOT READ LIST (88 = Ref 99 = DK)

			WHEN START H2O	WHEN END H2O	# ACRES (8888=REF)
P1500	&P1500	Alfalfa Hay	&P1600	&P1700	&P1800__ (9999=DK)
P1501	&P1501	Alfalfa Seed	&P1601	&P1701	&P1801__
P1502	&P1502	Almond	&P1602	&P1702	&P1802__
P1503	&P1503	Barley	&P1603	&P1703	&P1803__
P1504	&P1504	Beans	&P1604	&P1704	&P1804__
P1505	&P1505	Carrots	&P1605	&P1705	&P1805__
P1506	&P1506	Citrus	&P1606	&P1706	&P1806__
P1507	&P1507	Corn, Field/Sweet	&P1607	&P1707	&P1807__
P1508	&P1508	Corn, Silage	&P1608	&P1708	&P1808__
P1509	&P1509	Cotton	&P1609	&P1709	&P1809__
P1510	&P1510	Garlic	&P1610	&P1710	&P1810__
P1511	&P1511	Grapes	&P1611	&P1711	&P1811__
P1512	&P1512	Lettuce	&P1612	&P1712	&P1812__
P1513	&P1513	Melons	&P1613	&P1713	&P1813__
P1514	&P1514	Olives	&P1614	&P1714	&P1814__

CONTINUED ON NEXT SCREEN ENTER 1, OR ENTER 2 TO SKIP OUT --> &SKIP

SCREEN 57

			(88 = Refused 99 = Don't Know) WHEN START H2O	WHEN END H2O	# ACRES (8888=REF) (9999=DK)
P1515	&P1515	Onions/Fresh	&P1615	&P1715	&P1815__
P1516	&P1516	Onions/Dehydrator	&P1616	&P1716	&P1816__
P1517	&P1517	Peppers	&P1617	&P1717	&P1817__
P1518	&P1518	Pistachios	&P1618	&P1718	&P1818__
P1519	&P1519	Pomegranate	&P1619	&P1719	&P1819__
P1520	&P1520	Rice	&P1620	&P1720	&P1820__
P1521	&P1521	Safflower	&P1621	&P1721	&P1821__
P1522	&P1522	Sugar Beets	&P1622	&P1722	&P1822__
P1523	&P1523	Tomato, Fresh	&P1623	&P1723	&P1823__
P1524	&P1524	Tomato/Processing	&P1624	&P1724	&P1824__
P1525	&P1525	Wheat	&P1625	&P1725	&P1825__
P1526	&P1526	Gen. Veg. (Asparagus, Broccoli, Squash, Artichoke)	&P1626	&P1726	&P1826__
P1527	&P1527	Other:	&P1627	&P1727	&P1827__
SPECIFY	&P1528_____				

TO SKIP FORWARD ENTER 1 --> &SKIP

SCREEN 58

PP020. Did this pump supply the primary or supplementary water source for these crops in 1994?
&PP020
1=Primary -->SKIP TO PP022
2=Supplementary
8=(Refused) -->SKIP TO PP022
9=(Don't Know) -->SKIP TO PP022

PP021. What percent of the water did this pump provide in 1994?
&PP021
888=(Refused)
999=(Don't Know)

SCREEN 59

PP022. Did you have any surface water supplies for these crops in 1994?
&PP022
1=Yes
0=No -->SKIP TO PP024
8=(Refused) -->SKIP TO PP024
9=(Don't Know)-->SKIP TO PP024

PP023. On average, what was the percent of surface water allocation/irrigation district water/ditch water during 1994?
&PP023
888=(Refused)
999=(Don't Know)

SCREEN 60

PP024. **IF PP002=1,3,4 ELSE SKIP TO PP025**
In the Summer of 1994 (May 1 - Oct 31), what was the approximate flowrate during the hours of 11 am - 12 noon?
CODE AMOUNT UNITS FOR VOLUME AND TIME
&PP024 --> SKIP pp024e
8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION (888 = Refused)
PP024A	PP024B	PP024C	PP024D (999 = Don't Know)

&PP024A__ &PP024B per &PP024C for &PP024D (IN MINUTES)

1=Gallons	1=Hour
2=Acre-feet	2=Minute
3=Cubic-feet	3=Second

SCREEN 61

PP024E. Between 4 pm - 5 pm?
CODE AMOUNT UNITS FOR VOLUME AND TIME
&PP024RD --> SKIP pp025
8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION (888 = Refused)
PP024E	PP024F	PP024G	PP024H (999 = Don't Know)

&PP024E &PP024F per &PP024G for &PP024H (IN MINUTES)

1=Gallons	1=Hour
2=Acre-feet	2=Minute
3=Cubic-feet	3=Second

SCREEN 62

PP025. **IF PP002=2,3,4 ELSE SKIP TO PP026**
In the Winter of 1994 (Nov 1 - Apr 30), what was the approximate flowrate during the hours of 11 am - 12 noon?
CODE AMOUNT UNITS FOR VOLUME AND TIME
&PP025 --> SKIP pp025e
8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION 888 = (Refused)
PP025A	PP025B	PP025C	PP025D 999 = (Don't Know)

&PP025A__ &PP025B per &PP025C for &PP025D (IN MINUTES)

1=Gallons	1=Hour
2=Acre-feet	2=Minute
3=Cubic-feet	3=Second

SCREEN 63

PP025E. Between 4 pm - 5 pm?
CODE AMOUNT UNITS FOR VOLUME AND TIME
&PP025RD --> SKIP pp026
8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION (888 = Refused)
PP025E	PP025F	PP025G	PP025H (999 = Don't Know)

&PP025E__ &PP025F per &PP025G for &PP025H (IN MINUTES)

	1=Gallons	1=Hour
	2=Acre-feet	2=Minute
	3=Cubic-feet	3=Second

SCREEN 64

PP026. What type of irrigation was used on these fields in 1994?
&PP026
1 = Drip 8 = (Refused)
2 = Furrow 9 = (Don't Know)
3 = Sprinkler
4 = Flood

DO NOT READ:
Did the customer mention any secondary irrigation types?
&PP026A
1 = Yes
0 = No --> SKIP MP001/MP004/AD001

DO NOT READ
What other irrigation systems do they use, how much, how often?
&PP026B_____
&PP026C_____
&PP026D_____

ENTER 1 TO SKIP FORWARD --> &SKIP

SCREEN 73

ASK IF MEASURE=RETROFIT/ADJUSTMENT OR EMS=1 AND PUMPNUM=1*
ELSE IF PUMPNUM>1 THEN SKIP MP004*
ELSE SKIP AD001

Our records show that you also have an additional pump that was involved in the
&PROGRAM_____ .

MP001. Does this pump service the same kind of crop as the pump we just discussed?
&MP001
1=Yes
0=No-->SKIP TO AD001
8=(Refused)-->SKIP TO AD001
9=(Don't Know)-->SKIP TO AD001

SCREEN 74

MP002. How many acres of crop are serviced by this other pump?
&MP002
8888=(Refused)
9999=(Don't Know)

MP003. Is this a well pump, surface water lift pump or pressure booster pump?
&MP003
1=Well pump
2=Surface water lift pump
3=Pressure booster pump
8=(Refused)
9=(Don't Know)

MP003A. When did you have the work done under the
&PROGRAM_____ on this pump?
&MP003A___ (MON/YYYY)
&MP003B (8 = Refused)
(9 = Don't Know)

SCREEN 75

IF &PUMPNUM>1

MP004. Our records show that you also have &PUMPNUM additional pumps that were involved in the
&PROGRAM_____ .

How many of these pumps service the same kind of crop as the pump we just discussed?
&MP004
888=(Refused)
999=(Don't Know)

SCREEN 76

MP005. **IF MP004>0 ELSE SKIP TO AD001**
Considering only the pumps that service that crop:

How many acres does each of these pumps service:
PUMP 1: &ADDACRE1_____
PUMP 2: &ADDACRE2_____
PUMP 3: &ADDACRE3_____

8888=(Refused)
9999=(Don't Know)

ENTER 1 TO SKIP FORWARD: ---> &SKIP

SCREEN 77

MP006. For each pump please indicate whether it is a well pump, surface water lift pump or a pressure booster pump:
PUMP 1: &ADDPUMP1____
PUMP 2: &ADDPUMP2____
PUMP 3: &ADDPUMP3____

1=Well pump
2=Surface water lift pump
3=Pressure booster pump
8=(Refused)
9=(Don't Know)

TO SKIP FORWARD ENTER 1 --> &SKIP

SCREEN 78

MP007. Please also indicate when you had the work done under the &PROGRAM_____ for each pump:
PUMP 1: &ADDDAT1_ (MONYYYY)
&ADDDAT1A (8 = Refused)
(9 = Don't Know)
PUMP 2: &ADDDAT2_ (MONYYYY)
&ADDDAT2A (8 = Refused)
(9 = Don't Know)
PUMP 3: &ADDDAT3_ (MONYYYY)
&ADDDAT3A (8 = Refused)
(9 = Don't Know)

ENTER 1 TO SKIP FORWARD --> &SKIP

SCREEN 65

PG&E is planning on-site visits of selected Agricultural customers. These visits provide additional data that is used to evaluate the savings achieved by the program.

AD001. May we contact you again in the next few weeks to discuss a possible visit to your facility?
&AD001 1 = Yes
0 = No
2 = Maybe
8 = (Refused)
9 = (Don't Know)

SCREEN 66

IF AD001=1 or 3
AD002. Would you be the best person to contact to schedule an on-site visit?
&AD002
1 = Yes -->SKIP TO AD004
0 = No
8 = (Refused) -->SKIP TO AD004
9 = (Don't Know) -->SKIP TO AD004

AD003. Who would be the best person to contact?

Contact Name: &ADCON_____
Address: &ADADD_____
Business Name: &ADNAME_____
Phone Number (&AD1) &AD2 - &AD3_ , EX. &AD4_

-->SKIP TO FM001 ENTER 1 --> &SKIP

SCREEN 67

AD004. For the purposes of contacting you in the future, let me verify the following information:

Am I speaking with: &OSCONT_____
And your business name is: &OSBUSNAM_____
And your telephone number is: (&OSAC) &OSPRE - &OSLAST : &OSEXT
And my database shows your address as being:
Address: &OSADDR_____
City: &OSCITY_____

Is this information correct?
&AD004
1 = Yes -->SKIP TO FM001
0 = No
8 = (Refused) -->SKIP TO FM001
9 = (Don't Know) -->SKIP TO FM001

SCREEN 68 Last updated: 08/11/95

IF NOT CORRECT FILL IN ALL INFO:

Correct Contact Name: &OSCONT_____
Correct Address: &OSADDR_____
Correct Business Name: &OSBUSNAM_____
Correct Phone Number (&OSAC) &OSPRE - &OSLAST

ENTER 1 TO SKIP FORWARD --> &SKIP

SCREEN 69

Do you have any additional comments at this time?
&COMM 1 = Yes 0 = No
&NOTE1_____
&NOTE2_____
&NOTE3_____
&NOTE4_____
&NOTE5_____
Those are all the questions I have for today. On behalf of Pacific Gas and Electric, thank you very much for your time and cooperation.

PSC010. Did respondent request a PG&E contact number?
&PSC010 1 = Yes 0 = No
Cite reason contact number requested:
&PSC011_____
&PSC012_____
&PSC013_____

SCREEN 79

Our records show that you had &TOT_CORP locations participate in PG&E's &PROGRAM_____
We would like to collect information about as many of your locations as possible. I would first like to ask you about the location at
&ADDRESS_____
&CITY_____
which covers the account number &ACCOUNT_____ .

Are there additional people who I could contact to ask questions about details of your &NUM other sites?
&OTHRCONT 1 = Yes --> SKIP ADDITIONAL CONTACTS
0 = No
8 = (Refused)
9 = (Don't Know)

SCREEN 83

MS CONTACT 1
Name: &MSNAME1_____
Phone: (&MSAC1) &MSPR1 - &MSLST1
CATI_ID: &MSCAT1__

MS CONTACT 2:
Name: &MSNAME2_____
Phone: (&MSAC2) &MSPR2 - &MSLST2
CATI_ID: &MSCAT2__

MS CONTACT 3:
Name: &MSNAME3_____
Phone: (&MSAC3) &MSPR3 - &MSLST3
CATI_ID: &MSCAT3__

MS CONTACT 4:
Name: &MSNAME4_____
Phone: (&MSAC4) &MSPR4 - &MSLST4
CATI_ID: &MSCAT4__

Appendix E

FINAL NONPARTICIPANTS TELEPHONE SURVEY

SCREEN 1

```
&S1_____________   &S2_____________   QC: &QC__      Screen: &S_
Name: &NAME_____________________ MS: &MS CUSTID: &QCCU Obs#: &OBC  OF  &TOT
Latest Interviewer: &LI  Interviewer 1: &I1  Date: &IDATE1_ Time 1: &TIM1
PG&E Agr. NonPart        Interviewer 2: &I2  Date: &IDATE2_ Time 2: &TIM2
P725184                  Interviewer 3: &I3  Date: &IDATE3_ Time 3: &TIM3
CATI_ID: &CATI_ID_       Interviewer 4: &I4  Date: &IDATE4_ Time 4: &TIM4
Account: &ACCOUNT_____   Interviewer 5: &I5  Date: &IDATE5_ Time 5: &TIM5
                         Interviewer 6: &I6  Date: &IDATE6_ Time 6: &TIM6
Business: &BUSINESS_____________________  Bus Phone:  ( &HA ) &HP - &HL_
Address: &ADDRESS_______________________  Corr Ph:    ( &CA ) &CP - &CL_
City: &CITY_____________________ Zip: &ZIP_     Contact: &CONTACT_________
Callback Date: &CBD____  Callback Time: &CBT_____________
Comment: &COMMENT1_____________________________________________________
         &COMMENT2_____________________________________________________
Result1: &RESULT1________ Res2: &RESULT2_________ Res3: &RESULT3________
Result4: &RESULT4________ Res5: &RESULT5_________ Res6: &RESULT6________
 1=Complete      6=Refusal             11=Wrong Number   16=No Phone or Zero
 2=Partial       7=Answering Machine   12=Moved          17=T&T Part.
 3=Call Back     8=Busy Signal         13=Fax or Modem   18=Other
 4=No Answer     9=Not Elig for Int    14=Language       19=Business
 5=On Vacation  10=Disconnected No.    15=No Dir. Lst    20=Other T&T
```

SCREEN 2

```
Name: &NAME_____________________  Screen: &S_    Last: &P_  QC: &QC__
CONTACT NAME: &CONTAT_____________________________________________

 Hello this is &LI__ calling from Quantum Consulting, on behalf of
 PG&E.  Pacific Gas and Electric is conducting a telephone survey
 of agricultural customers.  Do you have 10 minutes to answer
 some questions?
 (**IF CUSTOMER ASKS QUESTIONS ABOUT SURVEY OR PROGRAM, GO TO SCREEN 3**)
 SHFT TAB AND ENTER CORRECTED CONTACT IF NEEDED:
 NEW CONTACT: &CONTACT_____________________________________________

 SR001.   Before we start, I would like to inform you that for
          quality control purposes, this call may be monitored by
          my supervisor.  Would this be OK with you?
          &SR001
          1=Yes
          0=No
          8=(Refused)
          9=(Don't Know)
IF THIS IS A MULTI-SITE OBS F5 TO SCREEN 79 AND READ INTRO: &MS
```

SCREEN 3

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

READ IF NECESSARY
This survey will provide data to evaluate the impact and success of PG&E's 1994 Agricultural Retrofit Program. In addition to surveying those customers who DID participate, information from customers who DID NOT participate is very valuable in measuring the success of these programs.

ENTER 1 TO GO BACK TO SCREEN 2 --> &SKIP

SCREEN 5

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

DV002. Would you be the best person to answer questions about pumps and other equipment at your place of business?

&DV002
1=Yes --> SKIP TO DV002A
0=No
8=(Refused)
9=(Don't Know)

SCREEN 6

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

DV003. **IF DV002=0**
Who would be the best person to talk to?

Contact Name &CONTACT_____
New Phone (&DA) &DP - &D3L EXT. &DV3EXT

TO SKIP TO THANK AND TERMINATE ENTER 1: --> &SKIP
ELSE ENTER 2 IF NEW CONTACT AVAILABLE NOW

SCREEN 7

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

DV002A. According to our records, the pump covered under
&ACCOUNT_____ did not have any work done under PG&E's
Agricultural Retrofit Express Program or
PG&E's Pump Test Program in 1994

IF CUSTOMER UNSURE WHICH PUMP THEN READ
This account is located at:
&SVADDR95_____
&SVCITY95_____

Is this correct?

&DV002A

1=Yes
0=No -->THANK AND TERMINATE
8=(Refused) -->THANK AND TERMINATE
9=(Don't Know) -->THANK AND TERMINATE

SCREEN 11

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

This survey will be about pumps and other equipment covered under
that same account. (&ACCOUNT_____)

DV007B. How many pumps does this account cover?
&DV007B --> IF 0, THEN T and T
88 = (Refused)
99 = (Don't Know)

DV007. What other equipment is covered under this account?
ENTER 1 FOR ALL THOSE THAT APPLY
DV007K &DV007K None --> SKIP TO DV008
DV007C &DV007C Lighting
DV007D &DV007D Refrigeration
DV007E &DV007E HVAC
DV007F &DV007F Ventilation
DV007G &DV007G Other SPECIFY: &DV007H_____
DV007I &DV007I (Refused)
DV007J &DV007J (Don't Know)
ALWAYS ENTER 1 --> &SKIP

SCREEN 12

```
Name: &NAME_____________________ Screen: &S_ Audit: &A Last: &P_ QC: &QC__
 DV008.  Since 1993, have you installed any of the following
         energy-saving equipment?

         **ENTER '1' FOR ALL THOSE THAT APPLY**
 PUMPS/WATER
         DV008C &DV008C  Well-Water Measurement Device
         DV008D &DV008D  Low-Pressure Impact Sprinkler Nozzle
 GREENHOUSE
         DV008F &DV008F  Rigid Double-Walled Plastic (Greenhouse)
         DV008G &DV008G  Double-Walled Polyethylene (Greenhouse)
         DV008H &DV008H  Heat Curtain (Greenhouse)
 TIMECLOCK
         DV008I &DV008I  Time Clock with Battery Back-up
 MILK
         DV008A &DV008A  Refrigeration Desuperheater
         DV008B &DV008B  Milk Pre-Cooler

         DV008W &DV008W  Refused
         DV008X &DV008X  Don't Know
                ALWAYS ENTER 1 --> &SKIP
```

SCREEN 13

```
Name: &NAME_____________________ Screen: &S_ Audit: &A Last: &P_ QC: &QC__
DV080.   When did you have this energy saving equipment installed?
         DV080   &DV080__ (MONYYYY)  - OR -
         DV081   &DV081__ (ENTER YEAR YYYY IF RESPONDENT DOESN'T KNOW
                           MONTH, OR REF/DK)
         8=(Refused)
         9=(Don't Know)

 DV008J. Since 1993, have you had your pump retrofitted or
         adjusted?
         (ENTER 1 FOR ALL THAT APPLY)
         DV008J   &DV008J  Yes, Pump retrofit
         PD133    &PD133_  Yes, Adjust the impeller relative to
                           the bowl assembly
         PD134    &PD134_  Yes, Adjust the bowl assembly
         PD135    &PD135_  Yes, Replace the impeller and/or bowl
         DV008K   &DV008K  Yes, Pump adjustment (Other)
         DV008L   &DV008L  No
         DV008Y   &DV008Y  (Refused)
         DV008Z   &DV008Z  (Don't Know)
                           ALWAYS ENTER 1 --> &SKIP
```

SCREEN 10

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

IF DV008J, PD133, PD134, PD135, OR DV008K=1

DV082. When did you have your pump adjusted or retrofitted?

DV082A &DV082A_ (MONYYYY)
- OR -
DV082B &DV082B_ (ENTER YEAR YYYY IF RESPONDENT DOESN'T KNOW MONTH, OR REF/DK)

8 = (Refused)
9 = (Don't Know)

SCREEN 14

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

DV013. Since 1993, has your pump been tested?
&DV013
1=Yes
0=No --> SKIP TO FS001
8=(Refused) --> SKIP TO FS001
9=(Don't Know) --> SKIP TO FS001
IF YES: When? &DV013A_ (MONYYYY)
- OR -
&DV013B (ENTER YEAR YYYY IF RESPONDENT DOESN'T KNOW MONTH, OR REF/DK)
8=(Refused)
9=(Don't Know)

DV014. Was the pump test part of PG&E's Pump Test program?
&DV014
1=Yes -->SKIP TO FS002
0=No (IF YES, AND DV013A/B IS IN 1994, THEN T AND T)
8=(Refused)
9=(Don't Know)

SCREEN 18

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

FS001. Have you heard of PG&E's Pump Test Program?

&FS001
1=Yes
0=No -->SKIP TO DV015
8=(Refused) -->SKIP TO DV015
9=(Don't Know) -->SKIP TO DV015

SCREEN 19

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

FS002. How did you first LEARN about PG&E's Pump Test Program?
DO NOT READ

&FS002
CUSTOMER APPROACHED SOMEONE:
1=Respondent approached vendor/contractor
2=Respondent approached PG&E concerning another matter and found out about program
SOMEONE APPROACHED THE CUSTOMER:
3=Contacted by PG&E account rep
4=Contacted by contractor
5=PG&E Brochure in mail
6=Bill Insert
7=Word of mouth
8=Television, Radio, Newspaper ad
10=Family tradition/recommendation
9=Other SPECIFY: &FS002B_____
88=(Refused)
99=(Don't Know)

SCREEN 16

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

IF FS001=1

FS002A. WHEN did you become aware of PG&E's Pump Test Program?

&FS002A

READ CHOICES
1 = Before you had your pump tested
2 = At the same time you had your pump tested
3 = After you had your pump tested
8 = (Refused)
9 = (Don't Know)

SCREEN 23

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__
IF AWARE OF THE PUMP TEST PROGRAM
IF FS001=1

FS005. Why did you choose NOT to participate in PG&E's Pump Test Program in 1994?

ENTER 1 FOR ALL THAT APPLY*

FS005A &FS005A Did not use the pump in 1994
FS005B &FS005B The pump worked fine
FS005C &FS005C Had someone else test the pump
FS005D &FS005D Other &FS005E_____
FS005F &FS005F (Refused)
FS005G &FS005G (Don't Know)

ALWAYS ENTER 1 --> &SKIP

SCREEN 15

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

DV015. Are you planning on having any work done on your pump?

&DV015
1 = Yes
0 = No --> SKIP TO FS003
8 = (Refused) --> SKIP TO FS003
9 = (Don't Know) --> SKIP TO FS003

DV016. Are you planning to have this work done under the PG&E's Retrofit Express Program?

&DV016
1 = Yes --> SKIP TO FS004
0 = No
8 = (Refused)
9 = (Don't Know)

SCREEN 20

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

FS003. Have you heard of PG&E's Retrofit Express Agricultural program?

&FS003
1=Yes
0=No --> SKIP TO AE001
8=(Refused) --> SKIP TO AE001
9=(Don't Know)--> SKIP TO AE001

SCREEN 21

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

FS004. How did you first LEARN about the Retrofit Express program?
DO NOT READ
&FS004
CUSTOMER APPROACHED SOMEONE:
1=Respondent approached vendor/contractor
2=Respondent approached PG&E concerning another matter and found out about program
SOMEONE APPROACHED THE CUSTOMER:
3=Contacted by PG&E account rep
4=Contacted by contractor
5=PG&E Brochure in mail
6=Bill Insert
7=Word of mouth
8=Television, Radio, Newspaper ad
9=From the PG&E pump tester
10=Family Tradition/Recommendation
11=Other SPECIFY: &FS004B_____
88=(Refused)
99=(Don't Know)

SCREEN 17

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

IF FS003=1

FS004A. When did you become aware of PG&E's Retrofit Express Agricultural Program?

&FS004A

READ CHOICES
1 = Before you decided to have work done on your pump
2 = At the same time you decided to have work done on your pump
3 = After you decided to have work done on your pump
8 = (Refused)
9 = (Don't Know)

SCREEN 25

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

IF AWARE OF THE RETROFIT EXPRESS PROGRAM
IF FS003=1

FS006. Why did you choose NOT to participate in PG&E's Retrofit Express Program in 1994?

&FS006
1 = Too much paperwork
2 = Didn't want to do any inspections
3 = Needed to take action immediately
4 = Rebate wasn't worth the extra effort
5 = Other SPECIFY: &FS006A_____
6 = Didn't need at this time
8=(Refused)
9=(Don't Know)

SCREEN 40

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

I'd now like to ask you some questions about your general energy use on this PG&E account:

AE033. Since January 1993, have you added or removed any equipment that has significantly affected your electric bill?

&AE033

1=Yes, Added Equipment-->SKIP TO AE004
2=Yes, Removed Equipment
3=Yes, BOTH added AND removed
0=No --> SKIP TO PP001
8=(Refused) --> SKIP TO PP001
9=(Don't Know) --> SKIP TO PP001

SCREEN 38

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__
 AE033A.  What equipment did you remove?
          **ENTER '1' FOR ALL THOSE THAT APPLY**

          AE033A  &AE033A  Lighting
          AE033B  &AE033B  Refrigeration
          AE033C  &AE033C  HVAC
          AE033I  &AE033I  Ventilation
          AE033H  &AE033H  Water Pumping
          AE033F  &AE033F  Other SPECIFY: &AE033G_____________________
          AE033Y  &AE033Y  (Refused)
          AE033Z  &AE033Z  (Don't Know)

          When did you remove this equipment?
          AE003D  &AE033D_  (MONYYYY)
          Or, if Refused or Don't Know:
          &AE033E
          8=(Refused)
          9=(Don't Know)

          ALWAYS ENTER 1 --> &SKIP
```

SCREEN 39

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__

 AE004.  What equipment did you add?
         **ENTER '1' FOR ALL THOSE THAT APPLY**

         AE004A  &AE004A  Lighting
         AE004B  &AE004B  Refrigeration
         AE004H  &AE004H  HVAC
         AE004I  &AE004I  Ventilation
         AE004E  &AE004E  Water Pumping
         AE004F  &AE004F  Other SPECIFY: &AE004G_____________________
         AE004Y  &AE004Y  (Refused)
         AE004Z  &AE004Z  (Don't Know)

        When did you add this equipment?
        AE004C  &AE004C_ (MONYYYY)
        Or, if Refused or Don't Know: &AE004D
        8=(Refused)
        9=(Don't Know)

         ALWAYS ENTER 1 --> &SKIP
```

SCREEN 37

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

AE005. What fuel does the new equipment use?

&AE005
1=Electricity
2=Natural Gas
3=Other SPECIFY: &AE005A_____
4=Diesel
8=(Refused)
9=(Don't Know)

SCREEN 44

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__
The next few questions pertain to the pump that is covered by this account. (&ACCOUNT_____)

PP001. Is this a well pump, surface water lift pump or a pressure booster pump?
&PP001
1=Well pump
2=Surface water lift pump
3=Pressure booster pump
8=(Refused)
9=(Don't Know)

PP002. In what season is this pump generally used?
&PP002
0=Not Used --> SKIP TO SCREEN 69 FOR ADDT'L COMMENTS
1=Summer (May 1 - Oct 31)
2=Winter (Nov 1 - Apr 31)
3=Year Round
4=Varies/Depends on weather
8=(Refused) --> SKIP TO SCREEN 69 FOR ADDT'L COMMENTS
9=(Don't Know) --> SKIP TO SCREEN 69 FOR ADDT'L COMMENTS

SCREEN 45

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP0031. Does this pump directly service fields, or does it feed into a reservoir?
&PP0031
1 = Services Fields
2 = Feeds into a reservoir --> SKIP TO SCR 69 FOR COMMENTS
3 = Other SPECIFY: &PP0032_____
8 = (Refused)
9 = (Don't Know)

SCREEN 46

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP005. What crops were grown in the acreage served by this pump during 1993?
ENTER '1' FOR ALL THOSE THAT APPLY
DO NOT READ LIST (88 = Ref 99 = DK)

			WHEN START H2O	WHEN END H2O	# ACRES
PP500	&PP500	Alfalfa Hay	&PP600	&PP700	&PP800__ (8888=REF)
PP501	&PP501	Alfalfa Seed	&PP601	&PP701	&PP801__ (9999=DK)
PP502	&PP502	Almond	&PP602	&PP702	&PP802__
PP503	&PP503	Barley	&PP603	&PP703	&PP803__
PP504	&PP504	Beans	&PP604	&PP704	&PP804__
PP505	&PP505	Carrots	&PP605	&PP705	&PP805__
PP506	&PP506	Citrus	&PP606	&PP706	&PP806__
PP507	&PP507	Corn, Field/Sweet	&PP607	&PP707	&PP807__
PP508	&PP508	Corn, Silage	&PP608	&PP708	&PP808__
PP509	&PP509	Cotton	&PP609	&PP709	&PP809__
PP510	&PP510	Garlic	&PP610	&PP710	&PP810__
PP511	&PP511	Grapes	&PP611	&PP711	&PP811__
PP512	&PP512	Lettuce	&PP612	&PP712	&PP812__
PP513	&PP513	Melons	&PP613	&PP713	&PP813__
PP514	&PP514	Olives	&PP614	&PP714	&PP814__

CONTINUED ON NEXT SCREEN ENTER 1 TO SKIP THERE, ELSE 2 TO SKIP OUT --> &SKIP

SCREEN 47

```
Name: &NAME_____________________ Screen: &S_ Audit: &A Last: &P_ QC: &QC__
                        (88 = Refused)  (99 = Don't Know)
                       WHEN START H2O   WHEN END H2O   # ACRES  (8888 = REF)
 PP515 &PP515 Onions/Fresh      &PP615      &PP715      &PP815__ (9999 = DK)
 PP516 &PP516 Onions/Dehydrator &PP616      &PP716      &PP816__
 PP517 &PP517 Peppers           &PP617      &PP717      &PP817__
 PP518 &PP518 Pistachios        &PP618      &PP718      &PP818__
 PP519 &PP519 Pomegranate       &PP619      &PP719      &PP819__
 PP520 &PP520 Rice              &PP620      &PP720      &PP820__
 PP521 &PP521 Safflower         &PP621      &PP721      &PP821__
 PP522 &PP522 Sugar Beets       &PP622      &PP722      &PP822__
 PP523 &PP523 Tomato, Fresh     &PP623      &PP723      &PP823__
 PP524 &PP524 Tomato/Processing &PP624      &PP724      &PP824__
 PP525 &PP525 Wheat             &PP625      &PP725      &PP825__
 PP526 &PP526 Gen. Veg.         &PP626      &PP726      &PP826__
 (ARTICHOKE, ASPARAGUS, BASIL, CABBAGE, CAULIFLOWER, CELERY, CUCUMBER)
 (PEA, PEPPER, POTATO, PUMPKIN, RADISH, SPINACH, SQUASH, TURNIP)
 PP527 &PP527 Other:            &PP627      &PP727      &PP827__
 SPECIFY &PP528_____________________________________________________

  TO MOVE FORWARD ENTER 1 --> &SKIP
```

SCREEN 48

```
Name: &NAME_____________________ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

 PP008.  Did this pump supply the primary or supplementary water
         source for these crops in 1993?
         &PP008
         1=Primary -->SKIP TO PP010
         2=Supplementary
         8=(Refused) -->SKIP TO PP010
         9=(Don't Know) -->SKIP TO PP010


 PP009.  What percent of the water did this pump provide in 1993?
         &PP009
         888=(Refused)
         999=(Don't Know)
```

SCREEN 49

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP010. Did you have any surface water supplies for these crops in 1993?
&PP010
1=Yes
0=No -->SKIP TO PP012
8=(Refused) -->SKIP TO PP012
9=(Don't Know)-->SKIP TO PP012

PP011. On average, what was the percent of surface water allocation (irrigation district water/ditch water) during 1993?
&PP011
888=(Refused)
999=(Don't Know)

SCREEN 50

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP012. **IF PP002=1,3,4 ELSE SKIP TO PP013**
In the Summer of 1993 (May 1, '93 - Oct 31, '93), what was the approximate flowrate during the hours of 11 am - 12 noon?
CODE AMOUNT UNITS FOR VOLUME AND TIME

&PP012 --> SKIP TO PP012E
0= Not On 8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION	(888 = Refused)
PP012A	PP012B	PP012C	PP012D	(999 = Don't Know)

&PP012A__ &PP012B per &PP012C for &PP012D (IN MINUTES)

1=Gallons	1=Hour
2=Acre-feet	2=Minute
3=Cubic-feet	3=Second

SCREEN 51

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP012E. Between 4 pm and 5 pm?
CODE AMOUNT UNITS FOR VOLUME AND TIME

&PP012RD -> SKIP TO PP013
0= Not On 8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION	(888 = Refused)
PP012E	PP012F	PP012G	PP012H	(999 = Don't Know)

&PP012E__ &PP012F per &PP012G for &PP012H (IN MINUTES)

1=Gallons	1=Hour
2=Acre-feet	2=Minute
3=Cubic-feet	3=Second

SCREEN 41

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP012I. There are about 22 weekdays per month. How many weekdays per month did you irrigate in the summer of 1993?

&PP012I_ (Enter # of weekdays)
88=Refused
99=Don't Know

SCREEN 52

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP013. **IF PP002=2,3,4 ELSE SKIP TO PP014**
In the Winter of 1993? (Nov 1, '93 - Apr 31, '94), what was the approximate flowrate during the hours of 11 am - 12 noon?
CODE AMOUNT UNITS FOR VOLUME AND TIME

&PP013 --> SKIP TO PP013E
0=Not On 8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION	(888 = Refused)
PP013A	PP013B	PP013C	PP013D	(999 = Don't Know)

&PP013A &PP013B per &PP013C for &PP013D (IN MINUTES)

1=Gallons	1=Hour
2=Acre-feet	2=Minute
3=Cubic-feet	3=Second

SCREEN 53

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP013E. Between 4 pm and 5 pm?
CODE AMOUNT UNITS FOR VOLUME AND TIME
&PP013RD --> SKIP PP014
0=Not On 8=(Refused) 9=(Don't Know)

AMOUNT	UNITS	TIME UNITS	DURATION	(888 = Refused)
PP013E	PP013F	PP013G	PP013H	(999 = Don't Know)

&PP013E__ &PP013F per &PP013G for &PP013H (IN MINUTES)
1=Gallons 1=Hour
2=Acre-feet 2=Minute
3=Cubic-feet 3=Second

SCREEN 42

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP013I. There are about 22 weekdays per month. How many weekdays per month did you irrigate in the winter of 1993?

&PP013I_ (Enter # of Days)
88=Refused
99=Don't Know

SCREEN 54

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP014. What type of irrigation was used on these fields in 1993?
(CODE FOR PRIMARY TYPE)
&PP014
1 = Drip 8 = (Refused)
2 = Furrow 9 = (Don't Know)
3 = Sprinkler
4 = Flood

DO NOT READ:
PP014a. Did the customer mention any secondary irrigation types?
&PP014A
1 = Yes
0 = No --> SKIP PP015A
DO NOT READ:
What other irrigation do they use, how much, and how often?
&PP014B_____
&PP014C_____
&PP014D_____
ENTER 1 TO SKIP FORWARD --> &SKIP

SCREEN 55

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

Now let's move to the 1994 season.

Are the approximate flowrates and crop information for this pump the same during 1994, as they were during 1993?

&PP015A
1 = Same
0 = Different
8 = (Refused)
9 = (Don't know)

SCREEN 56

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP15. What crops were grown in the acreage served by this pump during 1994?
ENTER '1' FOR ALL THOSE THAT APPLY
DO NOT READ LIST (88 = Ref 99 = DK)

			WHEN START H2O	WHEN END H2O	# ACRES (8888=REF)
P1500	&P1500	Alfalfa Hay	&P1600	&P1700	&P1800__ (9999=DK)
P1501	&P1501	Alfalfa Seed	&P1601	&P1701	&P1801__
P1502	&P1502	Almond	&P1602	&P1702	&P1802__
P1503	&P1503	Barley	&P1603	&P1703	&P1803__
P1504	&P1504	Beans	&P1604	&P1704	&P1804__
P1505	&P1505	Carrots	&P1605	&P1705	&P1805__
P1506	&P1506	Citrus	&P1606	&P1706	&P1806__
P1507	&P1507	Corn, Field/Sweet	&P1607	&P1707	&P1807__
P1508	&P1508	Corn, Silage	&P1608	&P1708	&P1808__
P1509	&P1509	Cotton	&P1609	&P1709	&P1809__
P1510	&P1510	Garlic	&P1610	&P1710	&P1810__
P1511	&P1511	Grapes	&P1611	&P1711	&P1811__
P1512	&P1512	Lettuce	&P1612	&P1712	&P1812__
P1513	&P1513	Melons	&P1613	&P1713	&P1813__
P1514	&P1514	Olives	&P1614	&P1714	&P1814__

CONTINUED ON NEXT SCREEN ENTER 1, OR ENTER 2 TO SKIP OUT --> &SKIP

SCREEN 57

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

(88 = Refused 99 = Don't Know)

			WHEN START H2O	WHEN END H2O	# ACRES (8888=REF) (9999=DK)
P1515	&P1515	Onions/Fresh	&P1615	&P1715	&P1815__
P1516	&P1516	Onions/Dehydrator	&P1616	&P1716	&P1816__
P1517	&P1517	Peppers	&P1617	&P1717	&P1817__
P1518	&P1518	Pistachios	&P1618	&P1718	&P1818__
P1519	&P1519	Pomegranate	&P1619	&P1719	&P1819__
P1520	&P1520	Rice	&P1620	&P1720	&P1820__
P1521	&P1521	Safflower	&P1621	&P1721	&P1821__
P1522	&P1522	Sugar Beets	&P1622	&P1722	&P1822__
P1523	&P1523	Tomato, Fresh	&P1623	&P1723	&P1823__
P1524	&P1524	Tomato/Processing	&P1624	&P1724	&P1824__
P1525	&P1525	Wheat	&P1625	&P1725	&P1825__
P1526	&P1526	Gen. Veg. (Asparagus, Broccoli, Squash, Artichoke)	&P1626	&P1726	&P1826__
P1527	&P1527	Other:	&P1627	&P1727	&P1827__

SPECIFY &P1528_____

TO SKIP FORWARD ENTER 1 --> &SKIP

SCREEN 58

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP020. Did this pump supply the primary or supplementary water source for these crops in 1994?
&PP020
1=Primary -->SKIP TO PP022
2=Supplementary
8=(Refused) -->SKIP TO PP022
9=(Don't Know) -->SKIP TO PP022

PP021. What percent of the water did this pump provide in 1994?
&PP021
888=(Refused)
999=(Don't Know)

SCREEN 59

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP022. Did you have any surface water supplies for these crops in 1994?
&PP022
1=Yes
0=No -->SKIP TO PP024
8=(Refused) -->SKIP TO PP024
9=(Don't Know)-->SKIP TO PP024

PP023. On average, what was the percent of surface water allocation (irrigation district water/ditch water) during 1994?
&PP023
888=(Refused)
999=(Don't Know)

SCREEN 60

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP024. **IF PP002=1,3,4 ELSE SKIP TO PP025**
In the Summer of 1994 (May 1, '93 - Oct 31, '93), what was the approximate flowrate during the hours of 11 am - 12 noon?
CODE AMOUNT UNITS FOR VOLUME AND TIME

&PP024 --> SKIP TO PP024E
0=Not On 8=(Refused) 9=(Don't Know)

AMOUNT	UNITS		TIME UNITS		DURATION (888 = Refused)
PP024A	PP024B		PP024C		PP024D (999 = Don't Know)
&PP024A__	&PP024B	per	&PP024C	for	&PP024D (IN MINUTES)
	1=Gallons		1=Hour		
	2=Acre-feet		2=Minute		
	3=Cubic-feet		3=Second		

SCREEN 61

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__

 PP024E. Between 4 pm - 5 pm?
         **CODE AMOUNT UNITS FOR VOLUME AND TIME**

         &PP024RD  --> SKIP TO PP025
         0=Not On   8=(Refused) 9=(Don't Know)

    AMOUNT   UNITS          TIME UNITS        DURATION  (888 = Refused)
    PP024E   PP024F         PP024G            PP024H    (999 = Don't Know)

    &PP024E  &PP024F  per  &PP024G      for  &PP024H  (IN MINUTES)
             1=Gallons     1=Hour
             2=Acre-feet   2=Minute
             3=Cubic-feet  3=Second
```

SCREEN 65

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__

 PP024I.  How many weekdays per month did you water in the
          summer of 1994?

         &PP024I_  (Enter Number of Days)
                    88=Refused
                    99=Don't Know

         ENTER 1 TO GO TO NEXT SCREEN --> &SKIP
```

SCREEN 62

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__

 PP025.  **IF PP002=2,3,4 ELSE SKIP TO PP026**
         In the Winter of 1994 (Nov 1, '93 - Apr 31, '94), what was the
         approximate flowrate during the hours of 11 am - 12 noon?
         **CODE AMOUNT UNITS FOR VOLUME AND TIME**

         &PP025   --> SKIP TO PP025E
         0=Not On  8=(Refused) 9=(Don't Know)

    AMOUNT   UNITS          TIME UNITS        DURATION   888 = (Refused)
    PP025A   PP025B         PP025C            PP025D     999 = (Don't Know)

  &PP025A__  &PP025B   per &PP025C       for &PP025D (IN MINUTES)
             1=Gallons     1=Hour
             2=Acre-feet   2=Minute
             3=Cubic-feet  3=Second
```

SCREEN 63

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__

 PP025E. Between 4 pm - 5 pm?
         **CODE AMOUNT UNITS FOR VOLUME AND TIME**

         &PP025RD --> SKIP TO PP026
         0=Not On  8=(Refused) 9=(Don't Know)

    AMOUNT   UNITS          TIME UNITS         DURATION (888 = Refused)
    PP025E   PP025F         PP025G             PP025H   (999 = Don't Know)

  &PP025E__  &PP025F   per &PP025G       for &PP025H (IN MINUTES)
             1=Gallons     1=Hour
             2=Acre-feet   2=Minute
             3=Cubic-feet  3=Second
```

SCREEN 66

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP025I.  How many weekdays
         per month did you irrigate in the winter of 1994?

         &PP025I_ (Enter # of Days)
                  88=Refused
                  99=Don't Know


         ENTER 1 TO GO TO NEXT SCREEN --> &SKIP
```

SCREEN 64

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

PP026. What type of irrigation was used on these fields in 1994?
&PP026
1 = Drip
2 = Furrow
3 = Sprinkler
4 = Flood
8 = (Refused)
9 = (Don't Know)

DO NOT READ:
Did the customer mention any secondary irrigation types?
&PP026A
1 = Yes
0 = No

DO NOT READ
What other irrigation systems do they use, how much, how often?
&PP026B_____
&PP026C_____
&PP026D_____

ENTER 1 TO SKIP FORWARD --> &SKIP

SCREEN 73

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__
IF CUSTOMER HAS MULTIPLE ACCOUNTS AT THIS PREMISE

MP004A. Our survey sample also includes additional accounts for you at this same premise.
These accounts are:

	(CODE)
Account &ACCT2_____	=1
Account &ACCT3_____	=2
Account &ACCT4_____	=3

Which of these accounts cover pumps that service the same kind of crop as we just discussed?
ENTER 1 FOR THOSE THAT APPLY

	(CODE)
&MP004A	1
&MP004B	2
&MP004C	3
&MP004D	8=Refused -->SKIP TO SCREEN 69
&MP004E	9=Don't Know -->SKIP TO SCREEN 69

ENTER 1 TO GO TO NEXT SCREEN--> &SKIP

SCREEN 74

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

IF MP004A=1, MP004B=1, MP004C=1 ELSE SKIP TO SCREEN 69

MP005A. Considering only the pumps that service that crop:

How many acres does each of these pumps service:

PUMP 1: &ADDACRE1
PUMP 2: &ADDACRE2
PUMP 3: &ADDACRE3

8888=Refused
9999=Don't Know

ENTER 1 TO SKIP FORWARD: --> &SKIP

SCREEN 75

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__

MP006A. For each pump please indicate whether it is a well pump, surface water lift pump, or a pressure booster pump:

PUMP 1: &ADDPUMP1
PUMP 2: &ADDPUMP2
PUMP 3: &ADDPUMP3

1=Well Pump
2=Surface water lift pump
3=Pressure booster pump
8=Refused
9=Don't Know

TO SKIP FORWARD ENTER 1 --> &SKIP

SCREEN 69

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__
 Those are all the questions I have for you today.
 Do you have any additional comments at this time?
    &COMM  1 = Yes     0 = No
 ***DO NOT READ, ENTER 1 FOR THOSE THAT APPLY**
 &NOTE1 Dislikes demand charge
 &NOTE2 Considering switching to diesel
 &NOTE3 Wants more information on programs
 &NOTE4 Other: &NOTE4A_____________________________________________
               &NOTE4B_____________________________________________
 On behalf of PG&E, thank you very much for your time and cooperation.
     PSC010.  Did respondent request a PG&E contact number?
              &PSC010    1 = Yes     0 = No
     Cite reason contact number requested:
     &PSC011_____________________________________________________
     &PSC012_____________________________________________________
 PSC014.  Did respondent want additional follow-up for a problem?
        &PSC014   (1=Yes 0=No)
     Problem: &PSC014A_____________________________________________
 ENTER 1 TO GO TO SCREEN 1 TO CODE RESULT,
 OR ENTER 2 TO GO TO INTERVIEWER COMMENT SCREEN--> &SKIP
```

SCREEN 76

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__

INTERVIEWER COMMENTS:

&INTCOMM1_____________________________________________________________
&INTCOMM2_____________________________________________________________
&INTCOMM3_____________________________________________________________
&INTCOMM4_____________________________________________________________
&INTCOMM5_____________________________________________________________
&INTCOMM6_____________________________________________________________

 <<F4 TO SCREEN 1 AND CODE RESULT>>
```

SCREEN 72

Name: &NAME_____ Screen: &S_ Audit: &A Last: &P_ QC: &QC__
THANK AND TERMINATE:

FOR PARTICIPANTS
At present, we are only surveying customers who have NOT participated in one of PG&E's Agricultural programs. Since you have participated in on of these programs, we have no further questions for you at this time. On behalf of PG&E, I'd like to thank you very much for your time and cooperation today.

FOR THOSE WITH NO PUMPS ON THEIR ACCOUNT
At present, we are only surveying customers who have at least one pump per account. Since this account does not have a pump, we have no questions for you at this time. On behalf of PG&E, Id like to thank you very much for your time and cooperation today.

FOR ALL OTHERS
Those are all the questions I have for you at this time.
On behalf of PG&E thank you very much for your time and cooperation today.
<< F4 TO FIRST SCREEN AND CODE RESULT >>

SCREEN 79

Name: &NAME_____. Screen: &S_ Audit: &A Last: &P_ QC: &QC__

Our records show that you have &TOT_CORP sites in our sample.
We would like to collect information about as many of your locations as possible. I would first like to ask you about the location at
&ADDRESS_____
&CITY_____
which covers the account number &ACCOUNT_____ .

Are there additional people who I could contact to ask questions about details of your &NUM other sites?

&OTHRCONT 1 = Yes --> SKIP TO ADDITIONAL CONTACTS (SCREEN 83)
0 = No --> GO TO SCREEN 5
8 = (Refused)
9 = (Don't Know)

SCREEN 82

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__

MULTI-SITE NOTES SCREEN:

ENTER ANY NOTES ON THE MULTI-SITE GROUP FOR THIS OBSERVATION

&FMSNOTE1_____________________________________________________________
&FMSNOTE2_____________________________________________________________
&FMSNOTE3_____________________________________________________________
&FMSNOTE4_____________________________________________________________
&FMSNOTE5_____________________________________________________________
&FMSNOTE6_____________________________________________________________
&FMSNOTE7_____________________________________________________________
&FMSNOTE8_____________________________________________________________
&FMSNOTE9_____________________________________________________________

<F4> TO FIRST SCREEN AND CODE RESULT
```

SCREEN 83

```
Name: &NAME_____________________  Screen: &S_ Audit: &A Last: &P_ QC: &QC__
MS CONTACT 1
   Name:   &MSNAME1_____________________________________________
   Phone: ( &MSAC1 ) &MSPR1 - &MSLST1
   CATI_ID:  &MSCAT1__

MS CONTACT 2:
   Name:   &MSNAME2_____________________________________________
   Phone: ( &MSAC2 ) &MSPR2 - &MSLST2
   CATI_ID:  &MSCAT2__

MS CONTACT 3:
   Name:   &MSNAME3_____________________________________________
   Phone: ( &MSAC3 ) &MSPR3 - &MSLST3
   CATI_ID:  &MSCAT3__

MS CONTACT 4:
   Name:   &MSNAME4_____________________________________________
   Phone: ( &MSAC4 ) &MSPR4 - &MSLST4
   CATI_ID:  &MSCAT4__
ENTER 1 TO SKIP FORWARD ---> &SKIP
```

Appendix F

FINAL PARTICIPANTS ON-SITE INSTRUMENT

On-Site Audit ID: _____
Data Class: _____
1= Good
2= Marginal
3= Bail Out
4= Refused
5= Can't Contact
6= Duplicate

Customer Name: _____
Customer Business Name: _____
Customer Address: _____
_____
Customer Phone: _____

PG&E Account Number: _____ Verified?__
New Acount Number: _____ (1=Yes,2=No)

PG&E Meter Number: _____ Verified?__
New PG&E Meter Number: _____ (1=Yes,2=No)

Location/Directions (major cross streets):

_____
_____

_____
_____

Type of Measure (1=Yes, 2=No):

Y/N	Meas #	Measure Name
___	1	Pump Adjustment (Rebate Express)
___	2	Repair (Rebate Express)
___	3	Greenhouse Retrofit (CI)
___	4	Low Pressure Sprinkler Nozzle Conversion (CI)
___	5	Irrigation System Conversion (CI)

Location (For Office Use):

Township: _____ Range: _____ Section: _____ Quarter: _____

This on-site survey conducted by: _____ On: _____

Note: Verify PG&E Control Number and Account Number from copy of customer's bill.

On-Site Audit ID: _____

REBATE EXPRESS -- PUMP ADJUSTMENT / REPAIR AUDIT

1. This pump is used as a (1-Deepwell, 2=Booster, 3= Lift, 4=Other)? ____
   If other what? _____

2. What type of pump is this (1=Turbine, 2=Centrifugal, 3=Other)? ____
   If other what? _____

3. Was this pump worked on in 1994 (1=Yes, 2=No)? . . . . . ____

4. If Yes, when was the work done (Month/Year)? . . . . . ____/____

5. What work was done?. . . . . ____
   (1=Adjusted Bolls, 2=Pump Rebuilt/Replaced, 3=Only Bolls Replaced)

6. Was the well worked on at the same time (1=Yes, 2=No)? . . . . . ____

7. Is there more than one meter on this account (1=Yes, 2=No)?. . . . ____

8. If Yes, what are the other meter numbers and uses?
   Meter No _____ Use _____

   Meter No _____ Use _____
   [If other meters on this account, then TERMINATE Audit]

9. Are there other loads on this meter (1=Yes, 2=No)? . . . . . ____

10. If yes, what are the other loads?

Horsepower	Description
_____	_____
_____	_____

    [If other loads on this meter are non-ag & of significant size, then TERMINATE audit]

11. Was this pump retested after the repairs were made (1=Yes, 2=No)? ____

12. If Yes, when was it retested? ___/___ and what was the plant Eff? ____%

13. Did The pumping water level change 1993 to 1994 (1=Yes, 2=No)? ____

14. If yes, by how much (+/- feet). . . . . ____

15. Is the water from this well commingled with other wells (1=Yes,2=No)?__

On-Site Audit ID: _____

{PRIVATE }16. Data For 1994:	FOR 1994		
Crop Acreage Served By This Pump:			
Crop Name			
Acres			
Plant Date (Mo/Yr)			
Harvest Date (Mo/Yr)			
Water Sources:			
This Pump was a: 1 = Supplementary, 2 = Primary, or 3 = Only?	1 2 3	1 2 3	1 2 3
Any Other Water Supplies for Crops Served by this Pump?	Yes No (1) (2)	Yes No (1) (2)	Yes No (1) (2)
If yes, what portion was "Other"?	%	%	%
Irrigation System:			
Type (1=Flood, 2=Spkr, 3=Low Vol)	1 2 3	1 2 3	1 2 3
These crops pre-irrigated when?	/	/	/
Do you have records of amounts of water applied to each crop?	Yes No (1) (2)	Yes No (1) (2)	Yes No (1) (2)
If Yes, inches per field were?	In	In	In
Well Water Salinity:			
Do you know your water salinity?	Yes (1) No (2)		
Known or est. water salinity is	ECw = _____ dS/m		
During summertime (May 1-Oct 31), what portion of weekdays (Mon-Fri) was this pump run between:			
11 - Noon	%	%	%
4 - 5 pm	%	%	%
Office Use Items:			
Crop ETc Estimate	In	In	In
Irrigation Efficiency Estimate	%	%	%
Applied Water After Repair (%)	%	%	%
Source For ECw	1-Customer	2=Measured	3=Estimate
Leaching Requirement Est	%	%	%

On-Site Audit ID: _____

{PRIVATE }17. Data For 1993:	FOR 1993		
Crop Acreage Served By This Pump:			
Crop Name			
Acres			
Plant Date (Mo/Yr)			
Harvest Date (Mo/Yr)			
Water Sources:			
This Pump was a: 1 = Supplementary, 2 = Primary, or 3 = Only?	1 2 3	1 2 3	1 2 3
Any Other Water Supplies for Crops Served by this Pump?	Yes (1) No (2)	Yes (1) No (2)	Yes (1) No (2)
If yes, what portion was "Other"?	%	%	%
Irrigation System:			
Type (1=Flood, 2=Spkr, 3=Low Vol)	1 2 3	1 2 3	1 2 3
These crops pre-irrigated when?	/	/	/
Do you have records of amounts of water applied to each crop?	Yes (1) No (2)	Yes (1) No (2)	Yes (1) No (2)
If Yes, inches per field were?	In	In	In
Well Water Salinity:			
Do you know your water salinity?	Yes (1)	No (2)	
Known or est. water salinity is	ECw = _____	dS/m	
During summertime (May 1-Oct 31), what portion of weekdays (Mon-Fri) was this pump run between:			
11 - Noon	%	%	%
4 - 5 pm	%	%	%
Office Use Items:			
Crop ETc Estimate	In	In	In
Irrigation Efficiency Estimate	%	%	%
Source For ECw	1-Customer	2=Measured	3=Estimate
Leaching Requirement Est	%	%	%

On-Site Audit ID: _____

18. Notes for questions 1 to 15: _____

_____

_____

_____

_____

_____

19. Notes for 1994 season: _____

_____

_____

_____

_____

_____

20. Notes for 1993 season: _____

_____

_____

_____

_____

_____

On-Site Audit ID: _____

LOW PRESSURE SPRINKLER NOZZLE CONVERSION AUDIT

1. The Low Pressure nozzles were placed in a system which is a:

   1 = Permanently Installation System
   2 = Hand Moved System Type = ____

2. The sprinkler brand and model are:

   Sprinkler Brand: _____

   Sprinkler Model: _____

3. The replacement nozzle manufacturer and size are:

   Nozzle Manufacturer: _____

   Nozzle Size: _____

4. The total number of nozzles/sprinklers in this system is: ____

5. When were the existing High Pressure nozzles replaced with Low Pressure nozzles were (month/year) . . . . . ___/___

6. If this is a permanent installation what is the location of the field:

   _____

   _____

On-Site Audit ID: _____

GREENHOUSE RETROFIT AUDIT

General Information:

1. When was retrofit done (month/year)? ___/___
2. How many peaks are in the nursery operation? _____
3. How many peaks were retrofited? _____
4. Number of square feet in total peak retrofit? Area = _____ ft^2

Construction Information:

5. What type of retrofit to the peaks was this:
   - 1 = Rigid Double Walled Plastic
   - 2 = Double Walled Polyethylene
   - 3 = Heat Curtain
   - 4 = Other _____ Type peak is:____
6. What are the walls composed of:

Portion	Composition (use code list)
_____ %	_____ _____
_____ %	_____
_____ %	_____

(If glass, include number of panes, size of panes, type of frame -- metal aluminum, wood.)

7. What is the wall framing: 1 = Wood studs on _____" centers
   2 = Metal studs on _____" centers
   3 = Metal tubes on _____" centers
8. What is the roof composed of (use code list):

_____ %	_____
_____ %	_____

9. The greenhouse floor is:
   - 1 = Concrete slab floor
   - 2 = Dirt floor
   - 3 = Raised wood floor
   - 4 = Other _____ Floor is: ____

Heating Information:

10. Months when heating at night: _____

On-Site Audit ID: _____

GREENHOUSE RETROFIT AUDIT

11. Heating Thermostat Setpoints:

Hour		to	Hour	Thermostat Setpoint
_____	a-p		_____ a-p	_____
_____	a-p		_____ a-p	_____
_____	a-p		_____ a-p	_____

HVAC Information:

12. Number of heater(s) in each peak? ____

13. Percent of heaters on at one time ____%

14. Heater equipment in one peak:

Heater Number (Zone)	1	2	3
Heater Manufacturer	_____	_____	_____
Heater Model	_____	_____	_____
Heater Capacity	_____ BTU	_____ BTU	_____ BTU
Approx Age of Heater	_____ yrs	_____ yrs	_____ yrs

Ventilation Information:

15. How are peaks ventilated? ____

N = natural convection with open windows
F = fans
AC= air conditioned

16. When are peaks ventilated?

	Hour		to	Hour	Thermostat Setpoint (if AC)	
Summer:	_____	a-p		_____ a-p	_____	Months: _____
Winter:	_____	a-p		_____ a-p	_____	Months: _____

17. Location of greenhouse (use street address or other exact designation:

_____

_____

_____

18. Sketches of peak floor plan and front view (pages 3 and 4).

P G & E Evaluation of the 1994 Agricultural Program

On-Site Audit ID: _____

IRRIGATION SYSTEM CONVERSION

1. This irrigation system conversion was:

   1 = From "furrow" to "sprinklers"

   2 = From "furrow" to "low volume" (drip or micro sprinklers)

   3 = From "sprinklers" to "low volume"

   4 = Other: _____ Conversion was: ____

2. Is new irrigation system:

   1 = Permanent

   2 = Movable ____

3. If conversion to sprinkers, brand and model was:

   Sprinkler Brand: _____

   Sprinkler Model: _____

4. If conversion to low volume, brand and model was:

   Emitter / Micro Sprinkler Brand: _____

   Emitter / Micro Sprinkler Model: _____

5. The total number of sprinklers/emitters in this system is: ____

6. When was this irrigation system converstion completed

   (month/year) . . . . . ___/___

7. What is the location of the field:

   _____

   _____

   _____

Crop Care Services, Inc.

Appendix I

COSTING TABLE

Exhibit I-1
Gross Demand and Energy Savings by Costing Period for the Agricultural Program

	RE/CI Program				*EMS Program*			
PG&E Cost Period	**Program kW Savings Coin. with System Max in Period**	**kW H-Factor**	**kWh Savings**	**kWh H-Factor**	**Program kW Savings Coin. with System Max in Period**	**kW H-Factor**	**kWh Savings**	**kWh H-Factor**
Summer On-Peak: **May 1 to Oct. 31** **12:00 - 6:00 PM Weekdays**	12,072	1.00	9,478	0.13	5,314	1.00	2,844	0.13
Summer Partial Peak: **May 1 to Oct. 31** **8:30 AM - 12:00 PM 6:00 PM - 9:30 PM** **Weekdays**	14,124	1.17	11,286	0.16	6,217	1.17	3,387	0.16
Summer Off-Peak: **May to Oct. 31** **Other**	13,158	1.09	30,097	0.42	5,792	1.09	9,032	0.42
Winter Partial Peak: **Nov. 1 to April 31** **8:30 AM - 9:30 PM Weekdays**	9,778	0.81	8,899	0.12	4,304	0.81	2,671	0.12
Winter Off-Peak: **Nov. 1 to April 31** **9:30 PM - 8:30 AM Other**	9,537	0.79	12,589	0.17	4,198	0.79	3,778	0.17

Appendix J

ENGINEERING REVIEW OF EX ANTE ESTIMATES

Appendix J

ENGINEERING REVIEW OF EX ANTE ESTIMATES

This appendix has the three ex ante engineering reviews. The Custom Rebates review is followed by the Energy Management Services Review and finally the Retrofit Express Review.

1994 Custom Installations Review

February 27, 1996

To: Mary Dimit, PG&E

From: Mary Sutter

Re: Assessment of AG Custom Rebates

Attached are the assessment forms filled out for the AG Custom Rebate sites. In general, the ex-ante assumptions and algorithms were good. The biggest problem was moving from nameplate data of a motor to the connected load for some of the non-pump measures. Our recommendations to alleviate this problem include: 1) using the motor efficiency when changing from horsepower to kW 2) using an appropriate operating factor for peak demand savings 3) using an appropriate operating factor for kWh savings when using the kW multiplied by the hours of operation to obtain kWh savings.

These 'problem' measures represented 4.4% of the ex-ante energy impact and 4.7% of the demand impact for the Custom Program. To put this into a different perspective, the 1994 Custom Program is 17.7% of the avoided costs. While motor efficiency and operating factor should be taken into account for future ex-ante algorithms, their inclusion into the current Custom retrofits would make little difference in the overall ex-ante impact estimates due to the compounding effect of a small change of savings for the small percent that these measures represent

For pumping measures, this was not an issue, as the kW value had the efficiency of the motor already taken into account by a pump test.

Our two other recommendations are in conjunction with the water system changes technology. We could not assess the assumptions on 3 of these sites due to incomplete documentation. For example, the pre-retrofit assumptions indicated at one site that the

values would provide inadequate watering for the crop. We could not ascertain if other water was available to supplement the pre-retrofit assumptions. We recommend that a line item be added under the technical review to assure plausibility of the existing and proposed systems as presented.

Our last recommendation is to resolve all discrepancies between the available invoices and how the pumps are used in the technical analysis. One case appeared to have slipped through the PG&E review process where the grower bought four pumps, yet the estimated kW was for less than four pumps. It was unclear whether the other pump(s) would be used during peak hours. This particular site also showed the inadequate watering of the crop, so this site may have been less stringently reviewed than other Custom sites.

MS:ms

cc: TOC

Pacific Gas and Electric Agricultural Program - Custom Rebate Assessment
AG - Water system changes

RECOMMENDATION:	For future technical reviews, adequate paperwork should be provided to assess assumptions and discrepancies between invoiced pumps and estimated kW should be resolved.
TECHNOLOGY DESCRIPTION:	Changes in the irrigation system to increase energy efficiency
NUMBER OF SITES REVIEWED:	17
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	Custom
EX-ANTE ASSUMPTION:	NA
ASSESSMENT OF ASSUMPTION:	Certain assumptions could not be accurately assessed due to lack of explanatory data (i.e. unable to determine some pump information for 3 of reviewed sites)
EX-ANTE IMPACT ALGORITHM:	NA
ASSESSMENT OF ALGORITHM:	Algorithms used in determination of energy and demand savings were reviewed and deemed appropriate.

Pacific Gas and Electric Agricultural Program - Custom Rebate Assessment
AG - Pumps

RECOMMENDATION:	None
TECHNOLOGY DESCRIPTION:	Change out of multiple motors to one motor.
NUMBER OF SITES REVIEWED:	3
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	Custom
EX-ANTE ASSUMPTION:	NA
ASSESSMENT OF ASSUMPTION:	Assumptions used in the determination of energy and demand savings were reviewed and deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	NA
ASSESSMENT OF ALGORITHM:	Algorithms used in the determination of energy and demand savings were reviewed and deemed appropriate.

RECOMMENDATION:
TECHNOLOGY DESCRIPTION:
NUMBER OF SITES REVIEWED:
CRITERIA FOR 1994 PROGRAM PARTICIPATION:
EX-ANTE ASSUMPTION:
ASSESSMENT OF ASSUMPTION:
EX-ANTE IMPACT ALGORITHM:
ASSESSMENT OF ALGORITHM:

The appropriate motor efficiency to convert hP to kW should be used. Operating factor should be used in determination of peak savings.
High Efficiency Milk Chiller
1
Custom
Chiller is at full load at all times.
Chiller will cycle on and off, affecting kWh and peak kW; chiller motor has efficiency which should be applied to determine kW
kW = hP * .745 ; kWh = kW * Annual Operating Hrs
HP should be converted to kW with appropriate efficiency applied. The kW needs the operating factor for peak kW. The chiller motor may run at part load efficiency as there may be a 10% - 20% safety factor built into the sizing of the chiller.

Pacific Gas and Electric Agricultural Program - Custom Rebate Assessment
AG - Motor

RECOMMENDATION:	None
TECHNOLOGY DESCRIPTION:	Energy Efficient Air Compressor Motor Retrofit
NUMBER OF SITES REVIEWED:	1
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	Custom
EX-ANTE ASSUMPTION:	NA
ASSESSMENT OF ASSUMPTION:	Assumptions used in the determination of energy and demand savings were reviewed and deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	NA
ASSESSMENT OF ALGORITHM:	Algorithms used in determination of energy and demand savings were reviewed and deemed appropriate.

Pacific Gas and Electric Agricultural Program - Custom Rebate Assessment
AG - Other

RECOMMENDATION:	None
TECHNOLOGY DESCRIPTION:	Well Enhancements
NUMBER OF SITES REVIEWED:	3
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	Custom
EX-ANTE ASSUMPTION:	NA
ASSESSMENT OF ASSUMPTION:	Assumptions used in the determination of energy and demand savings were reviewed and deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	NA
ASSESSMENT OF ALGORITHM:	Algorithms used in the determination of energy and demand savings were reviewed and deemed appropriate.

Pacific Gas and Electric Agricultural Program - Custom Rebate Assessment
AG - Process Heat Recovery

RECOMMENDATION:	None
TECHNOLOGY DESCRIPTION:	Heat Recovery Used for Process Drying
NUMBER OF SITES REVIEWED:	1
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	Custom
EX-ANTE ASSUMPTION:	NA
ASSESSMENT OF ASSUMPTION:	Assumptions used in the determination of energy and demand savings were reviewed and deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	NA
ASSESSMENT OF ALGORITHM:	Algorithms used in the determination of energy and demand savings were reviewed and deemed appropriate.

Pacific Gas and Electric Agricultural Program - Custom Rebate Assessment
AG - Refrigeration EMS

RECOMMENDATION:	None
TECHNOLOGY DESCRIPTION:	Implement or Upgrade an Energy Management System
NUMBER OF SITES REVIEWED:	3
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	NA
EX-ANTE ASSUMPTION:	NA
ASSESSMENT OF ASSUMPTION:	Assumptions used in the determination of energy and demand savings were reviewed and deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	NA
ASSESSMENT OF ALGORITHM:	Algorithms used in the determination of energy and demand savings were reviewed and deemed appropriate.

Pacific Gas and Electric Agricultural Program - Custom Rebate Assessment
AG - Refrigeration Change, Add

RECOMMENDATION:	The appropriate motor efficiency to convert hP to kW should be used. The appropriate operating factors should be used in determination of peak savings and kWh savings.
TECHNOLOGY DESCRIPTION:	Change Refrigeration Chiller
NUMBER OF SITES REVIEWED:	1
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	NA
EX-ANTE ASSUMPTION:	Nameplate hP is equivalent to kW; refrigeration compressors will be at full load at all times for both pre and post retrofit
ASSESSMENT OF ASSUMPTION:	kW is a function of efficiency of the motor; refrigeration compressors will cycle on and off, affecting kWh and peak kW
EX-ANTE IMPACT ALGORITHM:	kW = BHP * 0.7457 ; kWh = kW * annual hours of operation
ASSESSMENT OF ALGORITHM:	BHP should be converted to kW with appropriate motor efficiency applied. kW needs the appropriate operating factor to determine peak kW. Average operating factor should be used for kWh.

1994 Agricultural Energy Management Services Impact Review

Recommendations:

1) Clarify and document the % of people who performed pump measures outside the RE program.

2) Clarify and document the kW savings per audit.

3) Clarify and document the % of savings per pump measure.

4) Apply the kWh/year value based just on pumping measure values. Possibly add a constant to account for kWh/year savings due to other applied measures.

5) Clarify and document the NTG ratio.

Program Description: The PG&E Energy Management Services (EMS) program offers a range of information and evaluation services to help commercial, industrial and agricultural customers manage their energy consumption.

Criteria for 1994 Program Participation: Be a commercial, industrial or agricultural customer within PG&E territory.

Ex-Ante Assumption:

1) Result of EMS billing regression can be applied to pump billing information.

2) Billing regression analysis will supply a percent saved value for customers who did and did not implement EMS suggestions.

Assessment of Assumptions:

1) EMS suggestions did not always revolve around the pumps (i.e. set time clocks for security lighting was done by 68% of the on-site audits), yet the regression value was applied only to pump usage.

2) The regression was performed with temperature as an independent variable. There was no ability to take crop type into account. However, if the crop rotations were static between the years within the analysis, this would not be a factor.

Ex-Ante Impact Algorithm:

kWh Savings = Number of Audits * 2,452 kWh / year

kW Savings = Number of Audits * 0.69 kW

kWh / year = # of Pumps Tested * % Who did Measures * Mean HP * kWh / HP * % Saved * NTG Ratio

Where:

# of pumps tested = sum of 1990 through 1992 pump test database

% Who did Measures = 16.0% from unknown source

Mean HP = Mean from pump test database

kWh/HP = Mean kWh / HP from pump test database

% Saved = 11.8% from Regression Analysis in Reference 1

NTG Ratio = 0.54 from Reference 1

Assessment of Impact Algorithm:

1) kWh / year algorithm as presented is appropriate.

2) The % who did measures value should be tracked down for clarity or updated from this years analysis. Using values from Reference 1, this value appears to have been 16.8%, not 16.0%.

3) Nothing was written in Reference 1 about how the kW savings value was determined. No assessment of this value can be done.

References:

1) Impact Evaluation of 1990-1992 Nonresidential Energy Management Services Programs, PG&E Report Number CEQ-93-A01, December, 1993.

1994 Agricultural Retrofit Express Review

ITEM:	Pump Retrofit
RECOMMENDATION:	1) Update the OPE ratio to correspond to the 1993-94 pump test values. This will decrease the OPE ratios for the medium (0.21 to 0.14) and high (0.19 to 0.11) horsepower bins. 2) Thoroughly document and substantiate the CDF value of 0.53.
TECHNOLOGY DESCRIPTION:	The retrofit of the impeller/bowl assembly of a low efficiency pump, and the proper placement of the pump relative to the well water level during reinstallation, will reduce the energy required to deliver a unit (acre-foot) of water. PG&E offers rebates for retrofits of 5-400 horsepower pumps.
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	The project must include a retrofit of the impeller and bowls. The rebate will not exceed 50% of the project cost. New motors or motor rewinds will not be included in the project cost. A pump test may be required in certain situations. The retrofit must be performed by a licensed, qualified pump contractor.
EX-ANTE ASSUMPTION:	1) The pre-repair overall plant efficiency (OPE) is an average, for three pump horsepower categories, of historical repair data. 2) The post-repair OPE is a conservative estimate of the increased efficiency. The post OPE is also binned to three horsepower categories. 3) The coincident diversity factor (CDF) is 0.53. 4) The previous 12 months of energy use will predict the next years energy use.
ASSESSMENT OF ASSUMPTION:	1 & 2) Based on the PG&E 1993/94 pump test database, the binning into three bins only drops 1.1% of the pump tests. This is appropriate. The average pre-repair and estimated post-repair OPE for the bins from the 93-94

<table>
<tr><td>ITEM:</td><td>Pump Retrofit
pump test database are:

<table>
<tr><th>Bin Category</th><th>Pre-Retrofit OPE</th><th>Post-Retrofit Estimated OPE</th></tr>
<tr><td>5-15 HP</td><td>43.75</td><td>58.22</td></tr>
<tr><td>20-75 HP</td><td>54.75</td><td>63.31</td></tr>
<tr><td>100-400 HP</td><td>60.78</td><td>68.02</td></tr>
</table>

3) This value could not be substantiated from the references and should be explored more thoroughly to determine if this is the correct value.

4) Because of changes to crop irrigation requirements based on variation in crops and weather, the previous 12 months of use may not be representative of the next years use. An average of more than one year of use is recommended.</td></tr>
<tr><td>EX-ANTE IMPACT ALGORITHM:</td><td>kWh Savings = OPE Ratio * Annual kWh
kW Savings = HP * 0.746 * CDF * OPE Ratio

Where the OPE ratio and HP is a function of the horsepower bins. The bins are:

<table>
<tr><th>Bin Category</th><th>OPE Ratio</th><th>HP used for kW savings</th></tr>
<tr><td>5-15 HP</td><td>1-(42/52.3) =0.20</td><td>10.33</td></tr>
<tr><td>20-75 HP</td><td>1-(46.7/59) =0.21</td><td>44.16</td></tr>
<tr><td>100-400 HP</td><td>1-(51.4/63.7) =0.19</td><td>156.27</td></tr>
</table>

The coincident diversity factor (CDF) used was 0.53.</td></tr>
<tr><td>ASSESSMENT OF ALGORITHM:</td><td>kWh savings algorithm reviewed and deemed appropriate.

kW savings algorithm reviewed and deemed appropriate.</td></tr>
<tr><td>EXPECTED LIFE SERVICE:</td><td>9 years. (Reference 1)</td></tr>
</table>

ITEM:	**Pump Retrofit**
INCREMENTAL COST:	Varied based on size of pump. (Reference 1) For sample calculations only, the average cost of 1994 applications in the MDSS were: 5-15 hp = $3,445 20-75 hp = $6,719 100-400 hp = $13,709 The average cost this technology for the 1994 participants from the MDSS was $8,490.
REBATE:	For sample calculations only, the average rebate of 1994 applications in the MDSS were: 5-15 hp = $201 20-75 hp = $1,079 100-400 hp = $3,745 The average rebate for this technology for the 1994 participants from the MDSS was $1,812. 806 items were rebated in 1994.
REFERENCES:	1) PG&E 1994 Agricultural Retrofit Express Program, Ex-Ante Estimates, Program Technical Developers: Pete Canessa, P.E., Sam Cohen, Barakat & Chamberlin, Inc. and Steve Schiller, Schiller Associates.

ITEM:	**Pump Adjustment**
RECOMMENDATION:	1) Further assess the percent of savings from this measure. 2) Recommend that the approach used to determine the savings from the measure be similar to the pump retrofit with the kWh savings tied to the specific pump. 3) Further assess the demand portion of this measure.
TECHNOLOGY DESCRIPTION:	An adjustment of the position of the impeller relative to the bowl assembly will increase efficiency and lower the energy required to pump a unit of water. Proper pump adjustment will minimize the contact between the impeller and bowl while maximizing the quantity of water pumped.
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	Only for vertical turbine pumps with semi-open impellers. Voltage, running amps, and impeller adjustment must be checked, and the adjustment must be performed, by a licensed pump contractor.
EX-ANTE ASSUMPTION:	1) The average annual energy use from agricultural pumping accounts in PG&E's service area for 1990 was 125,910 kWh/year (PG&E 1991) 2) The proportion of energy saved from pump adjustment is 0.113, based on a statistical model (Reference 1). A conservative percentage of 11% is used in the calculation. 3) There are no demand savings claimed for this technology.
ASSESSMENT OF ASSUMPTION:	1) The average energy use from the 1993-1994 PG&E Pump dataset is 120,156 kWh/year. This value is no better or worse than the 1991 average. The original estimate of 125,910 kWh/year-pump is appropriate if implemented as an average value. 2) This value could not be assessed based upon the data available as the original source of this value is 8 years old and could not be located. However, an 11% savings is

	half the ex-ante pump retrofit savings and equal to the recommended savings from the pump retrofit of a large pump. This is not logical and should be assessed further. 3) If there is an improved efficiency, there will be a demand component to the savings. This value, although small for this measure, will be summed over the many adjustments performed under the program. Future analysis should be performed to determine the actual efficiency change due to a pump adjustment.
EX-ANTE IMPACT ALGORITHM:	kWh/yr savings pump = 11% * 125,910 kWh = 13,850 kWh/year - pump
ASSESSMENT OF ALGORITHM:	The algorithm is deemed appropriate. However, if the kWh/year value was based on the pumps previous year of use, as in the pump retrofit estimate, the estimated savings would be more closely related to actual savings.
EXPECTED LIFE SERVICE:	3 years.
INCREMENTAL COST:	The average paid project cost from the MDSS for this item was $46.
REBATE:	The average rebate for this technology for the 1994 participants from the MDSS was $36. 1362 items were rebated in 1994.
REFERENCES:	1) PG&E 1994 Agricultural Retrofit Express Program, Ex-Ante Estimates, Program Technical Developers: Pete Canessa, P.E., Sam Cohen, Barakat & Chamberlin, Inc. and Steve Schiller, Schiller Associates.

ITEM:	**Low Pressure Impact Sprinkler Nozzle**
RECOMMENDATION:	1) Update kWh/Nozzle estimate to 22.8 kWh/nozzle. 2) Update kW/Nozzle estimate to 0.011 kW/nozzle. 3) Thoroughly document and substantiate the CDF value of 0.53.
TECHNOLOGY DESCRIPTION:	Low pressure sprinkler nozzles, when used to replace high pressure nozzles, will results in a lower discharge pressure at the pump, and a consequent reduction in energy input per unit (acre foot) of water applied. Although a pump change can accompany this measure, it is not necessary for energy savings. The acres irrigated can be increased, thereby decreasing the kWh/acre or the flow from the nozzles can be increased, thereby saving kWh by irrigating the same acreage in less time.
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	This technology is restricted to a one-to-one replacement of high pressure nozzles by low pressure nozzles. The PG&E representative must verify existing equipment prior to purchase. A local pump dealer should be consulted to insure the pump operates most efficiently with the new low-pressure nozzles.
EX-ANTE ASSUMPTION:	1) Pressure reduction is 46.2 feet of water (20 psi). 2) Average annual water applied through sprinklers is 2.57 acre-feet per acre. This is often supplemented through flood irrigation and does not constitute the total amount of water applied. 3) Net annual water applied is 1.93 acre-feet per acre. 4) Overall irrigation efficiency is 75%. 5) OPE is 55%. 6) Average nozzles per acre is 12.44. 7) Brake Horse Power (BHP) per acre is 0.1561 BHP
ASSESSMENT OF ASSUMPTION:	1) Reviewed and deemed appropriate.

ITEM:	**Low Pressure Impact Sprinkler Nozzle**
	2) This value could not be determined from the possible ex-ante sources. The 1992 Canessa report states that 2.05 acre-feet per acre is supplied by the sprinkler system. This value was updated by Canessa, 1994 to take regional differences into account. The updated sprinkler acre-feet per acre of 2.29 is a weighted average across the regions. 3) This value could not be determined from the possible ex-ante sources. The 1992 Canessa report states that an average of 2.7 acre-feet per acre is supplied by all the irrigation systems. 4) Continued evaluation of sprinkler systems by the Mobil Irrigation Laboratories indicate that this value should be 70%. (Canessa, 1994) 5) Reviewed by determining average of 1993 and 1994 pump test database, both overall and by water source (tank/reservoir, well and canal). Since most sprinkler systems use wells as the water system, an OPE of 55% is appropriate. 6) This value was updated by Canessa, 1994. With regional differences taken into account, the average nozzles per acre is 12.33. 7) This value could not be verified as the information was not in the listed source. However, a different algorithm was used in Canessa, 1994, to determine the kW/acre value. This was deemed appropriate. The updated kW/acre value is 0.1378.

ITEM:	**Low Pressure Impact Sprinkler Nozzle**
EX-ANTE IMPACT ALGORITHM:	$\text{savings / acre / yr} = \frac{\text{pressure reduction} * \text{net water applied} * 1.024}{\text{irrigation efficiency} * \text{pumping plant efficiency}}$ $\text{savings / acre} = \frac{46.2 \text{ ft} * 1.93 \text{ acft / ac / yr} * 1.024 \text{ kWh / ac ft}^2}{0.75 * 0.55} = 221.35 \text{ kWh / ac / yr}$ $\text{savings / nozzle / yr} = \frac{221.35 \text{ kWh / ac / yr}}{12.44 \text{ nozzles / ac}} = 17.79 \text{ kWh / nozzle / yr}$ Non-coincident Demand Savings $\text{kW / ac} = \text{BHP / ac} * 0.746 \text{ kW / BHP}$ $\text{kW / nozzle} = \frac{\text{kW / ac}}{\text{nozzles / ac}} = \frac{0.1561 \text{ Hp/ac} * 0.746 \text{ kW / BHP}}{12.44 \text{ nozzles / ac}}$ $\text{kW / nozzle} = 0.009 \text{ kW / nozzle}$ Coincident Demand Savings $0.009 \text{ kW / nozzle} * 0.53 = 0.005 \text{ kW / nozzle}$
ASSESSMENT OF ALGORITHM:	1) Energy Savings - Application of the updated values listed in the assumption assessment of 2.29 acre-feet per acre of sprinkler applied water, irrigation efficiency of 70% and nozzles per acre of 12.33 provides an updated value of 22.8 kWh/nozzle 2) Demand Savings - Application of the updated values listed in the assumption assessment of 0.1378 kW/acre and 12.33 nozzles per acre provides an updated value of 0.011 kW/nozzle for non-coincident demand. Application of a coincident demand factor to the non-coincident demand is deemed appropriate.
EXPECTED LIFE SERVICE:	8 years (Reference 3)
INCREMENTAL COST:	Measure cost of $1.11/nozzle (Reference 3) The average incremental cost for this technology for the 1994 participants from the MDSS was $3,408.
REBATE:	The average rebate for this technology for the 1994 participants from the MDSS was $1,806. 57 items were rebated in 1994.
REFERENCES:	1) *Low Pressure Sprinkler Nozzles*, Peter Canessa, P.E., San Luis Obispo, CA, August, 1992. 2) *Low Pressure Sprinkler Nozzles*, Peter Canessa, P.E., San Luis Obispo, CA, November, 1994. 3) PG&E 1994 Agricultural Retrofit Express Program, Ex-

ITEM:	**Low Pressure Impact Sprinkler Nozzle**
	Ante Estimates, Program Technical Developers: Pete Canessa, P.E., Sam Cohen, Barakat & Chamberlin, Inc. and Steve Schiller, Schiller Associates.

ITEM:	**Milk Pre-Cooler**
RECOMMENDATION:	None.
TECHNOLOGY DESCRIPTION:	In-line milk precoolers are heat exchanges that use cool water pumped from wells to precool milk flowing from the milking parlor to the bulk refrigerator tanks. They save energy by reducing the refrigeration requirements of the main bulk tanks. They may be plate, shell and tube or concentric tube type heat exchangers.
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	Shipping records indicating gallons milked per day for 8 consecutive weeks prior to installation of the precooler must be attached. Rebate cannot exceed 50% of the total project cost, excluding taxes, in-house labor and other indirect costs.
EX-ANTE ASSUMPTION:	1) Precooler decreases the milk temperature by 20 degrees Fahrenheit. 2) Average efficiency of the milk chiller system is 7.5 EER, using 1.6 kW/ton refrigeration 3) Pumping power for the water required for heat exchanger is negligible. 4) There are no demand savings claimed from this technology.
ASSESSMENT OF ASSUMPTION:	1) Deemed appropriate. 2) Deemed appropriate. 3) Deemed appropriate. 4) Deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	$\text{kWh savings / year} = \frac{\text{gal milk}}{\text{day}} * \frac{8.6\ \text{lbs}}{\text{gal milk}} * 20\ \text{F} * \frac{0.896\ \text{Btu}}{\text{lb F}} * \frac{1\ \text{ton refrig}}{12{,}000\ \text{Btuh}} * \frac{1.6\ \text{kW}}{\text{ton}} * \frac{365\ \text{days}}{\text{year}}$
ASSESSMENT OF ALGORITHM:	Algorithm is appropriate for energy savings estimate.
EXPECTED LIFE	12 years. (Reference 1)

ITEM: SERVICE:	**Milk Pre-Cooler**
INCREMENTAL COST:	The average paid project cost from the MDSS for this item was $7327
REBATE:	The average rebate for this technology for the 1994 participants from the MDSS was $1,983. 13 items were rebated in 1994.
REFERENCES:	1) PG&E 1994 Agricultural Retrofit Express Program, Ex-Ante Estimates, Program Technical Developers: Pete Canessa, P.E., Sam Cohen, Barakat & Chamberlin, Inc. and Steve Schiller, Schiller Associates.

ITEM:	**Refrigeration Desuperheater**
RECOMMENDATION:	None.
TECHNOLOGY DESCRIPTION:	Desuperheaters are used in dairies to make use of waste heat generated by the refrigeration units. The desuperheaters heat water that is used for cleaning the milk-flow pipelines and for other uses that require lukewarm to hot water. Using the waste heat reduces the energy needed to heat water and may increase the efficiency of the refrigeration equipment.
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	Records from the eight consecutive weeks prior to desuperheater installation showing the number of cows milked per day must be attached. The desuperheater must be used to preheat water used for washing and cleaning milk-flow lines. The desuperheater must displace an electric water heater load. Rebate amount cannot exceed 50% of the total project cost, which includes cost of materials and outside or contract labor required to install the heat exchanger. Sales tax, in-house labor and other indirect costs are excluded.
EX-ANTE ASSUMPTION:	1) 0.8 gallons of water per cow is required for sterilization and general wash-up 2) Desuperheater will provide 50° F temperature rise in the water 3) There are no demand savings claimed for this technology.
ASSESSMENT OF ASSUMPTION:	1) Deemed appropriate. 2) Deemed appropriate. 3) Deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	$\text{lbs water / day} = \frac{\text{cows milked}}{\text{day}} * \frac{\text{0.8 gal water}}{\text{cow milked}} * * \frac{\text{8.3 lb}}{\text{gal water}}$

ITEM:	**Refrigeration Desuperheater** $\text{kWh savings / year} = \frac{\text{lbs water}}{\text{day}} * 50\,F * \frac{1.0\ \text{Btu}}{\text{lb F}} * * \frac{1\ \text{kW h}}{3412\ \text{Btu}} * \frac{365\ \text{days}}{\text{year}}$
ASSESSMENT OF ALGORITHM:	Algorithm is appropriate for energy savings estimate.
EXPECTED LIFE SERVICE:	10 years (Reference 1)
INCREMENTAL COST:	The average paid project cost from the MDSS for this item was $773.
REBATE:	The average rebate for this technology for the 1994 participants from the MDSS was $773. 2 items were rebated in 1994. Note that the rebated amount is equal to the incremental cost. This is the data in the MDSS, and if correct, does not follow the 50% rule stated in the ex-ante criteria.
REFERENCES:	1) PG&E 1994 Agricultural Retrofit Express Program, Ex-Ante Estimates, Program Technical Developers: Pete Canessa, P.E., Sam Cohen, Barakat & Chamberlin, Inc. and Steve Schiller, Schiller Associates.

ITEM:	**Well Water Measurement Device**
RECOMMENDATION:	1) Change the average kWh/year-pump from 179,134 to 149,247 kWh/year-pump to reflect the 1993-94 pump test database. 2) Change the average lift from 194.6 feet to 211.4 feet to reflect the 1993-94 pump test database. 3) These values would provide a savings of 46.4 kWh/ft. 4) Add a demand saving component to this measure using the same algorithm as the pump retrofit measure and a set OPE ratio value of (1-0.63/0.68)=0.074 for all horsepower bins.
TECHNOLOGY DESCRIPTION:	An airline, pressure transducer or sounding tube which provides for the accurate determination of pumping water levels will enable a pump dealer to select the most efficient bowl and impeller design. Without accurate water levels, the realized Overall Plant Efficiency (OPE) determined during a pump test may differ from optimal OPE by as much as 14%, after repair. This measure must be performed in conjunction with a pump retrofit.
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	Only pressure transducers, airlines and internal/external sounding tubes apply. All measures must provide for the accurate determination of standing and pumping water levels. These devices are limited to wells with pumping water levels greater than 100 feet.
EX-ANTE ASSUMPTION:	1) Without this device, the average OPE achieved would be approximately 63% (PG&E 1991b) 2) The OPE target, when water levels are accurately measured, is 68%. 3) There are no demand savings claimed for this technology. 4) Average kWh/year-pump = 179,134 (PG&E 1991a) 5) Average pumping water level > 100 = 194.6 feet (PG&E 1991a)

ITEM:	**Well Water Measurement Device** 6) 25 feet is added to pumping water level to account for the additional line required to span the distance from the cone of depression in the water level created by the pumping action, to the top of the pump bowls.
ASSESSMENT OF ASSUMPTION:	1) Reviewed by getting average from current 93-94 PG&E database and deemed appropriate. 2) Deemed appropriate. 3) This measure causes an increased efficiency which will create a demand savings. Where this savings is counted is unclear. It should be determined and counted for in the retrofit measure, however, the pump retrofit demand savings is based on a set value which does not vary. This measure should account for a demand savings since the pump retrofit does not. 4) The average kWh/year-pump from the PG&E 1993-94 Pump database for pumps with greater than 100 feet total lift was 149,247 kWh/year-pump. This value is 17% lower than the previous estimate. Assessment of the time clock measure also used an earlier kWh/year-pump value which was only 5% lower than the 93-94 database. Based on this comparison, 179,134 seems too high. 5) The average lift per pump from the PG&E 1993-94 Pump database for pumps with greater than 100 feet total lift was 211 feet. This value is 9% higher than the ex-ante assumption. This does not seem out of line with the possible variations between the databases. However, a greater total lift in feet does not match a lesser kWh pumping requirement from assumption #4. It is unclear which value may have been in error (if either) from the ex-ante assumption. 6) Deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	$179{,}134\ \text{kWh} * \left(1 - \frac{0.63}{0.68}\right) = 13{,}172\ \text{kWh}$ $13{,}172\ \text{kWh} / (194.6' + 25') = 60\ \text{kwh/ft}$

ITEM:	**Well Water Measurement Device**
ASSESSMENT OF ALGORITHM:	Algorithm is appropriate for energy savings estimate. A demand saving algorithm is recommended to be added that is the same as for the pump retrofit algorithm.
EXPECTED LIFE SERVICE:	9 years. (Reference 1)
INCREMENTAL COST:	The average incremental cost for this technology for the 1994 participants from the MDSS was $452.
REBATE:	The average rebate for this technology for the 1994 participants from the MDSS was $224. 6 items were rebated in 1994.
REFERENCES:	1) PG&E 1994 Agricultural Retrofit Express Program, Ex-Ante Estimates, Program Technical Developers: Pete Canessa, P.E., Sam Cohen, Barakat & Chamberlin, Inc. and Steve Schiller, Schiller Associates.

ITEM:	**Rigid Double-Walled Plastic**
RECOMMENDATION:	1) Update U-values to take construction into account. 2) Update heating degree day value to 2,092 HDD (computed as hours / 24 hours). 3) These changes will change the therm savings to 0.40 therms / ft^2 year
TECHNOLOGY DESCRIPTION:	In greenhouses, the addition of rigid double-wall plastic to replace single-wall polyethylene or fiberglass will reduce infiltration and conduction heat losses.
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	The minimum heating temperature of the greenhouse must be at least 60° F.
EX-ANTE ASSUMPTION:	1) Single-wall polyethylene or fiberglass would be used in the absence of this measure 2) Heat transfer of single-wall polyethylene = 1.2 Btu/hr-ft^2 ° F 3) Heat transfer of rigid double-wall plastic = 0.6 Btu/hr-ft^2 ° F 4) Greenhouse setpoint = 65° F 5) Average heat load is 2,650 heating degree days (base 65). 6) Average heating system efficiency is 70%.
ASSESSMENT OF ASSUMPTION:	1) Reviewed and deemed appropriate. 2) This assumption does not take the conduction of the framing into account. A metal frame would add approximately 2% more conduction, providing a U value of 1.224. (ASHRAE 1995, 20.9) 3) This value could not be found in the source listed. There are three thickness' of rigid double walled plastic.

ITEM:	**Rigid Double-Walled Plastic** The average of the three is 0.65. With a metal frame, the U value would be increased by 3% to 0.67. (ASHRAE 1995, 20.9) 4) Reviewed and deemed appropriate. 5) This value was not well documented in reference 3. However, CTZ weather tapes for Oakland, Sunnyvale and Sacramento CEC climate zones were analyzed to determine this value (This is comparable to TMY weather tapes). A HDD is determined by subtracting the mean daily temperature from the base value (in this case 65). A HDDHr/24 hrs is determined by subtracting the actual hourly value from the base value. For greenhouse impacts, a HDDHr/24 hrs may be most appropriate as heating is required at night, even if the daytime temperatures are above 65. Using 6 pm to 9 am as the "night" hours (to represent hours when solar gain will be minimal to non-existent) and only winter months (Oct-May), the HHDHr/24 hrs is 2,092. 6) Reviewed and deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	ΔQ = Change in Heat Transfer Rate $\Delta Q = \frac{0.6\ \text{Btu}}{\text{hr ft}^2\ ^\circ\text{F}} * \frac{2650\ ^\circ\text{F - day}}{\text{yr}} * \frac{24\ \text{hr / day}}{70\ \%\ \text{efficiency}} * \frac{1\ \text{Therm}}{100{,}000\ \text{Btu}}$ $\Delta Q = \frac{54{,}514\ \text{Btu}}{\text{ft}^2\ \text{- yr}} * \frac{1\ \text{Therm}}{100{,}000\ \text{Btu}} = 0.545 \frac{\text{Therm}}{\text{ft}^2\ \text{- yr}}$

ITEM:	**Rigid Double-Walled Plastic**
ASSESSMENT OF ALGORITHM:	Change in infiltration is not accounted for in this algorithm. If the assumption is made that the old greenhouse is in good condition, the infiltration in air changes per hour (ACH) could be 1.5. (ASHRAE 1995, 20.9) The change to rigid double-walled construction could decrease this ACH to 1.0, leaving a 0.5 ACH as the change in infiltration. However, this would provide less than a 1% change in savings, and so can be ignored. The current algorithm is deemed appropriate.
EXPECTED LIFE SERVICE:	16 years. (Reference 3)
INCREMENTAL COST:	$1.43/ft^2 (Reference 3) The average project cost for this technology for the 1994 participants from the MDSS was $56,742.
REBATE:	The average rebate for this technology for the 1994 participants from the MDSS was $32,196. 11 items were rebated in 1994.
REFERENCES:	1) ASHRAE HVAC Applications, 1991. 2) ASHRAE HVAC Applications, 1995. 3) PG&E 1994 Agricultural Retrofit Express Program, Ex-Ante Estimates, Program Technical Developers: Pete Canessa, P.E., Sam Cohen, Barakat & Chamberlin, Inc. and Steve Schiller, Schiller Associates.

ITEM:	**Double-Walled Polyethylene Plastic**
RECOMMENDATION:	1) Update U-values to take construction into account. 2) Update heating degree day value to 2092 HDD hours / 24 hours. 3) These changes will change the therm savings to 0.36 therms / ft^2 year
TECHNOLOGY DESCRIPTION:	In greenhouses, the addition of double-wall polyethylene plastic to replace single-wall polyethylene or fiberglass will reduce infiltration and conduction heat losses.
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	The minimum heating temperature of the greenhouse must be at least 60° F. Air-filled dead space must be at least six inches.
EX-ANTE ASSUMPTION:	1) Single-wall polyethylene or fiberglass would be used in the absence of this measure 2) Heat transfer of single-wall polyethylene = 1.2 Btu/hr-ft^2 ° F 3) Heat transfer of double-wall polyethylene plastic = 0.8 Btu/hr-ft^2 ° F 4) Greenhouse setpoint = 65° F 5) Average heat load is 2,650 heating degree days (base 65). 6) Average heating system efficiency is 70%.
ASSESSMENT OF ASSUMPTION:	1) Reviewed and deemed appropriate. 2) This assumption does not take the conduction of the framing into account. A metal frame would add approximately 2% more conduction, providing a U value of 1.224. (ASHRAE 1995, 20.9) 3) This value could not be found in the source listed. The U-value for double film, inflated is 0.70. With a metal frame, the U value would be increased by 3% to 0.721.

	(ASHRAE 1995, 20.9) 4) Reviewed and deemed appropriate. 5) This value was not well documented in reference 3. However, TMY weather tapes for Oakland, Sunnyvale and Sacramento CEC climate zones were analyzed to determine this value. A HDD is determined by subtracting the mean daily temperature from the base value (in this case 65). A HDDHr/24 hrs is determined by subtracting the actual hourly value from the base value. For greenhouse impacts, a HDDHr/24 hrs may be most appropriate as heating is required at night, even if the daytime temperatures are above 65. Using 6 pm to 9 am as the "night" hours (to represent hours when solar gain will be minimal to non-existent) and only winter months (October to May), the HHDHr/24 hrs is 2092. 6) Reviewed and deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	Δ_Q = Change in Heat Transfer Rate $\Delta Q = \frac{0.4\ \text{Btu}}{\text{hr ft}^2 \cdot \text{F}} * \frac{2650\ ^\circ\text{F-day}}{\text{yr}} * \frac{24\ \text{hr / day}}{70\ \%\ \text{efficiency}} * \frac{1\ \text{Therm}}{100{,}000\ \text{Btu}}$ $\Delta Q = \frac{36{,}343\ \text{Btu}}{\text{ft}^2 - \text{yr}} * \frac{1\ \text{Therm}}{100{,}000\ \text{Btu}} = 0.363\ \frac{\text{Therm}}{\text{ft}^2 - \text{yr}}$
ASSESSMENT OF ALGORITHM:	Change in infiltration is not accounted for in this algorithm However, this would provide less than a 1% change in savings, and so can be ignored. The current algorithm is deemed appropriate.
EXPECTED LIFE SERVICE:	2.4 Years (Reference 3)
INCREMENTAL COST:	$\$0.10/\text{ft}^2$ (Reference 3) The average project cost for this technology for the 1994 participants from the MDSS was $8,110

ITEM:	**Double-Walled Polyethylene Plastic**
REBATE:	The average rebate for this technology for the 1994 participants from the MDSS was $4,005. 9 items were rebated in 1994.
REFERENCES:	1) ASHRAE HVAC Applications, 1991. 2) ASHRAE HVAC Applications, 1995. 3) PG&E 1994 Agricultural Retrofit Express Program, Ex-Ante Estimates, Program Technical Developers: Pete Canessa, P.E., Sam Cohen, Barakat & Chamberlin, Inc. and Steve Schiller, Schiller Associates.

ITEM:	Heat Curtain
RECOMMENDATION:	1) Update U-values to take construction into account. 2) Update heating degree day value to 2092 HDD hours / 24 hours. 3) These changes will change the therm savings to 0.67 therms / ft^2 year 4) Determine how this measure is being implemented in the field for future modeling. Update algorithm to account for differing implementation of this measure if applicable.
TECHNOLOGY DESCRIPTION:	In greenhouses, the addition of thermal blankets to the greenhouse interior decreases heat losses resulting from radiation, convection and infiltration. Thermal blankets also reduce air stratification and the amount of space to be heated.
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	The minimum heating temperature of the greenhouse must be at least 60° F.
EX-ANTE ASSUMPTION:	1) A single glass covering would be used in the absence of this measure. 2) Heat transfer of single-layer glass = 1.1 Btu/hr-ft^2 ° F 3) Heat transfer of single layer glass and heat curtain = 0.5 Btu/hr-ft^2 ° F 4) Greenhouse setpoint = 65° F 5) Average heat load is 2,650 heating degree days (base 65). 6) Average heating system efficiency is 70%.
ASSESSMENT OF ASSUMPTION:	1) Reviewed and deemed appropriate. 2) This value could not be found in the source listed. The

	U-value of single glazing is 1.13. A metal frame with 24 inch framing construction would add approximately 8% more conduction, providing a U value of 1.22. (ASHRAE 1995, 20.9) 3) This value could not be found in the source listed. Based upon what was found in the on-site audits and a determination of the U-value of that configuration (single poly film which creates dead air space between film and roof), the U-value is 0.28. 4) Reviewed and deemed appropriate. 5) This value was not well documented in reference 3. However, CTZ weather tapes for Oakland, Sunnyvale and Sacramento CEC climate zones were analyzed to determine this value. A HDD is determined by subtracting the mean daily temperature from the base value (in this case 65). A HDDHr/24 hrs is determined by subtracting the actual hourly value from the base value. For greenhouse impacts, a HDDHr/24 hrs may be most appropriate as heating is required at night, even if the daytime temperatures are above 65. Using 6 pm to 9 am as the "night" hours (to represent hours when solar gain will be minimal to non-existent) and only winter months (October to May), the HHDHr/24 hrs is 2092. 6) Reviewed and deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	ΔQ = Change in Heat Transfer Rate $\Delta Q = \frac{0.6\ \text{Btu}}{\text{hr ft}^2\ ^\circ\text{F}} * \frac{2650\ ^\circ\text{F - day}}{\text{yr}} * \frac{24\ \text{hr / day}}{70\ \%\ \text{efficiency}} * \frac{1\ \text{Therm}}{100{,}000\ \text{Btu}}$ $\Delta Q = \frac{54{,}514\ \text{Btu}}{\text{ft}^2\ \text{- yr}} * \frac{1\ \text{Therm}}{100{,}000\ \text{Btu}} = 0.545 \frac{\text{Therm}}{\text{ft}^2\ \text{- yr}}$
ASSESSMENT OF ALGORITHM:	Algorithm has been reviewed and deemed appropriate.

ITEM:	**Heat Curtain**
EXPECTED LIFE SERVICE:	10 Years. (Reference 3)
INCREMENTAL COST:	$0.37/ft^2 (Reference 3). The average project cost for this technology for the 1994 participants from the MDSS was $38,020
REBATE:	The average rebate for this technology for the 1994 participants from the MDSS was $22,697. 17 items were rebated in 1994.
REFERENCES:	1) ASHRAE HVAC Applications, 1991. 2) ASHRAE HVAC Applications, 1995. 3) PG&E 1994 Agricultural Retrofit Express Program, Ex-Ante Estimates, Program Technical Developers: Pete Canessa, P.E., Sam Cohen, Barakat & Chamberlin, Inc. and Steve Schiller, Schiller Associates.

ITEM:	**Time Clock with Battery Backup**
RECOMMENDATION:	None
TECHNOLOGY DESCRIPTION:	A time clock with battery or spring-wound backup designed to operate irrigation systems on selected schedules and to retain those schedules during periods of pump shutdowns and/or power outages will conserve water and reduce pump operation.
CRITERIA FOR 1994 PROGRAM PARTICIPATION:	The time clock must control irrigation equipment.
EX-ANTE ASSUMPTION:	1) Average energy use is 125,910 kWh/yr-pump (PG&E 1991) 2) Average expected energy savings is 10% (SRC 1991) 3) The time clock controls one pump. 4) There are no demand savings claimed for this technology.
ASSESSMENT OF ASSUMPTION:	1) The average energy use from the 1993-1994 PG&E Pump dataset is 120,156 kWh/year. This value is no better or worse than the 1991 average. The original estimate of 125,910 kWh/year-pump is appropriate. 2) Reviewed and deemed appropriate. 3) Reviewed and deemed appropriate. 4) Reviewed and deemed appropriate.
EX-ANTE IMPACT ALGORITHM:	kWh / yr savings = 125,910 kWh / year - pump * 10% = 12,591 kWh / yr
ASSESSMENT OF ALGORITHM:	Algorithm is deemed appropriate.
EXPECTED LIFE SERVICE:	5 Years. (Reference 1)
INCREMENTAL COST:	The average paid project cost from the MDSS for this item

	was $297.
REBATE:	The average rebate for this technology for the 1994 participants from the MDSS was $40. 42 items were rebated in 1994.
REFERENCES:	1) PG&E 1994 Agricultural Retrofit Express Program, Ex-Ante Estimates, Program Technical Developers: Pete Canessa, P.E., Sam Cohen, Barakat & Chamberlin, Inc. and Steve Schiller, Schiller Associates.

Appendix K

RE/CUSTOMIZED PROGRAM PARTICIPANTS
REASONS FOR REFUSING THE SURVEY

OBS	COMMENT1
1	ALL PUMP ADJUSTMENT INTERVIEWS NECESSARY ARE COMPLETED
2	ALL PUMP ADJUSTMENT RECORDS NECESSARY ARE COMPLETE-/PRA/
3	ALL PUMP ADJUSTMENT INTERVIEWS NECESSARY ARE COMPLETE-/LAR/
4	WAS EXTREMELY IRATE WITH PGAND E. REFUSED TO ANSWER ANY QUE
5	REFUSAL
6	SAID THAT THEY ALREADY DID A SURVEY FOR PG&E WON'T DO-/CDM/
7	
8	DAIRY FARMERS WONT HAVE TIME TO TALK OVER THE PHONE-/LAR/
9	REFUSAL-/PRA/
10	"FOR 10 MINUTES YOU CAN ASK A LOT OF QUESTIONS"-/BAC/
11	THEY KEPT TRACK OF THE HOURS THEY SPENT DOING RESEARCH-/JAW/
12	JOHN CALLED OUR 800 # , SAYS HE'D RATHER NOT; REFUSAL-//
13	UPSET ABOUT THE COST OF HIS ELECTRIC BILLS; SEES NO REASON-
14	DOES NOT DO SURVEYS-/LMT/
15	WIFE TOLD ME THAT JACK DOES NOT FARM ANYMORE, HE RETIRED,-/B
16	POLITE REFUSAL-/JRJ/
17	DENNIS SAID HE DID A SURVEY LAST WEEK FOR PGE AG, WILL NOT-/
18	WANTS A SURVEY SENT TO HIM IN THE MAIL, BUT REFUSES TO-/PRA/
19	PETE SAYS PG&E RATES ARE TOO HIGH, AND HE DID NOT PARTICIPAT
20	JOSEF IS NOT HAPPY WITH PG & E, AND HUNG UP ON ME: REFUSAL.-
21	POSSIBLE MULTI-SITE** MR SIHOTA SAID HE ANSWERED THESE QUEST
22	ALL PUMP ADJUSTMENTS NECESSARY ARE COMPLETE-/PRA/
23	RICK SAID HE CANNOT RECALL EXACTLY WHICH PUMP HAD WHICH WORK
24	JUST DID NOT WANT TO PARTICIPATE-/LMT/
25	ROY FANUCCHI DID NOT REALLY KNOW ABOUT PROGRAM, AND COULDNT-

OBS	COMMENT2
1	-/PRA/
2	
3	
4	STIONS-/RJS/ .REFUSAL.-/RJS/
5	WAS NOT HAPPY WITH PG&E.
6	IT AGAIN-/CDM/
7	
8	MAIL QUESTIONS-/LAR/
9	-/PRA/
10	
11	PROJECTS AND DON'T DO THEM ANY MORE.-/JAW/
12	
13	TO HELP PG AND E-/RJS/
14	
15	THEN SHE HUNG UP ON ME.-/BAC/
16	
17	DO ANOTHER.-/CDM/
18	ANSWER THE QUESTIONS OVER THE PHONE.
19	IN THE PROGRAM.-/BAC/
20	
21	IONS LAST WEEK-/LAR/
22	
23	DONE, AND HE DOES NOT HAVE TIME TO CHK RECORDS-HARVESTING-/R
24	
25	REALLY TELL US ABOUT THE PUMP, NOBODY ELSE TO TALK TO.-/BAC/

OBS	COMMENT1
26	REFUSED-/LMC/
27	"I'M NOT INTERESTED AT THIS TIME"-/RWP/
28	SPOKE WITH HERB'S BROTHER. SAYS HERB REFUSES TO TAKE SURVEYS
29	DID NOT HAVE TIME FOR SUVERY-/LAR/
30	POLITE REFUSAL-/JRJ/
31	"UNLESS YOU'RE GONNA CUT THE COSTS ON IT SOMEWHERE, I DON'T-
32	HE SAYS HE DID A SURVEY LAST WEEK FOR ONE ACCOUNT AND SAYS-/
33	MR TOS HAS DONE ONE OR TWO OF THESE AND WOULD RATHER NOT DO-
34	REFUSAL; PARTICIPATED ONLY 1 YEAR -- NICELY REFUSED-//
35	VERY BUSY-/LMC/
36	MR. HUERTA SAID THEY DID A GOOD JOB, BUT HE DOES NOT WANT TO
37	MR. WILEY IS VERY ILL AND THEY ARE IN THE PROCESS OF-/REZ/
38	
39	
40	KEN SAID HE ALREADY DID SURVEY WITH A TIM JACOBSON(?). NICE-
41	
42	
43	
44	
45	
46	
47	
48	
49	
50	

OBS	COMMENT2
26	-/LMC/
27	
28	AND WILL NOT DO IT.-/JAW/
29	
30	-/JRJ/
31	GOT THE TIME FOR IT [THE SURVEY]"-/RWP/
32	HE THINKS "WE'VE DONE ENOUGH".-/BB/
33	ANY MORE-/LAR/
34	
35	REFUSED-/LMC/
36	ANSWER THE QUESTIONS.-/RWP/
37	SELLING THEIR HOME. NOT A GOOD TIME TO TALK ABOUT THIS.-/RE
38	
39	
40	MAN EXPLAINED HOW THIS WAS WRONG TIME OF YEAR."TYPICAL PG&E"
41	-//
42	
43	
44	
45	
46	
47	
48	
49	
50	

OBS	COMMENT1
51	
52	
53	
54	DO NOT CALL; SAME CONTACT ON CATI 24, QC 2779. "TOO MANY-/LA
55	
56	*DO NOT CALL* WOMAN CLAIMS TO HAVE BEEN CALLED OVER A DOZEN-
57	THEY HAVE 800# & MAY? CALL US, BUT DO >NOT< REPEAT --/SGW/
58	GLADYS SAID "WHAT KIND OF PROGRAM" AND THEN HUNG UP ON ME.-/
59	SAID HE DID A SURVEY ABOUT THE PUMP TEST LAST WEEK-/CDM/
60	I COMPLETED WITH MARK, BUT AT THE END HE SAID THE ADDRESS FO
61	DID NOT WANT TO TAKE THE TIME OUT TO FIND THE RIGHT ACCT-/LM
62	VERY NICE MAN ALREADY DID SURVEY FOR ANOTHER OF HIS PUMPS-/J
63	QUIT SURVEY AT SCR 28-/PRA/
64	
65	LEFT OUR 800 # FOR BOB.-/SGW/
66	
67	HAS BEEN CALLED TOO MANY TIMES. DOESN'T WANT TO BE/////////
68	
69	PARTIAL /REFUSAL-/LAR/
70	DAVID TOLD ME THAT IT IS THEIR POLICY NOT TO PARTICIPATE-/BA
71	
72	
73	.REFUSAL.-/DXA/
74	HAD TO GO BACK TO WORK, CALL LATER-/LAR/
75	

OBS	COMMENT2
51	
52	
53	
54	CALLS."-/LAR/
55	
56	TIMES. PROBABLY ON ANOTHER DATABASE. VERY ANNOYED.-/JAW/
57	DO >NOT< CALL AGAIN - PER CUSTOMER REQUEST. SEE SCR. 69.-/SG
58	
59	
60	R THE PUMP BELONGED TO HIS FATHER. SEE END COMMENTS(SCR 69)M
61	AND LOCATION FOR THE INFORMATION-/LMT/
62	AND DID NOT WISH TO DO IT AGAIN.-/JAW/
63	HE HAS NO IDEA ABOUT THE AGRIC. RETRO. EXPRESS PROGRAM
64	
65	-/SGW/
66	
67	BOTHERED ANYMORE.REFUSAL. DO NOT CALL.//////////////////
68	
69	-/LAR/
70	IN TELEPHONE SURVEYS.-/BAC/
71	
72	
73	-/DXA/
74	
75	

OBS	COMMENT1
76	GAVE RECEPT 800# AND ACCT#-/DXA/ (SCREEN 24)-/LAR/
77	REFUSAL
78	NOT INTEREST IN TAKING SURVEY-/NLM/
79	
80	REFUSAL-/BAC/
81	
82	
83	WANTS QUESTIONS MAILED-/LAR/
84	RESPONDENT WANTED INFORMATION MAILED TO P.O. BOX 1298 SHAFTE
85	
86	COULDN'T FIND MATCHING ACCOUNT # GOT FED UP.-/CDM/
87	POLITE REFUSAL-/LMT/
88	
89	HE DID SURVEY FOR A SINGLE ACCT LAST WEEK. HAS "DONE ENOUGH"
90	REFUSED-/LMC/
91	
92	
93	
94	
95	
96	
97	
98	MR KAGEHIRO SAID HE WAS NOT INTERESTED-/LAR/
99	
100	

OBS	COMMENT2
76	MR NICHOLAS CALLED IN BUT HAD ANOTHER CALL. CALL BACK-/LAR/
77	
78	-/NLM/
79	
80	-/BAC/
81	
82	
83	-/LAR/
84	R 92363-/LAR/
85	
86	
87	
88	
89	
90	
91	
92	
93	
94	
95	
96	
97	
98	-/LAR/
99	
100	

OBS	COMMENT1
101	
102	ALL PUMP ADJUSTMENT'S NECESSARY ARE COMPLETE-/PRA/
103	PROBABLE MULTI-SITE WITH QC 1.-/JCM/
104	WANTS INFORMATION SENT IN THE MAIL BECUASE HE IS IN HARVEST-
105	"IS THIS A SURVEY? WE DON'T NORMALLY DO SURVEYS OVER THE-/R
106	
107	"WE DON'T GIVE OUT INFORMATION ON STUFF LIKE THAT."-/JCM/
108	4921 HOUGTON BAKERSFIELD CA 943313-/LAR/
109	BOB BROWN AT ORIGINAL # SAYS NONE OF THIS RELATES TO HIM.-/B
110	*DO NOT CALL* SEE QC 2661.-/JAW/
111	*DO NOT CALL* SEE QC 2661.-/JAW/
112	
113	
114	PARTIAL-/LAR/

OBS	COMMENT2
101	
102	
103	
104	-/LAR/-/LAR/
105	PHONE. WE DON'T HAVE TIME." REFUSAL.-/REZ/
106	
107	
108	MAIL QUESTIONS-/LAR/
109	RECEPT AT NEW # SAYS CONTACT THERE IS BOB BROWN.-/BB/
110	
111	
112	
113	
114	SOME DATA CAN BE COLLECTED FROM 2244-/LAR/

Appendix L

EMS PROGRAM PARTICIPANTS REASONS FOR REFUSING THE SURVEY

OBS	COMMENT1
1	CUSTOMER VERY UPSET BUT SAID HE WAS VERY HAPPY WITH PG&E-/LA
2	NO ANSWER-/LAR/
3	ALREADY DID SURVEY W/PAUL-/LMC/
4	REFUSED - ALREADY DID SURVEY W/PAUL-/LMC/
5	HAS ALREADY BEEN CALLED TWICE ABOUT THIS PUMP. HE WAS ANGRY
6	SPOKE WITH ED. SAID HE WOULDN'T KNOW ENOUGH DETAILS TO BE OF
7	NOT INTERESTED-/LAR/
8	HAD TO LEAVE IN A HURRY-/GMP/
9	MR. KELLY WAS VERY IRRITATED WITH THE SURVEY, GOT TO SCR. 46
10	MR. LUDTKE DOES NOT WISH TO PARTICIPATE.-/BB/
11	SPOKE TO MR. LOBUE BUT HE WILL NOT PARTICIPATE UNTIL HE GETS
12	SAID HE HAS ALREADY DONE THIS-/LAR/
13	.REFUSAL.-/SGW/
14	JAMES STATED THAT HE'D RATHER DO THINGS IN PERSON NOT OVER-/
15	.REFUSAL.-/LAR/
16	"WE DON'T PARTICIPATE IN SURVEYS"-/BAC/-/BAC/
17	JIM WAS BUSY BUT NICE ABOUT IT. I LEFT 800#, BUT I SUGGEST-/
18	STEVE SAID NOT A GOOD TIME C/B MID SEPT JUST STARTED ALMOND-
19	SPOKE WITH JOHN. NOT INTERESTED IN PARTICIPATING.-/JAW/
20	SPOKE W/ C. CAMPBELL'S BUS MGR -- DON'T DO SURVEYS OVER THE-
21	REFUSAL-/LMC/
22	.REFUSAL.-/LAR/
23	REFUSAL-/LMC/
24	NOT INTERESTED.-/JAW/
25	VERY MAD AT PG&E SOMETHING ABOUT PG&E BURNING UP HIS PUMPS A

OBS	COMMENT2
1	8-21-/LAR/
2	REFUSAL-/LAR/
3	
4	
5	ABOUT THE OVERLAP-/RJS/ .REFUSAL.-/RJS/
6	USE. REFUSED TO GET INFO.-/JAW/
7	.REFUSAL.-/LAR/
8	
9	AND HE SAID IT WAS REDICULOUS AND HE HAD TO GO AND HUNG UP.-
10	
11	A LETTER FROM PG&E FOR HIS RECORDS ABOUT THIS SURVEY.-/REZ/
12	.REFUSAL.-/LAR/
13	
14	THE PHONE.-/DSH/
15	
16	
17	NOT CALLING HIM. SOUNDED LIKE HE WAS TRYING TO GET OUT OF IT
18	HARVEST.-/NLM/ YOU MAY CATCH HIM DURING LUNCH-UNLIKELY-/G
19	
20	PHONE-/LMC/
21	
22	
23	
24	
25	ND NOT PAYING ANYTHING FOR IT-/LMT/

OBS	COMMENT1
26	HE SAYS THERE IS NO WAY FOR THEM TO CONFIRM THE PG&E ACCT #.
27	WOMAN ON PHONE SAID LEROY DOESN'T LIKE TO BE BOTHERED WITH-/
28	MR VANELLI BECAME UPSET OVER THE COST OF THE PUMPS.-/LAR/
29	NOT AVAIL FOR INTERVIEW WILL C/B ON 800#-/NLM/-/NLM/
30	PERSON ON PHONE MUMBLED SOMETHING AND THEN HUNG UP ON ME.-/J
31	MS.HENNEMAN SAID THAT SHE REALLY DOESN'T LIKE TO ANSWER QUES
32	P.H. WISHES ONLY TO ADD THAT THE PUMP TESTER'S ARRIVE SLOWER
33	AT SCREEN 14 HE FELT THE QUESTIONS WERE NOT RELEVANT TO HIS-
34	JOE ANGRY AT PG&E AND THE FEDERAL LAND BANK. CLAIMS WAS-/JAW
35	JOE CLAIMS HE DID NOT AUTHORIZE THE TESTS. SEE COMMENTS ON-/
36	DON'T CALL. MULTI-SITE WITH QC3-/JAW/
37	BRUCE DID QC 2699, BUT DID NOT RECOGNIZE THIS ONES ADDRESS.-
38	SAID HE ALREADY COMPLETED A SURVEY LAST WEEK, GAVE US ALL-/C
39	DO NOT CALL BACK--HE HAS ALREADY BEEN CONTACTED BY US ABOUT-
40	GAIL IS VERY BUSY ONE PERSON OFFICE WONT BE ABLE TO DO THE S
41	"MY HUSBAND ISN'T INTESTED IN THESE SURVEYS."-/BB/
42	I REMEMBER MARK MC KEAN FROM THE SINGLE SITE LISTS. THEY-/J
43	REFUSAL BECAUSE THE OWNERS ARE NOT IN EVER AND THEY "HATE" T
44	STATED DID NOT HAVE OR WANT TO TAKE TIME TO ANSWER SURVEY-/D
45	I REMEMBER MARK MC KEAN FROM THE SINGLE SITE LISTS. THEY-/J
46	MR. KIMERER HAD RESERVATIONS ABOUT ANSWERING QUESTIONS ON-/R
47	SAID THAT HE JUST ANSW. QUESTION FRI. BECAUSE HE'S GETTING-/
48	REQUESTED HARDCOPY-/JRJ/
49	ORCHARD, NOT TYPICAL FIELD CROPS.-/SGW/
50	ANSWERING MACHINE-/LAR/

OBS	COMMENT2
26	
27	THINGS LIKE THIS. BESIDES, HE'S NEVER HOME.-/JCM/
28	HE ALSO NO LONGER GROWS CROPS BECUSED HE LEASED HIS LAND-/LA
29	-/NLM/
30	-/JCM/
31	T. OVER THE PHONE. SO SHE SAID JUST PASS HER UP-/RRF/
32	THEN HE WOULD LIKE.
33	SITUATION (CROP IRRIGATION) AND SO DID NOT WANT TO CONTINUE.
34	CHARGED FOR THE TESTS WRONGFULLY. SEE COMMENTS.-/JAW/
35	QC 2608-/JAW/
36	VERY BUSY UNTIL ABOUT EARLY OCTOBER.-/JAW/
37	DOES NOT WANT TO BE CALLED TO DO THIS ONE.-/JAW/
38	HIS INFO-/CDM/
39	THE PUMP TEST-/RJS/ .REFUSAL.-/RJS/
40	UVERY-/LAR/ .REFUSAL.-/LAR/
41	
42	WERE UPSET AT BEING CALLED SO MUCH.-/JAW/
43	O DO SURVEYS.-/LMT/
44	-/DXA/
45	WERE UPSET AT BEING CALLED SO MUCH.-/JAW/
46	THE PHONE. HE WANTS IT IN WRITING.-/REZ/
47	READY TO PUMP TEST SOME MORE PUMPS.-/RRF/
48	
49	DAVID, THE OFFICE MGR, SAYS HE HASN'T GOT THE INFO, & WON'T-
50	DO NOT CALL THIS IS A MULTI-SITE-/LAR/

OBS	COMMENT1
51	POLITE REFUSAL-/JRJ/-/JRJ/-/JRJ/
52	THIS IS A MULTI SITE AND THE GENTLEMAN SAID THAT HE'S DOSENT

OBS	COMMENT2
51	
52	SO SURVEY OVER THE PHONE.-THE OTHER OBS IS QC 18

Appendix M

NONPARTICIPANTS
REASONS FOR REFUSING THE SURVEY

OBS	COMMENT1
1	
2	WASN'T SURE ABOUT WHICH PUMP SEEM CONFUSED DO NOT CALL AGAIN
3	HE SAID GOODBYE & HUNG UP ON ME AS I MENTIONED MONITORING.-/
4	854-3663 RESPONDENT HAD TO LEAVE DON'T CALL BACK-/GMP/
5	ASKED FOR THE H.P. OF THE MOTOR, BUT WHEN I SAID I'D GET IT-
6	REFUSED TO DO TELEPHONE SURVEY.-/AMJ/
7	
8	
9	HE "DOESN'T HAVE THAT KIND OF TIME". FRIENDLY.-/BB/
10	IN HARVEST. C/B IN A MONTH.-/JAW/
11	MR THIESEN DECIDED NOT TO PARTICIPATE-/JEH/
12	REFUSAL-/GMP/
13	DAN PELLIGRI HAS PASSED,GINO WHICH SHOULD BE GINA IS NO LONG
14	
15	DR. WOLD SAID HE DIDN'T WANT TO WASTE OUR TIME BUT REALLY HE
16	DID NOT HAVE ANY TIME-/GMP/
17	MS.THOMPSON WASN'T INTERESTED-/GMP/
18	PARTIAL- SHE SAID SHE KNEW ALL ABOUT THE PUMP-BUT WHEN WE GO
19	THEY DECLINE TO PARTICIPATE; TOO BUSY; NO ONE IS AVAILABLE,-
20	
21	LADY WOULDN'T GIVE ME ANY INFO. SAID THEY WEREN'T INTERESTED
22	
23	WOULD RATHER NOT.-/SGW/
24	MR JENSEN IS DEAD AND MRS JENSEN IS NOT INTERESTED IN THESE-
25	

OBS	COMMENT2
1	
2	
3	
4	-/LAR/
5	AND CALL BACK, HE SAID NEVER MIND.-/JCM/
6	
7	
8	
9	
10	
11	-/JEH/
12	
13	ER IN THE HOUSE.-/JLD/
14	
15	DIDN'T WANT TO WASTE HIS TIME/NOT INTERESTED-/RRF/
16	
17	-/GMP/
18	T INTO IT, SHE DIDN'T KNOW MUCH SOME DATA BUT NO CROP, FLOW-
19	FOR MONTHS.-/SGW/
20	
21	
22	
23	
24	KIND OF PROGRAMS-/LAR/
25	SEE QC # 2364.-/SGW/

OBS	COMMENT1
26	"YOU'RE GONNA HAVE TO FIND ANOTHER 5 MINUTES"-/CDM/
27	WIFE SAYS THEY DON'T DO TELEPHONE SURVEYS.
28	REFUSED TO COMPLETE THE SURVEY -- NOT SURE OF PURPOSE OF-/LM
29	DO NOT CALL. DO NOT CALL.-/CDM/
30	
31	"IF YOU DON'T KNOW THE HOUSEPOWER, AND DON'T KNOW THE TIME-/
32	SEC. SAYS I'M THE THIRD PERSON THAT'S CALLED AND HE HAS NO-/
33	GUY THAT ANSW. PHONE SAID THEY WOULDN'T BE INTERESTED.-/RRF/
34	
35	-//
36	LADY SAYS THAT THE PUMPS WERE NOT USED LAST YEAR, THIS YEAR-
37	KEN SAYS HE'S ALREADY DONE THIS SURVEY RECENTLY.
38	SEE QC # 2358.-/SGW/
39	
40	
41	DOES NOT ANSWER TELEPHONE SURVEYS.-/AMJ/
42	PERSON ON PHONE WAS UPSET AT PG&E AND DID NOT WANT TO DO THE
43	"HE'S RETIRED, HE'S NOT FEELING WELL, BYE"- HUNG UP-/TRL/
44	AFTER MY INTRO, WOMAN ON PHONE SAID SHE WASN'T INTERESTED.-/
45	HAS BEEN CALLED ON A SEPERATE QC NUMBER ALREADY - USUALLY-/P
46	"HE'S NOT AROUND, AND HE WON'T BE."
47	MR. LUD SAID THEY ARE TOO BUSY HARVESTING AND DON'T HAVE TIM
48	MRS. BETTENCOURT SAYS MR. BETTENCOURT IS CONTACT. HE IS VERY
49	-/JLD/
50	MRS. FREGGIARO SAID EDDY IS NEVER AVAILABLE DURING WORKING-/

OBS	COMMENT2
26	
27	
28	QUESTIONS-/LMC/
29	
30	
31	OF USE, HOW CAN I FIGURE OUT WHICH PUMP YOU'RE TALKING ABOUT
32	TIME FOR THIS.*POSS. MULTI-SITE. DO NOT CALL*-/JAW/
33	'-/RRF/
34	
35	
36	NOR WILL THEY BE USED NEXT YEAR. THEY RENT LAND OUT.-/CLR/
37	
38	
39	
40	
41	
42	SURVEY.-/JCM/
43	
44	
45	GETS HOME ABOUT 5:00 - HAS CALLED LAST FRIDAY-/PRA/
46	
47	E TO PARTICIPATE IN SURVEY-/RRF/
48	BUSY WITH THE HARVEST. SHE DOES NOT WISH US TO CALL HIM BACK
49	WIFE SAYS SOMEONE SURVEYED HER HUSBAND. JLD.
50	HOURS.-/JCM/

OBS	COMMENT1
51	
52	
53	
54	SPOKE TO MR. ZIELKE FOR A LONG WHILE, BUT I WAS UNABLE TO-/R
55	
56	"NO ONE IS INTERESTED"-/TRL/
57	-/JLD/
58	BUSY W/ HARVEST- DID NOT WANT TO BE CALLED BACK-/RWP/
59	HAD AN EMERGENCY AND HAD TO LEAVE. C/B TOMORROW TO FINISH-/C
60	
61	"THIS IS A VERY BAD TIME TO BE DOING THIS" -WIFE-/TRL/
62	HIS ANSWERING MACHINE SAID HE DIDN'T DO SURVEYS-/LMC/
63	WOMAN ON PHONE WAS A BIT CONFUSED ABOUT WHICH ACCOUNTS WERE-
64	FRANK IS ONLY IN AT NIGHT-/JLD/
65	
66	R3: BAD CONNECTION.-/SIL/
67	"NO."-/JCM/
68	SUSPICIOUS-/LMC/
69	
70	NOT INTERESTED IN DOING SURVEY.-/JAW/
71	"IS THIS POLITICAL?" MR. TURNMIRE IS SIMPLY TOO BUSY TO DO-
72	SPOKE TO MRS SALINAS; ASK TO SPEAK TO MR S-/LMC/
73	
74	
75	THIS IS EQUIP RENTALS CO. MS B WORKS THERE -- CB 12+-/LMC/

OBS	COMMENT2
51	
52	
53	
54	CONVINCE HIM TO DO SURVEY. PLEASE SEE SCREEN 76.-/REZ/
55	
56	
57	FLOYD NO LONGER LIVING.-/JLD/
58	
59	START S/C74-/CLR/
60	
61	
62	
63	WHICH, EVEN THOUGH SHE HAD THE BILL WITH HER.-/JCM/
64	
65	
66	R4: "I JUST PREFER NOT TO ANSWER ANY QS."-/SIL/
67	
68	
69	
70	
71	THE SURVEY-/TRL/
72	HE DIDN'T WANNA TALK,
73	
74	
75	

OBS	COMMENT1
76	CORR PH IS JOHN A. DIR ASST ALSO HAS JOHN JR 209-279-8431-/L
77	
78	MRS. HENDERSON SAYS THE MR. DIED, AND SHE ISN'T INTERESTED-/
79	PUMP HAS BEEN OUT OF OPER. FOR A WHILE VERY NICE LADY, SAID-
80	I ASKED, "DO YOU HAVE 10 MINUTES.?" HE ANSWERED, "NO. BYE."
81	WRONG- OUT OF DATE- ACCOUNT #, HE HUNG UP.-/TRL/
82	.POLITE REFUSAL. DO NOT CALL .-/DXA/
83	*REFUSAL*-/PRA/
84	WIFE SAYS THAT HUSBAND IS NOT REACHABLE UNTIL 8:30P.M
85	LEO WOULD DO IT BUT DIDN'T WANT TO TAKE THE TIME TO LOOK UP-
86	-/PRA/
87	WIFE SAID HE WOULDN'T BE INTERESTED HE'S SO BUSY HE JUST DOE
88	I'M IN THE MIDDLE OF PAYROLL, I DON'T HAVE THE PATIENCE TO A
89	
90	SPOKE WITH DMH GAVE TIME ABOVE AS TIME FOR SURVEY-/RTM/
91	MR. BERTOLINI - NICE-/PRA/
92	HE HAS PASSED AWAY; SHE'S NOT INTERESTED.-/SGW/
93	MAN ON PHONE SAID HIS DAD JUST LEASED OUT THE RANCH, AND-/JC
94	
95	WIFE REFUSED TO GIVE HUBBY PHONE SHE REFUSED TO DO SURVEY-/J
96	I DON'T ANSWER SUCH THINGS OVER THE PHONE AND THEN HUNG UP-/
97	JAMES LEAVES AT 6 AM AND GETS IN AT 9 PM.-/JAW/
98	LADY SAID THE BEST TIME TO CATCH LANCE IS A NIGHT .
99	WANTED QUESTIONAIRE SENT TO HIM, NOT OVER PHONE-/RWP/
100	PETER ASKED IF I COULD CALL BACK AT 5PM TO SPEAK WITH WIFE.-

OBS	COMMENT2
76	"I DON'T THINK YOU CAN TALK TO HIM, HE'S VERY BUSY RIGHT NOW
77	
78	IN DOING ANY SURVEYS.-/SGW/
79	SHE DOESN'T WANT ME TO CALL HER HUBBY BEC. HE NEEDS TO MAKE$
80	
81	
82	
83	
84	
85	ACCOUNT #-SAID HE HAD 20 RANCHES-/CDM/
86	"WE DO NOT HAVE TIME FOR SURVEYS"-/PXA/
87	SN'T HAVE TIME, SHE ALSO SAID HE'S NOT USING THIS PUM[-/RRF/
88	NSWER ALL THESE QUESTIONS"-/TRL/
89	
90	
91	
92	
93	IT'S NOT VERY BIG ANYWAY. POLITE REFUSAL.-/JCM/
94	
95	HERSELF.-/JLD/
96	
97	
98	
99	
100	HE COULDN'T HEAR ME VERY WELL.-/JLD/

OBS	COMMENT1
101	"HE DOESN'T LIKE SURVEYS, HE NEVER ANSWERS THEM."-/TRL/
102	JUST DID PARTICIPANT SURVEY; REFUSED THIS ONE NICELY-/LMC/
103	MS. PRETZER SAID TALK TO HER SON NORMAN BUT HE HADN'T THE-/S
104	LADY WAS VERY EDGEY ASKING ME A LOT OF QUESTIONS, SHE,
105	MR SUZA SAID HE HAD NO SERVICE IN MERCED-/LAR/
106	SAID HE ALREADY DID A SURVEY, NOT GOING TO DO ANOTHER.-/CDM/
107	MAIL ME THE QUESTIONS AND I WILL SEND IT BACK-/LAR/
108	DO NOT CALL DO NOT CALL SHE SAID SOMEONE CALLED HER TEN-/CDM
109	
110	REFUSSED TO DO SURVEY-/AMJ/
111	"DOES NOT DO THIS TYPE OF THING OVER PHONE."-/GMP/
112	DOES NOT TAKE PART IN SURVEYS.-/AMJ/
113	CALLED # NOT EUGENE, SAID HE SPENT AN HOUR ON THE PUMP TEST-
114	SPOKE WITH BOYCE DOES NOT ANSWER ANYTHING OVER THE PHONE-/RT
115	
116	POLITE REFUSAL-/PLM/
117	
118	
119	THEY CHOOSE NOT TO PARTICIPATE IN THIS SURVEY.-/SGW/-/SGW/
120	
121	MR. BROOKS HAS HEALTH PROBLEMS AND HE WOULD RATHER NOT-/REZ/
122	747-0836 FRED IS CONTACT.-/GMP/
123	WASN'T INTERESTED IN PARTICIPATING'-/RRF/
124	C.B TOMORROW-/PXA/
125	CITY IS LA GRANDE NOT PLANADA. RECEPT SAID TO CB NEXT WEEK-/

OBS	COMMENT2
101	
102	NOT RELATED TO PHILLIP SOUZA'S DAIRY IN TURLOCK-/LMC/
103	TIME NOR THE INCLINATION; WANTED A PAPER SURVEY NOT PHONE.-/
104	"LIKE THINGS THE WAY THEY ARE NO CHANGE" DON'T CALL UNLESS D
105	
106	
107	
108	MINUTES AGO POSSIBLE MULTI-SITE W/ CATI 13-/CDM/
109	
110	
111	
112	
113	THIS MORNING NOT INTERESTED.-/CDM/
114	
115	
116	
117	
118	
119	THESE PUMPS WERE IN USE, BUT AREN'T, BY THEM, ANYMORE.-/SGW/
120	
121	PARTICIPATE IN THE SURVEY.-/REZ/
122	LLOYD 458-5256 COMPLETED PARTIAL SURVEY-/PXA/
123	
124	
125	"DO WE GET ANYTHING? HE PROBABLY WON'T"-/TRL/

OBS	COMMENT1
126	
127	WIFE SAID TO CALL BEFORE 6AM OR AFTER 9PM.-/JAW/
128	"NO, I'M NOT", REFUSAL. NO OTHER CONTACT, HE SAYS.-/BB/
129	AT SCREEN 46 RAY BECAME ANNOYNED AT THE REPETITIVE NATURE OF
130	WOULD NOT DO SURVEY OVER PHONE. WANTED IT MAILED TO HIM.-/JA
131	DO NOT CALL: THEY WERE CALLED LAST WEEK FOR ORIGINAL PG&E AG
132	SPOKE WITH 3 DIFFRNT PEOPLE BUT EVERYONE SAYS THAT SOMEONE-/
133	DON'T WANT TO DO SURVEYS-/RWP/
134	DO NOT CALL- TOOK OFF WORK 1 HOUR EARLY TO DO THE SURVEY BUT
135	484-9738 IS CELLULAR PHONE-/PLM/
136	BUSY LOADING RAISINS-/LMC/
137	-/SGW/
138	RATHER NOT BE ON A SURVEY-/LAR/
139	CODED REFUSE BECAUSE HE HUNG UP DURING COMPUTER PROBLEM (SEE
140	WIFE SAID HE COULD NOT BE REACHED UNTIL AFTER 6PM.-/JLD/
141	MRS. WEIS NOT THAT KNOWLEDGABLE. START WITH S/C13.-/CLR/
142	MR BEBOUT SAID SOMEONE CALLED YESTERDAY AND HE COMPLETED THE
143	
144	-/JLD/
145	LEFT 800# ON JIM'S MACHINE FOR HIM TO CALL US-/CDM/
146	DIR ASST HAS LIST FOR "MITSU" SHIMIZU-/LMC/
147	DIR ASST HAD M.S SINGH-/LMC/
148	DAN SAYS HE HAS NO TIME FOR ME; ALL PG&E IS INTERESTED IN IS
149	-/JLD/
150	MULTI-SITE LITTLE GIRL SAID SOMONE CALLED ABOUT THIS YESTER-

OBS	COMMENT2
126	
127	-/JAW/
128	
129	THE QUESTIONS AND BECAME ABUSIVE, SO I ENDED THE SURVEY-/JEH
130	
131	
132	ELSE WOULD BE BETTER TO DO IT.-/RTM/
133	
134	NOBODY CALLED AND IS UPSET WITH CALLERS.****-/PXA/
135	MR. MUSSI IS NOT INTERESTED IN PARTICIPATING IN SURVEY-/RRF
136	
137	DOESN'T WANT TO BE BOTHERED WITH SURVEY.-/SGW/
138	
139	LOG SHEET) AND HAD DISPUTE W/ PG&E-/TRL/
140	
141	
142	IR QUESTIONS-/RWP/
143	
144	WIFE SAID SHE OR HUSBAND WOULDN'T BE INTERESTED IN SURVEY.-/
145	
146	REFUSED-/LMC/
147	NOT SURE IF RIGHT CONTACT-/LMC/
148	TO KEEP HIKING THEIR PRICES, ETC. >> HOSTILE; DO NOT CALL <<
149	-/JLD/
150	DAY AT HER GRANNY'S THOMAS HAD TALKED TO THEM-/CDM/

OBS	COMMENT1
151	IN HARVEST, OUT AT 7 AM AND BACK AROUND 9 PM.-/JAW/
152	DO NOT CALL DO NOT CALL DO NOT CALL.-/CDM/
153	SAYS HE HAS NO TIME.
154	
155	FRANK IS RETIRED & NOT INTERESTED IN PARTICIPATING.-/SGW/
156	SPOKE WITH DAP NOT AVAILABLE TO DO SURVEY VERY BUSY---------
157	THEY POSTPONE THINGS LIKE SURVEYS UNTIL THE FIRST OF THE-/JA
158	C.B MON MORN.-/PXA/
159	SEE QC # 2364.-/SGW/
160	MR. PEDROTTI SAID THAT SOMEONE HAD CALLED HIM ALREADY ABOUT-
161	THEY WERE OUT MOVING THEIR CATTLE FROM THE BIG FIRE. LADY AT
162	NO TIME FOR A SURVEY-/LAR/
163	ANSWERING MACHINE.-//
164	MRS. VANILA SAID THAT SOMEONE HAD CALLED HER HUSBAND THE OTH
165	HAS DONE SURVEY ALREADY-/PXA/
166	WE COULDN'T FIGURE OUT WHICH PUMP OF TWO WAS THE ONE AND HE-
167	947-3730 BUISS
168	MAN GOT UPSET AND HUNG UP-/PXA/
169	-//
170	THEY USE DISEL WHAT DOSE PG&E HAVE TO DO WITH THEM-/LAR/
171	
172	WOMAN ON PHONE SAID SHE THINKS PG&E DOES SURVEYS JUST SO-/JC
173	SPOKE WITH MR. SCHOCK WHO IS ANGRY WITH PG&E BECAUSE OF HIGH
174	REFUSAL-/LAR/
175	SEC. SAID THAT DR. SANDBURG WAS IN W/A CLIENT SHE REQUESTED-

OBS	COMMENT2
151	
152	THEY HAVE PROBLEMS DON'T CALL-/CDM/
153	
154	
155	
156	
157	YEAR BECAUSE OF HARVEST.-/JAW/
158	
159	
160	THIS PARTICULAR PUMP AND HE ANSW. QUEST. MIGHT BE A MULTI-/R
161	HOUSE SAID TO C/B IN A FEW DAYS.-/JAW/
162	
163	-/JAW/
164	ER DAY TO DO SURVEY. SHE DOESN'T REMEM. THEIR NAME-/RRF/
165	
166	DID NOT WANT TO LOOK UP THE INFORMATION.-/JAW/
167	
168	
169	-//
170	
171	
172	THEY CAN RAISE CUSTOMERS' RATES.-/JCM/
173	ELECTRIC BILLS AND DOES NOT WANT TO TAKE A SURVEY-/CLR/
174	
175	800# SO DR. SANDBURG COULD GET IN TOUCH W/US.-/RRF/

OBS	COMMENT1
176	DECIDED TO REFUSE.-/CDM/
177	
178	MR. CARDEL IS CONTACT.
179	DOESN'T DO SURVEYS-/TRL/
180	"SOMEONE CALLED YESTERDAY, AND WE TOLD THEM WE WEREN'T-/SGW/
181	THEY DO NOT DO SURVEYS OVER THE PHONE.-/PLM/
182	"WOULDN'T BE INTERESTED"-/TRL/
183	ANSWERING MACHINE-/LAR/-/LAR/ HE HAS NO TIME DUE TO HARVESTI
184	*READ* PG&E ARE THEIVES - WORSE THAN THE FEDERAL GOV'T.HE-/
185	FIRST SHE SAID SHE WOULD DO SURVEY AND THEN SHE SAID THAT TH
186	MRS. LOHSE SAID SOMEONE FROM OUR OFFICE CALLED, AND HE COM--
187	-//

OBS	COMMENT2
176	
177	
178	
179	-/LAR/
180	INTERESTED."-/SGW/
181	
182	
183	NG.-/GMP/
184	SWITCHING OVER TO DIESEL - HE SPENDS HUNDREDS OF THOUSANDS-/
185	E TIME PERIOD WAS TOO LONG AND DIDN'T WANT TO PARTICIP.-/RRF
186	PLETED SURVEY-/AMJ/
187	CHOSE NOT TO PARTICIPATE SAYS THERES NOTHIN IN FOR HIM.-/JLD

Appendix N

PROTOCOL TABLE 6

Protocol Table 6 (Item 1-5)
Results of Impact Measurement Study
PG&E 1994 Agricultural Sector
Agricultural Pumping
Study ID 315

Table Item		Agricultural Pumping		
Item††† Number	Result Description	Estimate	Rel. Precision****	
			90%	80%
1.A†	Pre-installation Usage, Base Usage and Per-Unit Base Usage	-	-	-
1.B†	Impact Year Usage	-	-	-
2.A	Gross Peak kW Impacts**	7,951	37%	29%
	Gross Annual kWh Impacts**	43,619,032	36%	28%
	Gross Annual Therm Impacts	-	-	-
	Net Peak kW Impacts	6,933	38%	30%
	Net Annual kWh Impacts	38,654,571	37%	29%
	Net Annual Therm Impacts	-	-	-
2.B*	Per-Unit Gross Peak kW Impacts**	0.020	37%	29%
	Per-Unit Gross Annual kWh Impacts**	110	36%	28%
	Per-Unit Gross Annual Therm Impacts	-	-	-
	Per-Unit Net Peak kW Impacts	0.017	38%	30%
	Per-Unit Net Annual kWh Impacts	98	37%	29%
	Per-Unit Net Annual Therm Impacts	-	-	-
2.C	Percent change in usage of the participant groups and comparison group	-	-	-
2.D.1	Gross Demand Realization Rate**	1.05	37%	29%
	Gross Energy Realization Rate**	0.81	36%	28%
	Gross Therm Realization Rate	-	-	-
	Net Demand Realization Rate	1.17	38%	30%
	Net Energy Realization Rate	0.91	37%	29%
	Net Therm Realization Rate	-	-	-
2.D.2*	Gross Per-Unit Demand Realization Rate**	1.05	37%	29%
	Gross Per-Unit Energy Realization Rate**	0.81	36%	28%
	Gross Per-Unit Therm Realization Rate	-	-	-
	Net Per-Unit Demand Realization Rate	1.17	38%	30%
	Net Per-Unit Energy Realization Rate	0.91	37%	29%
	Net Per-Unit Therm Realization Rate	-	-	-
3.A	NTG Ratio Based on Avg. Load Impacts	0.87	0.10	0.08
3.B	NTG Ratio Based on Per-Unit Avg. Load Impacts	0.89	0.10	0.08
3.C	Percent change in usage relative to base usage	-	-	-
4.A	Pre Avg. kWh/AF (Part)††	322.5	4.5%	5.7%
	Pre Avg. kWh/AF (Comp)***	-	-	-
4.B	Post Avg. kWh/AF (Part)††	274.0	4.5%	5.7%
	Post Avg. kWh/AF (Comp)***	-	-	-

Note: footnotes follow.

Footnotes for Agricultural Pumping, Table 6 (Items 1-5)

Note: Cells filled with a dash (-) are not applicable.

† The change model estimates of impact did not estimate base usage.

* For Units, see attached table, 1994 Agricultural Program Measure Units.

†† Item 4 has a low relative precision for the participant group due to how the values were calculated. The unit of measure (kWh/AF) was participant specific in only 36% of those within the participant group. The other 64% used a mean value based on region and irrigation type. This caused a low variance in this unit.

*** Item 4 does not have comparison group values. The comparison group used mean values for all determinations of kWh/AF and therefore, these values would be misleading.

**** Relative precision values for gross impacts reflect a combination of engineering estimates with relative precision of 100% at the 90% confidence level (a conservative assumption) and pump retrofits with a relative precision of 46% at the 90% level (see *Exhibit 5-10*). These are combined with the relative precisions for NTG which are 10% and 8% at the 90% and 80% levels.

††† Item 7 is not applicable for the agricultural sector as per the Protocols.

PG&E 1994 Agricultural Program Measure Units

End Use	Units of Measure
Agricultural - Pumping	-
Agricultural Water System Equipment Change - ISS	per custom application
Agricultural Water System Changes	per custom application
Agricultural Change/Add Equipment	per custom application
Pump Retrofit	per pump retrofit
Time Clock with Battery Backup (Agricultural)	per time clock
Pump Adjustment	per adjustment
Well Water Measurement Device	per foot of device length installed
Sprinkler Nozzle : Low Pressure	per nozzle
Surge Valve	per surge valve
Motors: Energy Efficient	per motor installed
Agricultural - Miscellaneous	-
Agricultural Other	per custom application
Greenhouse : Heat Curtain	per square foot
Milk Pre-Cooler	per gallon milked per day
Refrig : Desuperheater (Agricultural)	per cows milked per day
Greenhouse : Rigid Double-Walled Plastic	per square foot
Greenhouse : Double-Walled Polyethylene	per square foot
Refrigeration	per sq. ft, ln. f t., ton or per custom application
Food Service	per application
Process	per application
HVAC	per measure installed
Lighting Indoor	per lamp, ballast or fixture
Lighting Outdoor	per lamp, ballast or fixture
Agricultural EMS Program	per audit

Protocol Table 6 (Item 6)
Measure Count Data
PG&E 1994 Agricultural Sector
Agricultural Pumping

Study ID 315

Program and Technology Group Description	Number of Measures - 1994			
	All Participant	Participant Group	Participant Survey Sample Spillover	Comparison Group
Agricultural - Pumping				
Agricultural Custom Water System Changes	8	5	-	-
Agricultural Other Custom Measures	12	4	-	-
Pump Retrofit	807	281	43	34
Time Clock with Battery Backup (Agricultural)	52	-	38	13
Pump Adjustment	1,380	148	47	20
Well Water Measurement Device	118	-	14	12
Sprinkler Nozzle : Low Pressure	69	28	25	23
Surge Valve	3	-	-	-
Motors : Energy Efficient	106	-	-	-
Agricultural Pumping Total	2,555	466	167	102

Protocol Table 6 (Item 1-5)
Results of Impact Measurement Study
PG&E 1994 Agricultural Sector
Agricultural Miscellaneous
Study ID 321

Table Item		Agricultural Miscellaneous		
Item††† Number	Result Description	Estimate	Rel. Precision****	
			90%	80%
1.A†	Pre-installation Usage, Base Usage and Per-Unit Base Usage	-	-	-
1.B†	Impact Year Usage	-	-	-
2.A	Gross Peak kW Impacts**	1,958	57%	45%
	Gross Annual kWh Impacts**	20,681,899	66%	52%
	Gross Annual Therm Impacts	1,725,050	62%	48%
	Net Peak kW Impacts	1,288	81%	63%
	Net Annual kWh Impacts	14,845,724	94%	73%
	Net Annual Therm Impacts	1,361,546	88%	68%
2.B*	Per-Unit Gross Peak kW Impacts**	0.076	57%	45%
	Per-Unit Gross Annual kWh Impacts**	1263	66%	52%
	Per-Unit Gross Annual Therm Impacts	0.465	62%	48%
	Per-Unit Net Peak kW Impacts	0.073	81%	63%
	Per-Unit Net Annual kWh Impacts	1232	94%	73%
	Per-Unit Net Annual Therm Impacts	0.367	88%	68%
2.C	Percent change in usage of the participant groups and comparison group	-	-	-
2.D.1	Gross Demand Realization Rate**	0.55	57%	45%
	Gross Energy Realization Rate**	0.87	66%	52%
	Gross Therm Realization Rate	1.03	62%	48%
	Net Demand Realization Rate	0.49	81%	63%
	Net Energy Realization Rate	0.86	94%	73%
	Net Therm Realization Rate	1.03	88%	68%
2.D.2*	Gross Per-Unit Demand Realization Rate**	0.55	57%	45%
	Gross Per-Unit Energy Realization Rate**	0.87	66%	52%
	Gross Per-Unit Therm Realization Rate	1.03	62%	48%
	Net Per-Unit Demand Realization Rate	0.49	81%	63%
	Net Per-Unit Energy Realization Rate	0.86	94%	73%
	Net Per-Unit Therm Realization Rate	1.03	88%	68%
3.A	NTG Ratio Based on Avg. Load Impacts	0.73	66%	52%
3.B	NTG Ratio Based on Per-Unit Avg. Load Impacts	0.73	66%	52%
3.C	Percent change in usage relative to base usage	-	-	-
4.A	Pre Avg. kWh/AF (Part)††	-	-	-
	Pre Avg. kWh/AF (Comp)***	-	-	-
4.B	Post Avg. kWh/AF (Part)††	-	-	-
	Post Avg. kWh/AF (Comp)***	-	-	-

Note: footnotes follow.

Footnotes for Agricultural Miscellaneous Table 6 (Items 1-5)

Note: Cells filled with a dash (-) are not applicable.

† The change model estimates of impact did not estimate base usage.

* For Units, see attached table, 1994 Agricultural Program Measure Units.

**** Relative precision values reflect a combination of engineering estimates with relative precision of 100% at the 90% level (a conservative assumption) and the ex ante NTG relative precisions (assumed to be 100%). These relative precision were set at the end-use level with the assumption that the estimates are independent at the end-use level.

††† Item 7 is not applicable for the agricultural sector as per the Protocols.

PG&E 1994 Agricultural Program Measure Units

End Use	Units of Measure
Agricultural - Pumping	-
Agricultural Water System Equipment Change - ISS	per custom application
Agricultural Water System Changes	per custom application
Agricultural Change/Add Equipment	per custom application
Pump Retrofit	per pump retrofit
Time Clock with Battery Backup (Agricultural)	per time clock
Pump Adjustment	per adjustment
Well Water Measurement Device	per foot of device length installed
Sprinkler Nozzle : Low Pressure	per nozzle
Surge Valve	per surge valve
Motors: Energy Efficient	per motor installed
Agricultural - Miscellaneous	-
Agricultural Other	per custom application
Greenhouse : Heat Curtain	per square foot
Milk Pre-Cooler	per gallon milked per day
Refrig : Desuperheater (Agricultural)	per cows milked per day
Greenhouse : Rigid Double-Walled Plastic	per square foot
Greenhouse : Double-Walled Polyethylene	per square foot
Refrigeration	per sq. ft, ln. f t., ton or per custom application
Food Service	per application
Process	per application
HVAC	per measure installed
Lighting Indoor	per lamp, ballast or fixture
Lighting Outdoor	per lamp, ballast or fixture
Agricultural EMS Program	per audit

Protocol Table 6 (Item 6)
Measure Count Data
PG&E1994 Agricultural Sector
Agricultural Miscellaneous

Study ID 321

	Number of Measures - 1994			
Program and Technology Group Description	**All Participant**	**Participant Group**	**Participant Survey Sample Spillover**	**Comparison Group**
Agricultural - Miscellaneous				
Agricultural Other	5	-	-	-
Greenhouse : Heat Curtain	17	-	1	-
Milk Pre-Cooler	15	-	4	-
Refrig : Desuperheater (Agricultural)	4	-	3	1
Greenhouse : Rigid Double-Walled Plastic	16	-	1	-
Greenhouse : Double-Walled Polyethylene	16	-	-	-
Refrigeration	25	-	-	-
Food Service	1	-	-	-
Process	2	-	-	-
HVAC	14	-	-	-
Lighting Indoor	259	-	-	-
Lighting Outdoor	45	-	-	-
Agricultural Miscellaneous Total	419	0	9	1

Protocol Table 6 (Item 1-5)
Results of Impact Measurement Study
PG&E 1994 Agricultural Sector
Agricultural EMS
Study ID 318

Table Item		Agricultural EMS		
Item††† Number	Result Description	Estimate ****	Rel. Precision 90%	80%
1.A†	Pre-installation Usage, Base Usage and Per-Unit Base Usage	-	-	-
1.B†	Impact Year Usage	-	-	-
2.A	Gross Peak kW Impacts**	-	-	-
	Gross Annual kWh Impacts**	-	-	-
	Gross Annual Therm Impacts	-	-	-
	Net Peak kW Impacts	3,205	166%	129%
	Net Annual kWh Impacts	13,831,040	166%	129%
	Net Annual Therm Impacts	-	-	-
2.B*	Per-Unit Gross Peak kW Impacts**	-	-	-
	Per-Unit Gross Annual kWh Impacts**	-	-	-
	Per-Unit Gross Annual Therm Impacts	-	-	-
	Per-Unit Net Peak kW Impacts	0.596	166%	129%
	Per-Unit Net Annual kWh Impacts	2571	166%	129%
	Per-Unit Net Annual Therm Impacts	-	-	-
2.C	Percent change in usage of the participant groups and comparison group	-	-	-
2.D.1	Gross Demand Realization Rate**	-	-	-
	Gross Energy Realization Rate**	-	-	-
	Gross Therm Realization Rate	-	-	-
	Net Demand Realization Rate	0.86	166%	129%
	Net Energy Realization Rate	1.05	166%	129%
	Net Therm Realization Rate	-	-	-
2.D.2*	Gross Per-Unit Demand Realization Rate**	-	-	-
	Gross Per-Unit Energy Realization Rate**	-	-	-
	Gross Per-Unit Therm Realization Rate	-	-	-
	Net Per-Unit Demand Realization Rate	0.86	166%	129%
	Net Per-Unit Energy Realization Rate	1.05	166%	129%
	Net Per-Unit Therm Realization Rate	-	-	-
3.A	NTG Ratio Based on Avg. Load Impacts	-	24%	18%
3.B	NTG Ratio Based on Per-Unit Avg. Load Impacts	-	24%	18%
3.C	Percent change in usage relative to base usage	-	-	-
4.A	Pre Avg. kWh/AF (Part)††	-	-	-
	Pre Avg. kWh/AF (Comp)***	-	-	-
4.B	Post Avg. kWh/AF (Part)††	-	-	-
	Post Avg. kWh/AF (Comp)***	-	-	-

Note: footnotes follow.

Footnotes for Agricultural EMS Table 6 (Items 1-5)

Note: Cells filled with a dash (-) are not applicable.

† The change model estimates of impact did not estimate base usage.

* For Units, see attached table, 1994 Agricultural Program Measure Units.

** All EMS program effects are shown in the table as net effects since program impacts are interpreted as spillover from the EMS audit.

**** Relative precision values reflect a combination of SAE regression errors (see *Exhibit C-8*) with relative precisions of 165% and 128%, for the 90% and 80% confidence levels, respectively, and relative precisions for the spillover effect (with relative precisions of 24% and 18%, for the 90% and 80% confidence levels, respectively).

††† Item 7 is not applicable for the agricultural sector as per the Protocols.

PG&E 1994 Agricultural Program Measure Units

End Use	Units of Measure
Agricultural - Pumping	-
Agricultural Water System Equipment Change - ISS	per custom application
Agricultural Water System Changes	per custom application
Agricultural Change/Add Equipment	per custom application
Pump Retrofit	per pump retrofit
Time Clock with Battery Backup (Agricultural)	per time clock
Pump Adjustment	per adjustment
Well Water Measurement Device	per foot of device length installed
Sprinkler Nozzle : Low Pressure	per nozzle
Surge Valve	per surge valve
Motors: Energy Efficient	per motor installed
Agricultural - Miscellaneous	-
Agricultural Other	per custom application
Greenhouse : Heat Curtain	per square foot
Milk Pre-Cooler	per gallon milked per day
Refrig : Desuperheater (Agricultural)	per cows milked per day
Greenhouse : Rigid Double-Walled Plastic	per square foot
Greenhouse : Double-Walled Polyethylene	per square foot
Refrigeration	per sq. ft, ln. f t., ton or per custom application
Food Service	per application
Process	per application
HVAC	per measure installed
Lighting Indoor	per lamp, ballast or fixture
Lighting Outdoor	per lamp, ballast or fixture
Agricultural EMS Program	per audit

Protocol Table 6 (Item 6)
Measure Count Data
PG&E 1994 Agricultural Sector
Agricultural EMS

Study ID 318

	Number of Measures - 1994			
Program and Technology Group Description	**All Participant**	**Participant Group**	**Participant Survey Sample Spillover**	**Comparison Group**
Agricultural - Pumping				
Agricultural Custom Water System Changes	-	-	-	-
Agricultural Other Custom Measures	-	-	-	-
Pump Retrofit	-	-	3	34
Time Clock with Battery Backup (Agricultural)	-	-	13	13
Pump Adjustment	-	-	7	20
Well Water Measurement Device	-	-	7	12
Sprinkler Nozzle : Low Pressure	-	-	14	23
Surge Valve	-	-	-	-
Motors : Energy Efficient	-	-	-	-
Agricultural - Miscellaneous				
Agricultural Other	-	-	-	-
Greenhouse : Heat Curtain	-	-	-	-
Milk Pre-Cooler	-	-	-	-
Refrig : Desuperheater (Agricultural)	-	-	-	1
Greenhouse : Rigid Double-Walled Plastic	-	-	-	-
Greenhouse : Double-Walled Polyethylene	-	-	-	-
Refrigeration	-	-	-	-
Food Service	-	-	-	-
Process	-	-	-	-
HVAC	-	-	-	-
Lighting Indoor	-	-	-	-
Lighting Outdoor	-	-	-	-
EMS Program Total	5,380	455	44	103

Appendix O

PROTOCOL TABLE 7

Appendix O

PROTOCOL TABLE 7

1994 AGRICULTURAL PROGRAMS—PUMPING AND RELATED MEASURES

This section provides backup documentation for the Impact Evaluation of Pacific Gas & Electric Company's 1994 Agricultural Programs (the Report). The purpose of this section is to provide the documentation for data quality and processing as required in Table 7 of the Protocols. Major topics are organized and presented in the same order as they are listed in Table 7 for ease of reference and review. When responses to the items are discussed in detail elsewhere in the Report, only a reference or a brief summary will be given in this section to avoid redundancy.

A. OVERVIEW INFORMATION

1. Study Title and Study ID Number

Study Title: Impact Evaluation of Pacific Gas & Electric Company's 1994 Agricultural Programs--Pumping and Related Measures. (Note revised title.)

Study ID Number: 315 (Agricultural Pumping).

2. Program, Program Year and Program Description

Program: Two PG&E Programs (Agricultural sector only) are evaluated: (1) Retrofit Express (RE) Program and (2) Customized Incentive (Customized) Program.

Program Year: Rebates Paid in the 1994 Calendar Year, which include measures implemented between 1992-1994 and 1991-1994 for the RE and Customized Programs, respectively. The majority of the measures (over 99%) were implemented under the RE/Customized Programs in 1993 and 1994.

Program Description:

The RE program offered fixed rebates to CIA customers that installed specific gas or electric energy-efficiency equipment in their facilities. The program covered the most common energy saving measures, including lighting, air conditioning, refrigeration, motors, agricultural applications, and food service. Customers were required to submit proof of purchase with their applications in order to receive rebates. The program was marketed primarily to small- and medium-sized commercial, industrial, and agricultural customers. The maximum rebate amount, including all measure types, was $300,000 per account. No minimum amount was required to qualify for a rebate.

Specifically, the program offered rebates on the following relevant technologies for the Agricultural sector:

- Pumping Measures
  - Pump retrofits
  - Pump adjustments
  - Well water measurement devices
  - Low pressure sprinkler nozzles[1]
  - Time clocks with battery backup
- Miscellaneous Measures
  - Heat curtains to reduce heating in greenhouse
  - Double-walled polyethylene to reduce heating in greenhouses
  - Rigid double-walled plastic to reduce heating in greenhouses
  - Milk pre-coolers
  - Refrigeration desuperheaters

In addition, measures from the commercial applications were applied in the agricultural segment. These include energy efficient motors, HVAC, food service, lighting, refrigeration, and process applications.

The Customized program offered financial incentives to CIA customers who undertook large or complex projects that save gas or electricity. These customers were required to submit calculations for projected first-year energy impacts with their applications and prior to installation of the project. The maximum incentive amount for the Customized

[1] See *Appendix J* for further discussion on this measure.

program was $500,000 per account, and the minimum qualifying incentive was $2,500 per project. The total incentive payment for kW, kWh, and therm savings was limited to 50% of direct project cost for retrofit of existing systems. Since the program also applied to expansion projects, the new systems incentive was limited to 100% of the incremental cost to make new processes or added systems energy efficient. Customers were paid 4 cents per kWh and 20 cents per therm for first-year annual energy impacts. A $200 per peak kW incentive and a $50 per peak kW early completion (October 31, 1994) bonus for peak demand impacts required that savings be achieved during the hours PG&E experiences high power demand.

The measures rebated under the Customized program varied widely. The two measure types that contributed most to the Customized impacts were water system improvements and refrigeration.

3. End Uses and/or Measures Covered

End Use Covered: Agricultural Pumping (electric) and Related Measures.

Measures Covered: For the list of measures covered in this Evaluation, see Exhibit 3-1 in the Report.

4. Methods and Models Used

The PG&E Agricultural Programs Evaluation (the Evaluation) consisted of three key analysis components: engineering analysis, billing data regression analysis, and net-to-gross analysis. This integrated approach reduces a complicated problem to manageable components, while incorporating the comparative advantages of each analysis method. For a detailed discussion of analysis method used, see *Section 5: Evaluation Methodology* in the Report.

5. Participant and Comparison Group Definition

Participant:

Participants of the Agricultural RE and Customized Programs, Pumping and Related Measures, are defined as those PG&E agricultural customers who received PG&E rebates in the 1994 calendar year for installing at least one agricultural pumping or related measure under the RE and Customized Programs.

Comparison Group:

The comparison group for this study is defined as a group of PG&E agricultural customers who did not receive any rebates in the 1994 calendar year under the RE and Customized Programs and who represent the non-participant population distribution as a random selected sample. Customers who participated in previous years are eligible for the comparison group. Customers who participated in PG&E's Agricultural EMS Program are not eligible because this comparison group was selected to serve as the control group for the evaluation of both programs.

6. Analysis Sample Size

Two telephone survey samples (466 participants and 453 comparison group customers) were collected as part of this evaluation. In addition to the telephone survey sample, a total of 219 on-site surveys were collected from customers who participated in the Agricultural Programs, Pumping and Related Measures. The final sample distribution by sample type, program, and measure type is presented in Exhibit A-4 of the Report.

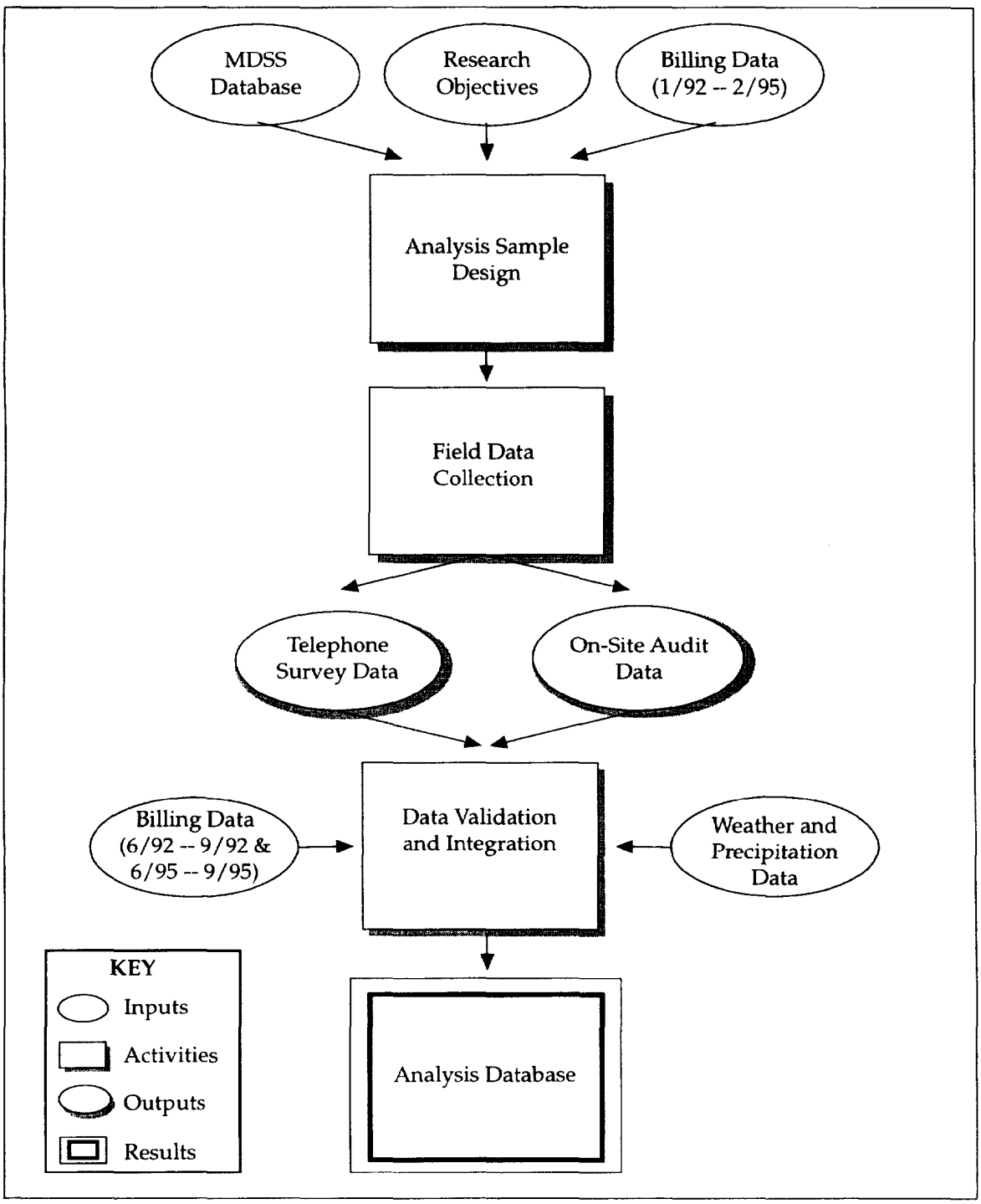
B. DATABASE MANAGEMENT

1. Data Description and Flow Chart

The Evaluation was based on a nested sample design. The main feature of this approach is that it consists of three groups of customers subsetted according to the type of information available. For the participant sample, the largest customer group included all of the agricultural customers who participated in 1994 (the participant population) with monthly PG&E billing data and participant tracking data. The smallest group included the on-site audited participants with the most comprehensive information available—on-site audit data, telephone survey, participant tracking data, and billing data. A similar nested sample design was also implemented for the comparison group with the exception that the on-site audit data was not collected for the comparison group. The advantage of a nested sample design was that it yielded overlapping samples which were used to leverage key items from the on-site audit sample to the larger telephone survey sample.

All data elements mentioned above were linked to the final analysis database through the unique customer identifier—PG&E's customer control number. For this evaluation, the analysis database served as a centralized tracking system for customers' billing history, program participation, and sampling status and helped to reduce data problems such as account mis-match, double counting, or repeated customer contacts. Exhibit O-1 illustrates how each key data element was used to create the final analysis database for the Evaluation.

Exhibit O-1
Analysis Database Development



2. Key Data Elements and Sources

A complete list of data elements and their sources can be found in *Section 5.1* of the Report. The key analysis data elements and their sources are summarized below:

- **Program Participant Tracking System** - The participant tracking system for the RE and Customized programs was maintained as part of the PG&E MDSS. It contains program application, rebate, and technical information about installed measures, including measure description, quantity, rebate amount, and ex ante demand, energy, and therm saving estimates. The MDSS database is linked to the billing database and other program databases through PG&E's customer control numbers.

- **PG&E Billing Data** - Initially, the PG&E billing data were obtained from two PG&E data sources. The original nonresidential billing dataset contains monthly energy usage for all nonresidential accounts in the PG&E service territory, and was used in the sample design as described in *Appendix A* of the Report. The second billing dataset, which consists only of customer accounts in the surveyed dataset, was later obtained from PG&E's Load Data Services.[2] Since the second billing dataset has many useful fields not included in the first dataset, a decision was made to use the second billing dataset to conduct the statistical analysis. The billing series used in the analysis is the PG&E prorated monthly usage data, a series calculated by PG&E for each calendar month, from two time periods: June 1992- September 1992 and June 1995-September 1995.

- **Telephone Survey Data** - Two telephone survey samples (466 RE/Customized participants and 453 comparison group customers) were collected as part of this evaluation. The telephone survey supplies information on customer decision-making, equipment operation characteristics, and energy-related changes at each site for the billing period covered by the billing regression analysis. The final telephone sample distribution is presented in Exhibit 5-9 in the Report and the sample design procedures are presented in *Appendix A*, pages A-4 - A-11.

[2] A preliminary analysis has concluded that the monthly usage and bill read date information in these two datasets is consistent.

- **On-Site Audit Data** - On-site audit data was collected as part of this evaluation for the participant group. The on-site audit is designed to support the telephone sample for the largest participation segments. This sample contributes site-specific equipment details, and better estimates of operating hours and operating factors. There are a total of 165 on-site audits used for this impact evaluation, including 111 pump testing sites and 54 pump adjustment sites. In addition, on-site audit data was collected on a total of 54 low pressure nozzles sites for the purpose of the retention study.

Other data elements include weather data from various sources, PG&E program marketing data, program procedural manuals, technical documents, crop information/handbook, and other industry standard data sources.

3. *Data Attrition Process*

All data elements mentioned above were first validated and then merged together to form the final analysis dataset. Records with out-of-range or questionable data were either deleted or flagged to ensure that only those records with sufficient data, both in terms of data quality and representativeness, were used in the analysis. The key data attrition decisions are summarized in *Appendix A*, pages A-5 - A-7.

4. *Internal Data Quality Procedures*

The Evaluation contractor of this project, Quantum Consulting Inc. (QC), has performed extensive data quality control on all categories of program data, including utility billing data, program tracking data, telephone survey data, and on-site audit data. QC's data quality procedures are consistent with PG&E's internal database guidelines and the guidelines established in the Protocols.

Throughout the course of sample design and creation, survey data collection, and data analysis, several data quality assurance procedures were in place to insure that all energy usage data used in analysis and all telephone survey data collected were of high quality and would prove useful in later analysis. The stages of data validation undertaken and the methods employed are detailed below:

- **Pre-Survey Usage and Account Characteristic Data Validation** - The goal of this stage of data validation was to screen out customers who had unreasonable or unreliable usage data, or who had changes in key elements of their billing data over the 1992 to 1995 period. Accounts for which changes were observed in account numbers, service addresses, SIC codes, electric rate schedules, electric meter numbers, or corporation and premise identification variables, were excluded from sample eligibility. Usage data reliability screening first eliminated from sample eligibility accounts which experienced service interruptions, exhibited inconsistent read dates, or for which bills were estimated. Additionally, based on comparisons of account usage between years, and between different months in the same year, customers with unusual usage patterns such as unusually high variation in monthly

or yearly usage were given special attention and, in some cases, excluded from the sample frame. A more detailed discussion of the steps undertaken in the pre-survey usage and account characteristics data validation, is provided in the discussion of survey sample creation in *Appendix A*, pages A-5 - A-7.

- **Real Time Survey Data Validation** - Survey data collection was performed using QC's 24 station Computer Aided Telephone Interviewing (CATI) center. Data entry applications, programmed using SAS/AF software, employed logical branching routines and real-time data validation procedures to insure that survey questions were appropriate for each customer's situation and that recorded responses were reasonable and logical. Data entry applications also performed real time range checks and field protection for out of range values during the data collection process thereby affording an additional means of ongoing data validation. Finally, because SAS/AF was used to program the data collection software, the survey data was on-line in the form of a SAS dataset continuously throughout the course of data collection. This allowed for the generation of frequency distributions and cross-tabs on data at regular stages throughout the survey fielding to facilitate QC's internal early detection and correction of data entry errors.

- **Final Survey Data Validation** - Following the completion of survey data collection, all data were subjected to a final stage of validation and cleaning during which illogical responses were identified and corrected or flagged, and corrections were made to any miscoding of data not detected in earlier stages of cleaning and validation. All activities undertaken in the course of survey were documented in accordance with QC's Enumerated Quality Assurance Logs and Standards (EQUALS) survey data collection documentation protocols.

- **On-Site Audit Data Validation** - Each audit performed was checked for completeness of the audit. Input on the audits which appeared to be out of line with expected values were checked with the auditor and re-entered if necessary.

5. Unused Data Elements

All data collected specifically for the Evaluation was utilized in this impact evaluation with the exception of 54 on-site audits (all low pressure nozzles sites) that were collected for the retention study.

C. SAMPLING

1. Sampling Procedures and Protocols

The sampling procedures and protocols are presented in *Appendix A: Sample Design.* This includes a detailed discussion on sampling frame definition for participants and

comparison group, sampling strategy, sampling unit definition, data preparation for sample selection, sample target and final achieved sample. It also presents the procedures and results of sample relative precision calculation based on the total energy usage and demonstrates how the Evaluation sample design meets the Protocols' requirement in terms of sample size and relative precision.

2. *Survey Information*

Data collection instruments are presented in *Appendix D* (participant telephone survey), *Appendix E* (comparison group telephone survey), and *Appendix F* (participant on-site audit) of the Report. Participant and comparison group customer's survey response frequencies are presented in *Appendices G* and *H*, respectively, of the Report. Finally, reasons for refusals are presented in *Appendices K* (for participants) and *M* (for comparison group customers) of the Report.

3. *Statistical Descriptions*

As mentioned above, a complete set of participant and comparison group customers' responses frequencies are presented in *Appendices G* and *H*, respectively. In addition, statistics on key variables that were used in the billing data regression models are also presented in *Appendix C* of the Report, pages C-5 - C-10.

D. DATA SCREENING AND ANALYSIS

A detailed discussion of the billing data regression data analysis is presented in *Appendix C*. The specific procedures and modeling issues are further discussed below.

1. *Outliers, Missing Data and Weather Adjustment*

Outlier analysis was conducted using statistical outlier tests (e.g., studentized residuals and the hat matrix) in combination with the model graphical outputs (e.g., two-dimension scatterplots, residual graphs, partial regression graphs, etc.). This is well known that the graphical displays are often the most powerful outlier diagnoses tools because they can detect both explicit and hidden outlier and influential observations. An observation is called an "outlier" if it is distinct from most of the data points in a sample and an outlier is called an "influential" if its deletion from the analysis causes a pronounced change in one or more of the estimated parameters. Sometimes, one observation may have sufficiently extreme values on both response variable and on one or more of the regressors so that it has an overriding effect on the estimates, even though the residuals for that observation is small. In this case, this observation may be "invisible" or "hidden" from some statistical outlier tests based on residuals, but its impact can often be detected from a graphic display.

Observations with missing energy consumption data were eliminated from the analysis. There are only two customers in the sample that cannot be merged with the billing data and therefore have missing energy usage data. For survey responses, a major effort has

been made to reduce the non-response rate on specific questions. Dependent upon the nature of the fields, missing or non-response items in the analysis samples were either filled with interpolation values or defaulted to some kind of sample means.

Weather adjustment was conducted to reflect the difference of required pumping energy as a function of weather effects. A thirty year average precipitation value was used in the engineering algorithm to represent the normalized weather. This information is presented in *Appendix B* of the Report, page B-10.

2. Background Variables

Background variables, water policy, and agricultural economic factors were not explicitly modeled in the final model, However, the effect of these factors was explicitly accounted for when a cross-sectional time series model was used with a comparison group. This is based on the assumption that the comparison group was equally impacted by the same set of background variables.

3. Data Screen Process

As explained in *Appendix C*, pages C-4 - C5, the final model was fitted based on the summer electricity usage between pre-installation summer period (June 1992 - September 1992) and post-installation period (June 1995 - September 1995). Observations with largest summer usage were removed from the final model. The cut point is around 500 MWh and it removed a total of 10 observations from the analysis. After this removal, the final model was estimated on a total of 907 observations with 456 participants and 451 comparison group customers.

4. Regression Statistics

The results of the billing regression analysis for the RE/Customized Programs are presented below. This model was estimated on a total 907 observations with 456 participants and 451 comparison group customers. A detailed parameter definition is presented in *Appendix C*, pages C-4 - C-12.

Exhibit O-2
RE/Customized Programs Billing Regression Model Results

Parameter Description	Parameter Estimate	t-statistic
Region Specific Intercept		
Region 1	5,256	3.2
Region 2	7,235	3.3
Region 3	2,839	1.6
Region 4	2,709	1.0
Slopes on Pre-Usage by Utilization Segment		
Normal to Normal	1.00	39
Normal to Low	0.00	0.1
Low to Normal	4.46	6.9
Low to Low	0.52	1.7
Impacts as Percentage of Pre-Usage		
Pump Retrofit	-0.12	3.6
Pump Adjustment	-0.06	0.6
RE/Customized with EMS	-0.03	0.9
Low Pressure Sprinkler and Nozzles	-0.07	0.6
Customized Measures	-0.06	0.8
Change Variables (Multiplied by Pre-Usage)		
Outside Program Retrofit	0.026	0.7
Outside Program Adjustment	0.055	1.0
Outside Program Nozzles	-0.243	1.0
Other Outside Program Measures	-0.055	0.8
Implement EMS Recommendations	-0.055	0.8
Acreage Changes	-0.25	5.7
Other End Use Changes	0.283	0.6

Number of Observation:	907
R-squared:	0.83

As shown in the above exhibit, most of the impact coefficients in the model are not statistically significant with the exception of the pump retrofit measures, which show an impact of 12% on the pre-installation usage level. The 90% confidence interval around this estimate is ±5%.

5. *Model Specification*

The model specifications are presented in *Appendix C,* pages C-11 - C-12. Specific model specification issues are further discussed below:

a. **Cross-sectional Variation** - The final model specification recognizes the potential heterogeneity problem in the model and uses the following procedures to eliminate the impacts of the cross-sectional variation: (1) observations with highest usage values were removed in the model to reduce the overall variance of the sample in terms of usage and size and (2) independent variables were all intercepted with the pre-installation usage to ensure that change of independent variable will be proportional to the usage value.

b. **Time Series Variation** - The key factors to control for the time series variation in the final model are: (1) use of the comparison group to define the relationship of the energy consumption between two different time periods and (2) eliminate the multiple time period interactions by using only one seasonal pre-installation period (June 1992 - September 1992) and one post-installation period (June 1995 - September 1995).

c. **Self-selection** - Self-selection is not treated explicitly in the billing regression analysis. The reasons for excluding such a correction is based on the following considerations: (1) the objective of the billing regression analysis is to estimate the program gross energy impacts. The self-selection bias, even exists, has very limited impacts on the outputs of such estimation when both cross-sectional and time series data are used and (2) the existing self-selection correction procedures all have serious flaws in their underlying assumptions. For example, the Mills ratio approach requires that the comparison group customers are in the market and it often introduces multi-collinearity between the Mills ratio variable and other variables that are already in the model, such as impacts or usage.

d. **Collinearity** - Based on the collinearity analysis, survey variables that are potentially correlated were grouped together in the final model to form new independent variables. For example, all EMS recommendations were collapsed into one variable and region 4, 5, and 6 were combined to form a new region due to low participation and correlation with other variables.

e. **Net Impact** - The billing regression model was used to estimate the gross energy impact only. The net impact analysis was conducted based on the survey self-report as discussed in more detail in *Section 5.3* in this Report.

6. Measurement Errors

For the billing data regression analysis, the main source of measurement error is the telephone survey. Our approach has been to proactively stop the problem before it happens so that statistical corrections are kept to a minimum.

Measurement errors are a combination of random and non-random error components that plague all survey data. The non-random error frequently takes the form of

systematic bias, which includes, but is not limited to, ill-formed or misleading questions and miscoded study variables. In this project, we have implemented several controls to reduce the systematic bias in the data. These steps included (1) thorough auditor/coder training; (2) instrument pretest; and (3) cross-validation between on-site audit data and telephone survey responses.

The random measurement error, such as data entry error, has no impact on estimating mean values because the errors are typically unbiased. For the measures that were modeled in the billing regression analysis, the impact of random unbiased measurement errors was accounted for as part of the overall standard variance in the parameter estimate.

7. Autocorrelation

The autocorrelation problem exists if the residuals in one time period are correlated with the residuals in the previous time period. Since the final model is based on a seasonal pre- and post-installation period comparison with only one season in each period, the autocorrelation problem was unlikely to occur under this scenario, as was confirmed by examining the Durbin-Watson statistic for these models.

8. Heteroskedasticity

See *D.1* of this Appendix.

9. Collinearity

Various statistical tests (such as COLLIN and VIF options in SAS) were used to check multiple collinearity problem among independent variables in the model to ensure that the final parameter estimates are robust.

10. Influential Data Points

See *D.1* of this Appendix.

11. Missing Data

See *D.1* of this Appendix.

12. Precision

The relative precision of the parameter estimate is calculated based on the model estimated mean and standard error values. For example, the relative precision at the 90 percent confidence level can be estimated as (1.645*standard error)/mean.

For the sample relative precision in terms of annual usage, see *Appendix A.*, pages A-11 - A-12.

E. DATA INTERPRETATION AND APPLICATION

The engineering analysis (results and methods) is covered in detail in *Sections 3.1, 5.2.2-5.2.3* and *Appendix B*. The billing regression analysis is discussed in *Sections 3.1, 5.2.4* and *Appendix C*. The program net-to-gross analysis was conducted based on survey self-report. For a detailed NTG analysis discussion, see *Sections 3.2, 5.3* and *Appendix P* of the Report.

Appendix O

PROTOCOL TABLE 7

1994 AGRICULTURAL PROGRAMS— MISCELLANEOUS MEASURES

This section provides backup documentation for the Impact Evaluation of Pacific Gas & Electric Company's 1994 Agricultural Programs (the Report). The purpose of this section is to provide the documentation for data quality and processing as required in Table 7 of the Protocols. Major topics are organized and presented in the same order as they are listed in Table 7 for ease of reference and review. When responses to the items are discussed in detail elsewhere in the Report, only a reference or a brief summary will be given in this section to avoid the information redundancy.

A. OVERVIEW INFORMATION

1. Study Title and Study ID Number

Study Title: Impact Evaluation of PG&E's 1994 Agricultural Programs–Miscellaneous Measures. (Note revised title.)

Study ID Number: 321 (Agricultural Miscellaneous).

2. Program, Program Year and Program Description

Program: Two PG&E Programs (Agricultural sector only) are evaluated: (1) Retrofit Express (RE) Program and (2) Customized Incentive (Customized) Program.

Program Year: Rebates Paid in the 1994 Calendar Year, which include measures implemented between 1992-1994 and 1991-1994 for the RE and Customized Programs, respectively. The majority of the measures (over 99%) were implemented under the RE/Customized Programs in 1993 and 1994.

Program Description: See *Section 2.1* (for the RE Program) and *Section 2.2* (for the Customized Program).

3. End Uses and/or Measures Covered

End Use Covered: Miscellaneous Agricultural and Other Technologies.

Measures Covered: For the list of measures covered in this evaluation, see Exhibit 3-1 in the Report.

4. Methods and Models Used

The PG&E Agricultural Programs Evaluation (the Evaluation) is based on the engineering analysis of two key technologies: Greenhouse and Indoor Lighting. For the greenhouse measures, an engineering review of the ex ante algorithms and assumptions was performed as well as an engineering analysis of therm impact using the computer simulation, DOE-2. For indoor lighting, an engineering review of operating hours and peak operating factors for specific technologies was performed. All other miscellaneous measures received an engineering review of the ex ante algorithms and assumptions. For a more detailed discussion, see *Appendix B* of the Report, *pages B-21 through B-25* for greenhouse analysis and *Appendix R* of the Report, for the lighting analysis.

5. Participant and Comparison Group Definition

Participant: Participants of the Agricultural RE and Customized Programs, Miscellaneous Agricultural and Other Technologies, are defined as those PG&E agricultural customers who received PG&E rebates in the 1994 calendar year for installing at least one miscellaneous measure under the RE and Customized Programs.

Comparison Group: A comparison group was not required and was not collected for this evaluation.

6. Analysis Sample Size

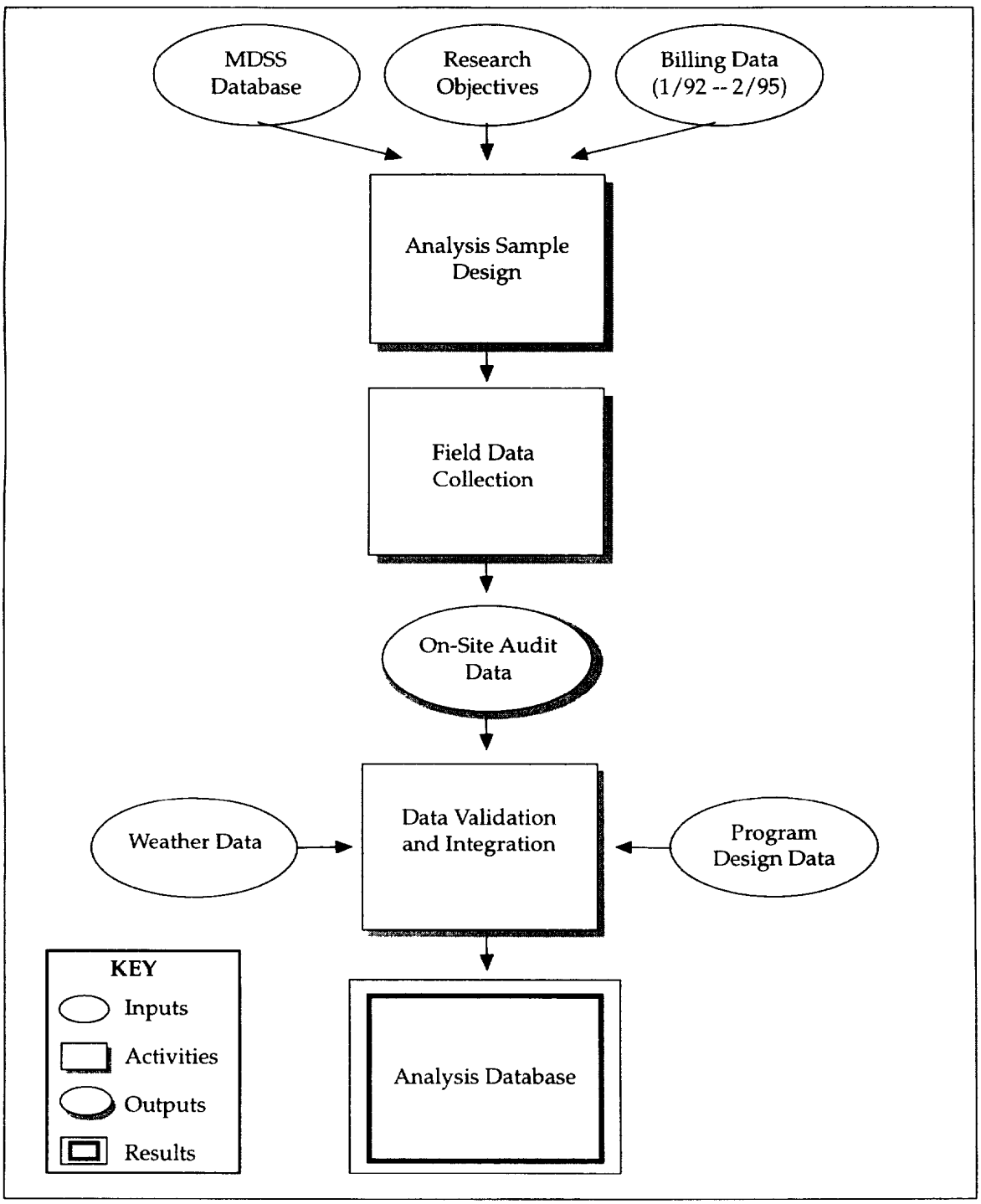
As part of this evaluation, a total of 42 on-site audits were collected for greenhouse participants. The final sample distribution by sample type, program, and measure type is presented in the retention database.

B. DATABASE MANAGEMENT

1. Data Description and Flow Chart

All data elements collected were linked to the final analysis database through the unique customer identifier—PG&E's customer control number. For this Evaluation, the analysis database served as a centralized tracking system for program participation and sampling status and helped to reduce data problems such as account mis-match, double counting. Exhibit O-1 illustrates how each key data element was used to create the final analysis database for the Evaluation.

Exhibit O-1
Analysis Database Development



2. *Key Data Elements and Sources*

A complete list of data elements and their sources can be found in *Section 5.1* of the Report. The key analysis data elements and their sources are summarized below:

- **Program Participant Tracking System** - The participant tracking system for the RE and Customized programs was maintained as part of the PG&E MDSS. It contains program application, rebate, and technical information about installed measures, including measure description, quantity, rebate amount, and ex ante demand, energy, and therm saving estimates. The MDSS database is linked to the billing database and other program databases through PG&E's customer control numbers.

- **On-Site Audit Data** - A total of 42 on-site audits were collected for greenhouse participant as part of this evaluation. This sample contributes site-specific equipment details and better estimates of operating hours.

- Other data elements include weather data from various sources, PG&E program marketing data, program procedural manuals, technical documents, and other industry standard data sources.

3. *Data Attrition Process*

All data elements mentioned above were first validated and then merged together to form the final analysis dataset. Records with out-of-range or questionable data were either deleted or flagged to ensure that only those records with sufficient data, both in terms of data quality and representativeness, were used in the analysis.

4. *Internal Data Quality Procedures*

The evaluation contractor of this project, Quantum Consulting Inc. (QC), has performed extensive data quality control on all categories of program data, including program tracking data and on-site audit data. QC's data quality procedures are consistent with PG&E's internal database guidelines and the guidelines established in the Protocols.

Several data quality assurance procedures were in place to insure that all data collected and used in analysis were of high quality and would prove useful in later analysis. The stages of data validation undertaken and the methods employed are detailed below:

- Each on-site audit performed was checked for completeness of the audit. Input on the audits which appeared to be out of line with expected values were checked with the auditor and re-entered if necessary.

5. *Unused Data Elements*

Without exception, all data collected specifically for the Evaluation was utilized in the analysis.

C. SAMPLING

1. Sampling Procedures and Protocols

Not applicable because the billing regression analysis was not conducted in this evaluation.

2. Survey Information

Participant on-site audit instrument is presented in *Appendix F* of the Report. The on-site audit database is a separate deliverable in conjunction with the retention database.

3. Statistical Descriptions

Not applicable because the billing regression analysis was not conducted in this evaluation.

D. DATA SCREENING AND ANALYSIS

Not applicable because the billing regression analysis was not conducted in this evaluation.

E. DATA INTERPRETATION AND APPLICATION

The engineering analysis (results and methods) is covered in detail in *Sections 3.1, 5.2.2-5.2.3, Appendix B* and *Appendix R*. NTG values used for Agricultural Miscellaneous were taken from the MDSS.

Appendix O

PROTOCOL TABLE 7
1994 AGRICULTURAL PROGRAMS—
ENERGY MANAGEMENT SERVICES

This section provides backup documentation for the Impact Evaluation of Pacific Gas & Electric Company's 1994 Agricultural Programs (the Report). The purpose of this section is to provide the documentation for data quality and processing as required in Table 7 of the Protocols. Major topics are organized and presented in the same order as they are listed in Table 7 for ease of reference and review. When responses to the items are discussed in detail elsewhere in the Report, only a reference or a brief summary will be given in this section to avoid the redundancy.

A. OVERVIEW INFORMATION

1. Study Title and Study ID Number

Study Title: Impact Evaluation of PG&E's 1994 Agricultural Programs–Energy Management Services. (Note revised title.)

Study ID Number: 318 (Agricultural EMS).

2. Program, Program Year and Program Description

Program: Energy Management Services (EMS) Program, Agricultural Sector.

Program Year: Pump tests conducted in 1994.

Program Description:

The EMS program offered information to CIA customers regarding energy efficiency technologies and practices. PG&E representatives worked with customers to identify cost effective improvements with special emphasis on operational and maintenance measures at the customers' facilities. For agricultural customers the services generally include a pump test and a walk-through audit culminating in a list of recommendations for capital intensive or low-cost/no-cost energy efficiency improvements. The most common recommendations were for pump adjustments or retrofits. Where applicable, customers were advised to apply for a rebate under PG&E's retrofit programs.

The end uses addressed in the agricultural audits primarily included water pump tests, retrofits and adjustments. Other end uses addressed included lighting, crop water requirements, refrigeration compressor and HVAC electricity use.

3. End Uses and/or Measures Covered

End Uses Covered: Agricultural Pumping (electric) and Related Agricultural Technologies.

Measures Covered: For the list of potential measures covered in this evaluation, see *Section 2.3* of the report.

4. Methods and Models Used

The PG&E EMS Program Evaluation (the Evaluation) consisted of two key analysis components: (1) an EMS spillover analysis based on telephone survey data to determine the adoption rates of energy efficient measures that can be attributed to the EMS Program and (2) an application of per unit impact results from the Rebate Program to calculate the total program impact. Billing data regression analysis was also conducted for EMS participants and the comparison group. However, the regression results were statistically insignificant due to relative low impacts of the program. For a detailed discussion of the spillover analysis method used, see *Section 5: Evaluation Methodology*. Refer to *Appendix Q* of the Report for the application of the per unit results to the EMS participants.

5. Participant and Comparison Group Definition

Participant:

Participants of the EMS Program are defined as those PG&E agricultural customers who received a PG&E pump energy audit in the 1994 calendar year, independent of whether or not they installed the recommended measures or took the recommended actions. To avoid double counting, customers who received a rebate in 1994 under the RE and Customized Programs are classified as participants of the Rebate Program in this evaluation.

Comparison Group:

The comparison group for this study is defined as a group of PG&E agricultural customers who did not participant the EMS Program in the 1994 calendar year and who represent the non-participant population distribution as a random selected sample. Customers who participated in the previous years are eligible for the comparison group. Customers who participated in the PG&E's Rebate Program are not eligible because this comparison group was selected to serve as the control group for the evaluation of both programs.

6. Analysis Sample Size

Two telephone survey samples (455 EMS only participants and 453 comparison group customers) were collected as part of this evaluation. An on-site audit sample was not collected for this evaluation.

B. DATABASE MANAGEMENT

1. Data Description and Flow Chart

The telephone survey data for both participant and comparison group were linked to the final analysis database through the unique customer identifier—PG&E's customer control number. For this evaluation, the analysis database served as a centralized tracking system for customers' billing history, program participation, and sampling status and helped to reduce data problems such as account mis-match, double counting, or repeated customer contacts. Exhibit O-1 illustrates how each key data element was used to create the final analysis database for the Evaluation.

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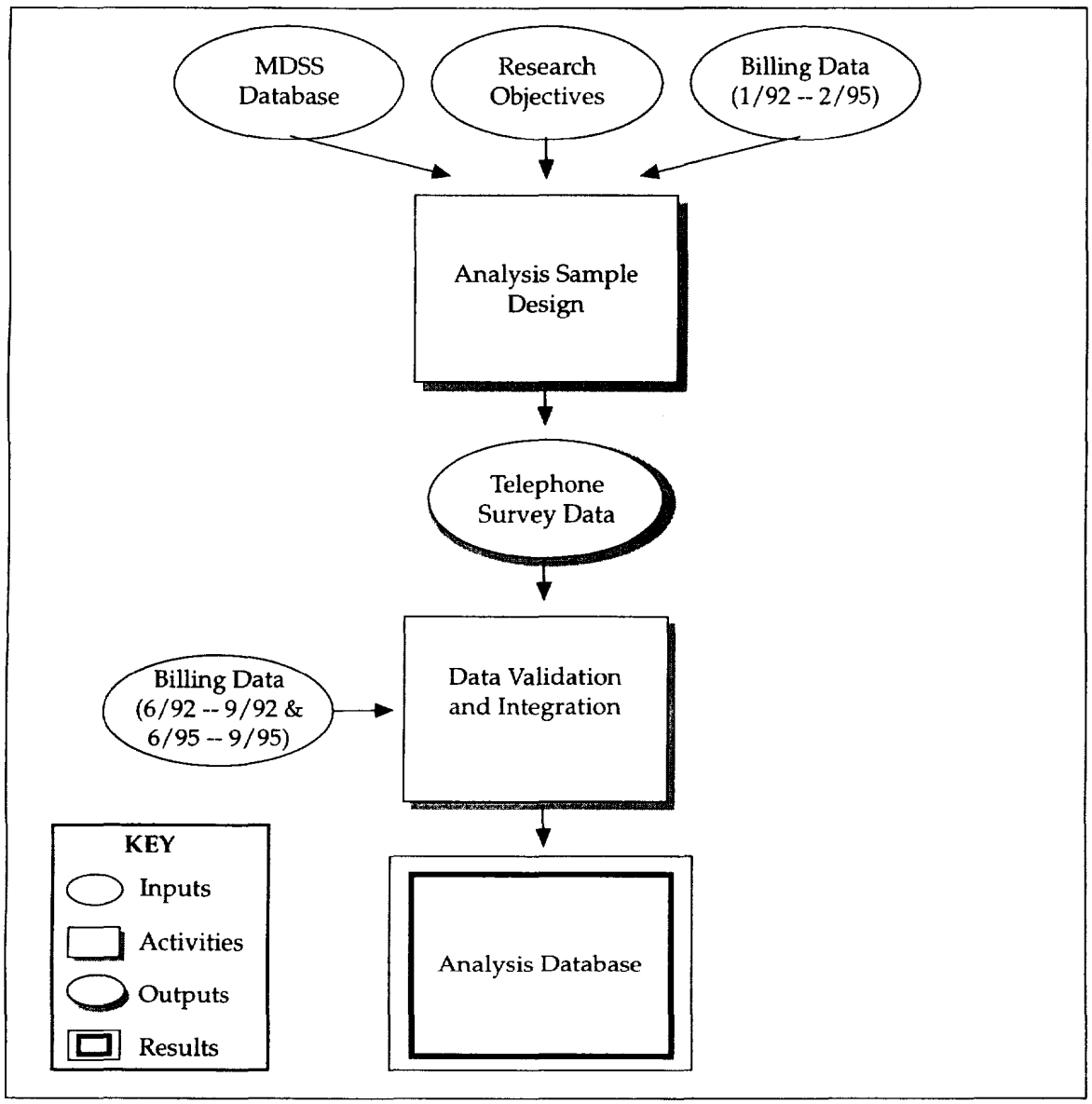

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- **Program Participant Tracking System** - The participant tracking system for the EMS Program was maintained as part of the PG&E MDSS. It contains program application, pump site and identification information, and technical information about pump test results and various pump measurement data. The MDSS database is linked to the billing database and other program databases through PG&E's customer control numbers.

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Other data elements include PG&E program marketing data, program procedural manuals, technical documents/handbook, and other industry standard data sources.

3. *Data Attrition Process*

All data elements mentioned above were first validated and then merged together to form the final analysis dataset. Records with out-of-range or questionable data were either deleted or flagged to ensure that only those records with sufficient data, both in terms of data quality and representativeness, were used in the analysis. The key data attrition decisions are summarized in *Appendix A*, pages A-5 - A-7.

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[1] A preliminary analysis has concluded that the monthly usage and bill read date information in these two datasets is consistent.

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Without exception, all data collected specifically for the Evaluation was utilized in the analysis.

C. SAMPLING

1. *Sampling Procedures and Protocols*

The sampling procedures and protocols are presented in *Appendix A: Sample Design*. This includes a detailed discussion on sampling frame definition for participants and comparison group, sampling strategy, sampling unit definition, data preparation for sample selection, sample target and final achieved sample. It also presents the procedures and results of sample relative precision calculation based on the total energy usage and demonstrates how the Evaluation sample design meets the Protocols' requirement in terms of sample size and relative precision.

2. *Survey Information*

Telephone survey instruments are presented in *Appendix D* (for participants) and *Appendix E* (for comparison group customers) of the Report. Participant and comparison group customer's survey response frequencies are presented in *Appendices G* and *H* of the Report, respectively. Finally, reasons for refusals are presented in *Appendices L* (for participants) and *M* (for comparison group) of the Report.

3. *Statistical Descriptions*

As mentioned above, a complete set of participant and comparison group customers' responses frequencies are presented in *Appendices G* and *H*, respectively. In addition, statistics on key variables that were used in the billing data regression models are also presented in *Appendix C* of the Report, pages C-5 - C-10.

D. Data Screening and Analysis

As mention above, the final regression model parameter estimates are not statistically significant due to relatively low expected program impacts and therefore the model output was not used in the final impact calculation. A detailed discussion of the billing data regression data analysis and the model specification are presented in *Appendix C*. The specific procedures and modeling issues are further discussed below.

1. Outliers, Missing Data and Weather Adjustment

Outlier analysis was conducted using statistical outlier tests (e.g., studentized residuals and the hat matrix) in combination with the model graphical outputs (e.g., two-dimension scatterplots, residual graphs, partial regression graphs, etc.). This is well known that the graphical displays are often the most powerful outlier diagnoses tools because they can detect both explicit and hidden outlier and influential observations. An observation is called an "outlier" if it is distinct from most of the data points in a sample and an outlier is called an "influential" if its deletion from the analysis causes a pronounced change in one or more of the estimated parameters. Sometime, one observation may have sufficiently extreme values on both response variable and on one or more of the regressors so that it has an overriding effect on the estimates, even though the residuals for that observation is small. In this case, this observation may be "invisible" or "hidden" from some statistical outlier tests based on residuals, but its impact can often be detected from a graphic display.

Observations with missing energy consumption data were eliminated from the analysis. There are only two customers in the sample that cannot be merged with the billing data and therefore have missing energy usage data. For survey responses, a major effort has been made to reduce the non-response rate on specific questions. Dependent upon the nature of the fields, missing or non-response items in the analysis samples were either filled with interpolation values or defaulted to some kind of sample means.

Weather adjustment was conducted to reflect the difference of required pumping energy as a function of weather effects. A thirty year average precipitation value was used in the engineering algorithm to represent the normalized weather. This information is presented in *Appendix B* of the Report, page B-10.

2. Background Variables

Background variables, water policy, and agricultural economic factors were not explicitly modeled in the final model, However, the effect of these factors was explicitly accounted for when a cross-sectional time series model was used with a

comparison group. This is based on the assumption that the comparison group was equally impacted by the same set of background variables.

3. Data Screen Process

As explained in *Appendix C,* pages C-4 - C5, the final model was fitted based on the summer electricity usage between pre-installation summer period (June 1992 - September 1992) and post-installation period (June 1995 - September 1995). Observations with largest summer usage were removed from the final model. The cut point is around 330 MWh and it removed a total of 6 points from the model with the final model estimated on a sample of 900 observations (450 EMS only participants and 450 comparison group customers.)

4. Regression Statistics

The regression statistics are presented in Exhibit C-9.

5. Model Specification

The model specifications are presented in *Appendix C,* pages C-4 - C-14. Specific model specification issues are further discussed below:

a. **Cross-sectional Variation** - The final model specification recognizes the potential heterogeneity problem in the model and uses the following procedures to eliminate the impacts of the cross-sectional variation: (1) observations with highest usage values were removed in the model to reduce the overall variance of the sample in terms of usage and size and (2) independent variables were all intercepted with the pre-installation usage to ensure that change of independent variable will be proportional to the usage value.

b. **Time Series Variation** - The key factors to control for the time series variation in the final model are: (1) use of the comparison group to define the relationship of the energy consumption between two different time periods and (2) eliminate the multiple time period interactions by using only one seasonal pre-installation period (June 1992 - September 1992) and one post-installation period (June 1995 - September 1995).

c. **Self-selection** - Self-selection is not treated explicitly in the billing regression analysis. The reasons for excluding such a correction is based on the following considerations: (1) the objective of the billing regression analysis is to estimate the program gross energy impacts. The self-selection bias, even exists, has very limited impacts on the outputs of such estimation when both cross-sectional and time series data are used and (2) the existing self-selection correction procedures all have serious flaws in their underlying assumptions. For example, the Mills ratio approach requires that the comparison group customers are in the market and it often introduces multi-collinearity between the Mills ratio variable and other variables that are already in the model, such as impacts or usage.

d. **Collinearity** - Based on the collinearity analysis, survey variables that are potentially correlated were grouped together in the final model to form new independent variables. For example, all EMS recommendations were collapsed into one variable and region 4, 5, and 6 were combined to form a new region due to low participation and correlation with other variables.

e. **Net Impact** - The billing regression model was used to estimate the gross energy impact only. The net impact analysis was conducted based on the survey self-report as discussed in more detail in *Section 5.3* in the Report.

6. Measurement Errors

For the billing data regression analysis, the main source of measurement error is the telephone survey. Our approach has been to proactively stop the problem before it happens so that statistical corrections are kept to a minimum.

Measurement errors are a combination of random and non-random error components that plague all survey data. The non-random error frequently takes the form of systematic bias, which includes, but is not limited to, ill-formed or misleading questions and miscoded study variables. In this project, we have implemented several controls to reduce the systematic bias in the data. These steps included (1) thorough auditor/coder training; (2) instrument pretest; and (3) cross-validation between on-site audit data and telephone survey responses.

The random measurement error, such as data entry error, has no impact on estimating mean values because the errors are typically unbiased. For the measures that were modeled in the billing regression analysis, the impact of random unbiased measurement errors was accounted for as part of the overall standard variance in the parameter estimate.

7. Autocorrelation

The autocorrelation problem exists if the residuals in one time period are correlated with the residuals in the previous time period. Since the final model is based on a seasonal pre- and post-installation period comparison with only one season in each period, the autocorrelation problem was unlikely to occur under this scenario, as was confirmed by examining the Durbin-Watson statistic for these models.

8. Heteroskedasticity

See *D.1* of this Appendix.

9. Collinearity

Various statistical tests (such as COLLIN and VIF options in SAS) were used to check multiple collinearity problem among independent variables in the model to ensure that the final parameter estimates are robust.

10. Influential Data Points

See *D.1* of this Appendix.

11. Missing Data

See *D.1* of this Appendix.

12. Precision

The relative precision of the parameter estimate is calculated based on the model estimated mean and standard error values. For example, the relative precision at the 90 percent confidence level can be estimated as (1.645*standard error)/mean.

For the sample relative precision in terms of annual usage, see *Appendix A.*, pages A-11 - A-12.

E. DATA INTERPRETATION AND APPLICATION

The engineering analysis (results and methods) is covered in detail in *Sections 3.1, 5.2.2 - 5.2.3* and *Appendix Q*. The billing regression analysis is discussed in *Sections 3.1, 5.2.4* and *Appendix C*. The program net-to-gross analysis was conducted based on survey self-report. For a detailed spillover analysis discussion, see *Section 3.3* and *Appendix Q*.

Appendix P

FREE RIDERSHIP LOGISTIC REGRESSION MODEL

Appendix P

FREE RIDERSHIP LOGISTIC REGRESSION MODEL

A logistic regression model predicting free ridership was developed using self-report data in a pooled model incorporating data from all surveyed Agricultural Program participants. *Section 5, Methodology,* contains a description of the superset of variables included in the model and rationale for their inclusion. This appendix describes the analytical steps undertaken in the model selection, building, and refinement process and presents the final model results.

Exhibit P-1
Self-Reported Free Ridership: Superset of Model Variables

		Predicted Direction	
Model Variable	**Wording of Question**	**Net Participant**	**Free Rider**
PD002	Would you have <taken the measure> if the program did not exist?	no	yes
PD003	How long would you have waited to <take the measure> without the program?	long period	short period
PD004	How long were you considering <the measure> before you heard about the program?	short-moderate period	long period
PD005	How long did you take to decide to participate after becoming aware of the program?	long period	short period
PD008B	Did you consider purchasing standard-efficiency equipment? (For low pressure sprinkler nozzles only)	yes	no
PD009	Did an EMS pump tester recommend that you participate in...the Ag Program?	yes	no
APPROACH	(Did the customer approach a contractor or PG&E rep?)	no	yes
REBATE	(Did the customer mention the rebate?)	yes	no
BILLS	(Did the customer mention bill savings?)	yes	no
BROKEN	(Did the customer mention broken equipment?)	yes	no
EMSPART	(Did the customer also participate in the EMS Program?)	no	yes
PD007	Before you knew about the program, which of the following statements best describes your company's plans to <take the measure>?	had considered, but no plans	planning to do it within the next 12 months

Variables Excluded from Model

As described earlier in *Section 5*, variable PD002 was dropped from the model before the model building process began in earnest. This variable was so strongly associated with the dependent variable, PD007, that it induced singularity problems in models with additional variables.

Variable PD008B (Did you consider purchasing standard-efficiency equipment?) was only asked of customers installing low pressure sprinkler nozzles. This question was omitted from the pooled logistic regression model.

Bivariate relationships between other independent variables and PD007 (examined through cross-tabs and bivariate logistic regressions) showed them to be sufficiently

associated, i.e., they were at least marginally statistically significant, and were therefore included in the first model run.

Functional Form of Variables Included in Free Ridership Model

"Yes" or "No" questions were entered into the initial model as dummy variables coded either "1" or "0." Continuous variables PD003, PD004, and PD005 were initially entered as continuous covariates with Box-Tidwell transformation terms. The Box-Tidwell terms are formed by creating an additional variable, "xlnx," for each continuous variable. Results of these tests showed that PD003 could be entered as a continuous variable, but PD004 and PD005 demonstrated nonlinear components and needed recoding. Techniques following Hosmer and Lemeshow[1] were used to identify the correct functional forms of PD004 and PD005. A dummy variable was created for PD004, which was set equal to "1" for those customers who reported they were in the market for one to three months before becoming aware of the program. Further follow-up tests showed that PD005 should be provisionally retained in the model as a continuous variable.

Variables Dropped from Model During Model Building

The initial, full model contained all variables mentioned previously, and interaction terms for variables PD003-PD005 (in the correct functional form). The model-building process involved testing subsets of variables until stable results were obtained. Criteria used to drop variables from the model included nonsignificant regression coefficients (e.g., the Wald Chi-Square test was not significant in a multivariate model) and change in model log-likelihood ratios with the inclusion or omission of the variable.

Interaction terms for PD003-PD005 were not statistically significant, and were dropped from the final model.

Variable PD005 was dropped because of its correlation with PD003 (as seen by a relatively large Pearson correlation coefficient and regression coefficient intercorrelation). When other variables were included in the model, this variable showed unstable results.

The EMSPART variable proved consistently nonsignificant and was also dropped.

[1] Hosmer, D., and Lemeshow, S. (1989). *Applied Logistic Regression.* Wiley, New York.

Goodness-of-Fit Tests: Outliers, High Leverage Values, and Influential Observations

Pearson residuals, deviance residuals, and hat values resulting from the later model specifications were examined. In the final model, Pearson residuals had an average value of 0.03, and a variance of 0.9. This quantity is thought to be N(0,1) when the model is correct. Deviance residuals followed the same pattern as the Pearson residuals, with the same observations showing extreme values. Overall, only eight cases had Pearson or deviance residuals greater than 2 or less than -2. This represents less than 5% of the sample used in the final model. Hat values showed that high-leverage values were not also influential outliers. Large hat values indicate points with undue weight on regression results and/or parameter estimates. Using a criterion of hat values exceeding 2k/n [where k is the # of independent vars and n is the # of obs in the model], only 10% of the cases demonstrated high leverage. Only one of the eight outliers had a leverage value greater than the criterion.

An examination of outliers revealed that the model tended to overpredict free ridership by approximately 5% to 6%. For this reason, an adjustment was made to the predicted free ridership values using the following adjustments: If 5% of the pump retrofit cases were overpredicted, the "adjusted" free ridership value for the pump retrofit measure group was reduced by 5%.

Collinearity

Correlations between the continuous independent variables were checked, as well as the correlation matrix of regression coefficients. This caused PD005 to be dropped from the final model.

Missing Data

Because many of the survey questions used in the model required the customer to recall various decision-making stages, there was a great deal of missing data. Rather than including missing data with mean or median values, the model was run with fewer observations. If the sample size had permitted, cross-validation of model results on a hold-out dataset would have been performed, but these data were not available. The final model was run with sample weights constructed in the method described in *Section 5*. Weighted and unweighted model results were not appreciably different in their statistical significance.

Precision of Results

Results presented in *Section 3* are shown with 90% confidence intervals.

Exhibit P-2
Descriptive Statistics for Variables Included in Final Model

Variable	N	Mean	Std	Min	Max
APPROACH	418	0.053	0.221	0	1
REBATE	439	0.201	0.398	0	1
BILLS	439	0.473	0.495	0	1
BROKEN	439	0.108	0.308	0	1
PD009	408	0.106	0.306	0	1
PD003	300	3.247	6.152	0	24
PD4_D	290	0.149	0.351	0	1
FR	444	0.548	0.494	0	1

Source: Telephone Survey Data

Descriptive Statistics

All but one of the independent variables in the model are dummy variables. Mean values for these dummy variables are the percentage of customers reporting, "yes," or otherwise responding affirmatively.

As shown in Exhibit P-2, many customers mentioned bill savings as the most important reason for participating in the program. Customers, on average, would have waited more than three months to adopt the measure without the program. According to question PD007, more than half the sample members were classified as free riders.

Exhibit P-3
Final Model Results

Variable	B	SE	Wald Chi-Square	P
APPROACH	-1.5185	0.7459	4.1446	0.0418
REBATE	-1.6378	0.6994	5.4832	0.0192
BILLS	-1.1895	0.6266	3.604	0.0576
BROKEN	-2.1009	0.7898	7.0764	0.0078
PD009	-0.9986	0.6343	2.4785	0.1154
PD003	-0.3012	0.0579	27.0547	0.0001
PD4_D	1.649	0.7693	4.5944	0.0321
INTERCEPT	2.8579	0.6044	22.3584	0.0001
N	173			
-2LLR	69.905			
P	0.0001			

Source: Telephone Survey Data

Model Results

All variables retained in the final model were significant at the p<.10 level, except EMSREC, which was marginally significant. The overall model-2 log-likelihood ratio, a measure of goodness-of-fit, was 73.404, with seven degrees of freedom (p<.0001). This indicates a statistically significant model. Data contributed to the final model came from 173 customers, from a possible 467 customers. As stated above, we elected to run the model with fewer data points rather than drop interesting variables with higher percentages of missing data. As with all behavioral models, results should be considered provisional and viewed in context. Cross-validation of the model on a separate dataset would test the reliability of the model in predicting free ridership and help strengthen the conclusions.

All variables showed effects in the direction predicted (see Section 5), except APPROACH, which is associated here with decreasing likelihood of free ridership. This could be a result of the effect of controlling for other predictors of free ridership, i.e., when other factors are also taken into consideration, customers who ask for information may be those most in need of the incentives provided by the program.

The dummy variable for PD004 (PD4_2) also showed interesting results. The variable was coded "1" for customers who spent one to three months researching equipment options before becoming aware of the program. Compared to contractor-driven participants (who should not have spent time considering

measures before becoming aware of the program), and risk-averse participants (who spent more time than others considering options), the group that spent moderate amounts of time shopping before becoming aware of the program (PD4_2=1) showed the greatest tendency toward free ridership.

Predicted Free Ridership

Model results were used to obtain probabilities of free ridership for each measure group. These probabilities were calculated in SAS using Proc Logistic. The probability of being a free rider, for any given measure group is

$$\hat{p} = \frac{e^{bX}}{1+e^{bX}}$$

where b is a vector of regression coefficients and X is a vector of mean values for the different explanatory variables. These predicted free ridership rates appear in *Section 3*, along with other measures of free ridership.

Appendix Q

EMS EVALUATION ESTIMATES

Appendix Q

EMS EVALUATION ESTIMATES

The EMS program impacts estimates used the responses from the EMS participants telephone survey. Specific questions were designed to determine whether the customer would have installed the self-reported agricultural measure without the EMS program influence. The percent of those who stated they would not have performed the retrofit without the EMS program was then applied to the EMS population to determine the number of measures installed due to the program. Exhibit Q-1 shows the number of people who stated that the EMS program helped in their decision to implement the measure, the percent this represents for the telephone population and this percentage extrapolated to the EMS population.

Exhibit Q-1
Number of Agricultural Measures Installed due to EMS Program

Spillover Measure	Number that EMS helped in decision to implement	Number who would have done it anyway, w/o EMS	% EMS helped	% Do it anyway, w/o EMS	Estimated number in EMS who installed measure due to program
Pump Retrofit	3	7	0.58%	1.54%	31
Pump Adjustment	7	13	1.58%	2.95%	85
Rigid Double Walled Plastic	0	0	0.00%	0.00%	0
Double-Walled Polyethylene	0	1	0.00%	0.13%	0
Heat Curtain	0	1	0.00%	0.13%	0
Low Pressure Sprinkler Nozzle	14	5	3.12%	1.09%	168
Milk Pre-cooler	0	0	0.00%	0.00%	0
Refrigerator Desuperheater	0	0	0.00%	0.00%	0
Well Water Measurement Device	7	7	1.58%	1.57%	85
Time Clock with Battery Backup	13	13	2.76%	2.83%	148

Telephone Survey Size = 455

1994 EMS Participant Population = 5380

Once the number of measures installed by EMS participants was settled, the impact for each measure was determined. Average units were used to create the impacts for each installed measure. The RE program evaluation average usage for the pump retrofit and

pump adjustment participants was used for these two measures. The average horsepower for pump retrofits was from the average of turbine and centrifugal pumps within the pump test database. It is smaller than the horsepower shown in the well water measurement device because this average is for pumps with > 100 feet of lift only. The number of nozzles installed was the average from the MDSS with outliers removed.

Impact multipliers for pump retrofit and pump adjustment are from the program evaluation. The pump retrofit kW impact multiplier is the updated OPE ratio of 0.14 (corresponding to the average size in the 20-75 hp bin) multiplied by the CDF of 0.53 and the conversion value of 0.746. The well water measurement device kW saving OPE ratio (0.074) and the energy impact multiplier are documented on page 20-21 in appendix J. The low pressure sprinkler nozzle and time clock multipliers are also documented in *Appendix J.* Table Q-2 has the EMS energy and demand impacts.

Exhibit Q-2
EMS Energy and Demand Impacts

Measure	N	Avg Unit	Unit	From	Impact Multiplier	Impact - kWh	Impact - kW
Pump Retrofit - kWh	31	254,897	kWh/yr	1994 RE Evaluation	0.12	953,987	
Pump Retrofit - kW	31	68	HP	93/94 Pump Test Database	0.0554		117
Pump Adjustment	85	48,533	kWh/yr	1994 RE Evaluation	0.015	61,810	
Nozzle - kWh	168	2,955	Number of Nozzles	MDSS	22.8	11,309,927	
Nozzle - kW	168	2,955	Number of Nozzles	MDSS	0.0058		2,894
Water Well Measurement - kWh	85	379	Ft	MDSS	46.4	1,492,725	
Water Well Measurement - kW	85	77	Hp	93/94 Pump Test Database	0.0297		194
Time Clock	148	125,910	kWh/hr	93/94 Pump Test Database	0.1	12,591	
					Total EMS	**13,831,040**	**3,205**

Appendix R

ENGINEERING LIGHTING REVIEW

Appendix R

ENGINEERING LIGHTING REVIEW

The purpose of this appendix is to provide the documentation for the engineering review of lighting hours of operation and peak operating factors. A memo to the project manager and supporting exhibits follow.

February 26, 1996

To: Mary Dimit

From: Mary Sutter

Re: Review of AG Lighting Hours of Operation

QC has investigated the hours of operation and peak operating factors for the Agricultural Program Lighting component. This memo is the result of that work.

The program participation was researched first. Exhibit 1 shows the peak kW and kWh impacts using the MDSS ex-ante estimates. Hours of operation were derived from the MDSS values using the peak kW, number of fixtures installed and coincident operating factor (0.67). With a few exceptions, these meet the expected number of 4000 hours from the "Other" category in the MDSS. Some fluorescent fixture replacements used number of lamps instead of number of fixtures according to Ken Barskey of PG&E, so it is expected that the hours of operation would show up somewhat different than 4000. This was not investigated any further. High Intensity Discharge (HID) values slightly larger than 4000 hours (4100) were also not investigated further due to their relative lack of impact (just over 2.5% of total). The hours showing for halogen lights and other lights are as expected from the ex-ante estimates.

Compact fluorescent and HID technologies were targeted for further exploration because, together, they made up 95% of the kW and kWh impact. These technologies were then pooled into just compact fluorescent (CF) and HID to determine what type of business in which they were most installed. Exhibit 2 shows that there are 26 business types as segmented by the MDSS variable SIC1NM95. Again, the top segments were targeted for further research. They are indicated by the gray background in exhibit 2. Also indicated by a gray background are those business' which, although not having a large percent of impact, were comparable to a business which did have a large impact (i.e. poultry hatcheries was pooled with poultry slaughtering). The SIC1NM95 variable which resulted in a poultry slaughtering and processing name actually had farms which raised fryers, according to Ashley Able, the Fresno PG&E AG representative.

We contacted three PG&E AG representatives, Ashley Able from the Fresno district, David Head from the North Coast and Dana Estison from Stockton to determine how these top business' (those

within the gray background) operated within their districts. We also contacted Tim Jacobsen of Crop Care Services and Peter Canessa. Based on this input, the hours of operation were changed as shown in exhibit 3 for the large impact business'. Although dairy farms did not have a large impact, they were included in this analysis of hours of operation since the people we contacted had knowledge of the use of the dairy. The business of Crop Preparation had two possible operating hours. Either the business was seasonal (24 hours/day for some months of the year) or it ran year round (24 hours/day). We had conflicting responses from the sources contacted about whether cold storage sites were always year round or sometimes seasonal. Although the 1994 population indicated that it was 60% cold storage (7 of 12 listed businesses), for this analysis, 50% were considered year round and 50% were considered seasonal. A single weighted average was used for the hours of operation for the business of Crop Preparation.

The updated hours of operation were implemented back to the MDSS ex-ante estimates just for those technologies and business as investigated. The results are shown in exhibit 4.

The peak operating factor were unchanged for all technologies except those installed by ornamental nurseries. The exterior HID technologies currently have a peak operating factor of zero. Work done by QC on the commercial and industrial segments puts this operating factor at 0.10 for commercial weekday and 0.50 for industrial weekday. Because of the difference in magnitude between these two values and the expectation that the AG sector would not map directly to either one, the exterior peak kW impact was left at zero for the AG sector. Future work should explore this further.

50% of the peak impact for the lighting portion of the 1994 program (or about 22% of the total program) are from HID interior technologies seen in the ornamental nursery business. Our sources stated that lighting technologies are used within this business to extend the hours of lighting for the plants. Dana Estison, the Stockton PG&E representative, contacted one of their customers to discuss how they used their lights. This mode of lighting was confirmed by the nursery owner. That particular nursery had lights on from 3 am to dawn only from October to March. He stated that

the hours of operation are similar, but that some growers run their lights to extend the day after the sun goes down. Given these parameters, the probability that the lights are operating from 3-4 pm (summer peak period) in the summer is zero. However, they probably are operating from 5-6 pm (winter partial peak) in the winter, although the diversity across growers is unknown. The peak operating factor for technologies installed within the ornamental nursery business were set to zero and implemented. The results are shown in exhibit 4.

Based on the work done, we recommend that ex-ante hours of operation for the AG sector be unchanged for all technologies except for CF and HID technologies which have been installed in poultry, crop preparation, dairy farms or ornamental nursery business'. Future work should focus on creating peak operating factors and hours of operation that are business group specific and determining if the technologies implemented by business groups are stable between the program years. If this is the case, then a technology based hours of operation and operating factor could be implemented for the AG sector as a whole that is weighted by business participation.

Please call me if you have any questions about the results.

MS:ms
Exhibits 1-4

Exhibit R-1
PG&E Agricultural Program Lighting Participation

Measure Code	RE Program Year Code	Application Frequency	Percentage of Lighting Peak kW Impact	Percentage of Lighting kWh Impact	Hours of Operation	Measure Description
L03	1993	50	24.7%	24.1%	4000	COMPACT FLUORESCENT: SCREW-IN, REPLACE LMP,REUSE BLST
L04	1993	3	1.1%	1.0%	4000	COMPACT FLUORESCENT: HARDWIRE
L63	1994	1	0.0%	0.0%	4000	COMPACT FLUORESCENT: SCREW-IN, INTEGRAL BLST, 14-26 W
L64	1994	6	2.2%	2.1%	4000	COMPACT FLUORESCENT: SCREW-IN, MODULAR BLST, 5-13 W
L65	1994	10	0.7%	0.7%	4000	COMPACT FLUORESCENT: SCREW-IN, MODULAR BLST, 14-26 W
L66	1994	4	0.1%	0.1%	4000	COMPACT FLUORESCENT: HARDWIRE FIXTURE, 5-13 WATTS
L67	1994	2	0.0%	0.0%	4000	COMPACT FLUORESCENT: HARDWIRE FIXTURE, 14-26 WATTS
L68	1994	1	0.0%	0.0%	4000	COMPACT FLUORESCENT: HARDWIRE FIXTURE, 27-50 WATTS
CF Total		**77**	**28.8%**	**28.1%**		
L10	1993	4	0.0%	0.0%	4211	FIXTURE: T-8, 2-LAMP, 4 FT FIXTURE
L11	1993	3	0.0%	0.0%	4000	FIXTURE: T-8, 3-LAMP, 4 FT FIXTURE
L12	1993	3	0.0%	0.0%	4000	FIXTURE: T-8, 4-LAMP, 8 FT FIXTURE
L13	199?	3	0.0%	0.0%	4000	LAMP: T-8
L14	1993&4	5	0.0%	0.0%	4000	BALLAST: ELECTRONIC, 2-LAMP BALLAST
L19	1993&4	1	0.0%	0.0%	4000	FIXTURE: MODIFICATION/LAMP REMOVAL, 4 FT LAMP REMOVED
L23	1993&4	7	0.1%	0.1%	4000	FIXTURE: MODIFICATION/REPLACE LAMPS & BLST, 4 FT FIXT
L24	1993&4	7	0.3%	0.3%	4182	FIXTURE: MODIFICATION/REPLACE LAMPS & BLST, 8 FT FIXT
L69	1994	1	0.0%	0.0%	4000	FIXTURE: 2 FT T-8 W/EL BLST, 1 31-W T-8 U OR 2 17-W T-8
L72	1994	1	0.1%	0.1%	4000	FIXTURE: 4 FT T-8 W/ELEC BLST, 1 32-WATT T-8 LAMP
L73	1994	16	0.3%	0.3%	4000	FIXTURE: 4 FT T-8 W/ELEC BLST, 2 32-WATT T-8 LAMPS
L74	1994	3	0.1%	0.0%	4000	FIXTURE: 4 FT T-8 W/ELEC BLST, 3 32-WATT T-8 LAMPS
L75	1994	12	1.0%	0.9%	4000	FIXTURE: 8-FT T-8 W/EL BLST, 2 8-FT T-8 OR 4 32-W, 4-FT T-8
Fluorescent Total		**66**	**2.0%**	**1.9%**		
L60	1994	1	0.0%	0.0%	2000	HALOGEN LAMP: <= 45 WATTS
L61	1994	1	0.0%	0.0%	3000	HALOGEN LAMP: >= 50 WATTS
Halogen Total		**2**	**0.0%**	**0.0%**		
L25	1993	1	0.0%	0.0%	4000	HID FIXTURE: INTERIOR, 0-100 WATTS LAMP
L26	1994	8	1.1%	1.1%	4000	HID FIXTURE: INTERIOR, 101-175 WATTS LAMP
L27	1994	17	5.4%	5.2%	4000	HID FIXTURE: INTERIOR, 176-250 WATTS LAMP
L28	1993&4	6	0.0%	0.1%	4100	HID FIXTURE: EXTERIOR, 0-100 WATTS LAMP
L29	1993&4	15	0.0%	0.7%	4100	HID FIXTURE: EXTERIOR, 101-175 WATTS LAMP
L30	1993&4	24	0.0%	1.7%	4100	HID FIXTURE: EXTERIOR, >= 176 WATTS LAMP
L37	1993	22	9.5%	9.2%	4000	HID FIXTURE: INTERIOR, >= 176 WATTS LAMP
L79	1994	1	0.0%	0.0%	4000	HID FIXTURE: COMPACT, 36-70 WATTS LAMP
L80	1994	1	0.0%	0.0%	4000	HID FIXTURE: COMPACT, 71-100 WATTS LAMP
L81	1994	35	51.0%	49.5%	4000	HID FIXTURE: INTERIOR, 251-400 WATTS LAMP
HID Total		**130**	**67.0%**	**67.7%**		
L07	1993&4	2	0.2%	0.2%	4000	FIXTURE: INCAND TO FLUOR CONVERSION W/ES BLST
L08	1993&4	7	2.0%	1.9%	4000	FIXTURE: INCAND TO FLUOR CONVERSION W/ELEC BLST
Incadescent Total		**9**	**2.2%**	**2.1%**		
L31	1993&4	4	0.0%	0.1%	1248	TIME CLOCK: LIGHTING
L35	1993&4	1	0.0%	0.0%	2608	BYPASS/DELAY TIMER: LIGHTING
L36	1993&4	15	0.0%	0.1%	280	PHOTOCELL: LIGHTING
Other Total		**20**	**0.0%**	**0.2%**		

Exhibit R-2
PG&E Agricultural Business Percentages for CF and HID Technologies

	Frequency		Number Fixtures Purchased			Peak Demand Impact			kWh Impact		
SIC1NM95	CF	HID	CF	HID	Both Measures	CF	HID	Both Measures	CF	HID	Both Measures
ANIMAL SPECIALTY SERVICES, EXCEPT VETERINARY	0	1	0.0%	0.1%	0.1%	0.0%	0.4%	0.4%	0.0%	0.4%	0.4%
BEEF CATTLE, EXCEPT FEEDLOTS	0	1	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.0%	0.2%	0.2%
BERRY CROPS	0	2	0.0%	0.1%	0.1%	0.0%	0.6%	0.6%	0.0%	0.6%	0.6%
BROILER, FRYER, AND ROASTER CHICKENS	12	0	11.5%	0.0%	11.5%	3.9%	0.0%	3.9%	3.9%	0.0%	3.9%
CANNED FRUITS AND VEGETABLES	0	3	0.0%	0.2%	0.2%	0.0%	0.9%	0.9%	0.0%	0.9%	0.9%
CANNED SPECIALTIES	0	1	0.0%	0.2%	0.2%	0.0%	0.4%	0.4%	0.0%	0.4%	0.4%
CHICKEN EGGS	3	0	7.0%	0.0%	7.0%	2.4%	0.0%	2.4%	2.4%	0.0%	2.4%
CITRUS FRUITS	1	1	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.0%	0.2%	0.2%
CROP PREPARATION SERVICES FOR MARKET	1	12	0.0%	1.7%	1.7%	0.0%	7.9%	7.9%	0.0%	7.9%	7.9%
DAIRY FARMS	0	10	0.0%	0.5%	0.5%	0.0%	1.7%	1.7%	0.0%	1.7%	1.7%
DECIDUOUS TREE FRUITS	0	7	0.0%	0.3%	0.3%	0.0%	1.6%	1.6%	0.0%	1.6%	1.6%
FIELD CROPS, EXCEPT CASH GRAINS, NEC	0	1	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%
FLOWERSAND FLORISTS' SUPPLIES	0	1	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%
FRUITS AND TREE NUTS, NEC	0	2	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%
GENERAL FARMS, PRIMARILY ANIMAL	0	1	0.0%	0.1%	0.1%	0.0%	0.2%	0.2%	0.0%	0.2%	0.2%
GENERAL FARMS, PRIMARILY CROP	0	11	0.0%	0.6%	0.6%	0.0%	3.1%	3.1%	0.0%	3.1%	3.1%
GRAPES	0	2	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%
NONCLASSIFIABLE ESTABLISHMENTS (2)	0	1	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%
OPERATIVE BUILDERS	1	0	0.8%	0.0%	0.8%	0.3%	0.0%	0.3%	0.3%	0.0%	0.3%
ORNAMENTAL NURSERY PRODUCTS	0	10	0.0%	10.6%	10.6%	0.0%	50.2%	50.2%	0.0%	50.1%	50.1%
POULTRY HATCHERIES	2	0	0.4%	0.0%	0.4%	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%
POULTRY SLAUGHTERING AND PROCESSING	38	5	61.4%	0.3%	61.8%	20.8%	0.6%	21.4%	20.9%	0.6%	21.5%
S.I.C. CODE NOT ASSIGNED	0	1	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.0%	0.2%	0.2%
SUGAR CANE AND SUGAR BEETS	0	1	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%
TREE NUTS	0	5	0.0%	0.2%	0.2%	0.0%	0.6%	0.6%	0.0%	0.6%	0.6%
TURKEYS AND TURKEY EGGS	8	3	3.2%	0.5%	3.7%	1.1%	2.0%	3.1%	1.1%	2.0%	3.1%

= business operating hours explored further

Exhibit R-3
Updated Hours of Operation

Business	Hours/Day	Days/Year	Fog Days	Weight	Updated Hours
Poultry	24	304	-	-	7296
Crop Preparation - Seasonal	24	154	-	0.5	
Crop Preparation - Year Round	24	335	-	0.5	5868
Ornamental Nursery	5	183	10	-	1033
Dairy Farms	24	365	-	-	8760

Exhibit R-4
PG&E Agricultural Program Lighting Impacts with Updated Hours of Operation

Measure Code	Peak kW Impact	New Peak kW Impact	Old kWh Impact	New kWh Impact	Measure Description
L03	605.9	605.9	3,635,460	6,134,003	COMPACT FLUORESCENT: SCREW-IN, REPLACE LMP,REUSE BLST
L04	26.3	26.3	157,644	157,644	COMPACT FLUORESCENT: HARDWIRE
L63	0.1	0.1	360	360	COMPACT FLUORESCENT: SCREW-IN, INTEGRAL BLST, 14-26 W
L64	52.7	52.7	316,440	576,737	COMPACT FLUORESCENT: SCREW-IN, MODULAR BLST, 5-13 W
L65	17.7	17.7	106,200	112,285	COMPACT FLUORESCENT: SCREW-IN, MODULAR BLST, 14-26 W
L66	3.2	3.2	19,080	19,080	COMPACT FLUORESCENT: HARDWIRE FIXTURE, 5-13 WATTS
L67	0.4	0.4	2,520	2,520	COMPACT FLUORESCENT: HARDWIRE FIXTURE, 14-26 WATTS
L68	0.0	0.0	208	208	COMPACT FLUORESCENT: HARDWIRE FIXTURE, 27-50 WATTS
CF Total	**706**	**706**	**4,237,912**	**7,002,837**	
L10	1.2	1.2	7,360	7,360	FIXTURE: T-8, 2-LAMP, 4 FT FIXTURE
L11	0.8	0.8	4,752	4,752	FIXTURE: T-8, 3-LAMP, 4 FT FIXTURE
L12	0.8	0.8	4,524	4,524	FIXTURE: T-8, 4-LAMP, 8 FT FIXTURE
L13	0.7	0.7	3,880	3,880	LAMP: T-8
L14	1.2	1.2	6,992	6,992	BALLAST: ELECTRONIC, 2-LAMP BALLAST
L19	0.7	0.7	4,416	4,416	FIXTURE: MODIFICATION/LAMP REMOVAL, 4 FT LAMP REMOVED
L23	2.6	2.6	15,840	15,840	FIXTURE: MODIFICATION/REPLACE LAMPS & BLST, 4 FT FIXT
L24	6.2	6.2	37,812	37,812	FIXTURE: MODIFICATION/REPLACE LAMPS & BLST, 8 FT FIXT
L69	0.2	0.2	1,344	1,344	FIXTURE: 2 FT T-8 W/EL BLST, 1 31-W T-8 U OR 2 17-W T-8
L72	1.3	1.3	7,832	7,832	FIXTURE: 4 FT T-8 W/ELEC BLST, 1 32-WATT T-8 LAMP
L73	7.4	7.4	43,560	43,560	FIXTURE: 4 FT T-8 W/ELEC BLST, 2 32-WATT T-8 LAMPS
L74	1.2	1.2	7,252	7,252	FIXTURE: 4 FT T-8 W/ELEC BLST, 3 32-WATT T-8 LAMPS
L75	23.5	23.5	141,120	141,120	FIXTURE: 8-FT T-8 W/EL BLST, 2 8-FT T-8 OR 4 32-W, 4-FT T-8
Fluor Total	**48**	**48**	**286,684**	**286,684**	
L60	0.0	0.0	60	60	HALOGEN LAMP: <= 45 WATTS
L61	0.1	0.1	600	600	HALOGEN LAMP: >= 50 WATTS
Halogen Total	**0**	**0**	**660**	**660**	
L25	0.1	0.1	680	680	HID FIXTURE: INTERIOR, 0-100 WATTS LAMP
L26	27.7	27.7	165,120	212,256	HID FIXTURE: INTERIOR, 101-175 WATTS LAMP
L27	131.7	0.0	785,664	385,521	HID FIXTURE: INTERIOR, 176-250 WATTS LAMP
L28	0.0	0.0	21,761	21,761	HID FIXTURE: EXTERIOR, 0-100 WATTS LAMP
L29	0.0	0.0	112,176	112,176	HID FIXTURE: EXTERIOR, 101-175 WATTS LAMP
L30	0.0	0.0	257,603	257,603	HID FIXTURE: EXTERIOR, >= 176 WATTS LAMP
L37	232.2	0.0	1,386,000	464,769	HID FIXTURE: INTERIOR, >= 176 WATTS LAMP
L79	0.6	0.6	3,584	3,584	HID FIXTURE: COMPACT, 36-70 WATTS LAMP
L80	0.2	0.2	1,240	1,240	HID FIXTURE: COMPACT, 71-100 WATTS LAMP
L81	1249.2	0.0	7,464,800	2,974,191	HID FIXTURE: INTERIOR, 251-400 WATTS LAMP
HID Total	**1642**	**29**	**10,198,628**	**4,433,782**	
L07	5.1	5.1	30,528	30,528	FIXTURE: INCAND TO FLUOR CONVERSION W/ES BLST
L08	48.3	48.3	288,000	288,000	FIXTURE: INCAND TO FLUOR CONVERSION W/ELEC BLST
Incand Total	**53**	**53**	**318,528**	**318,528**	
L31	0.0	0.0	18,451	18,451	TIME CLOCK: LIGHTING
L35	0.5	0.5	2,060	2,060	BYPASS/DELAY TIMER: LIGHTING
L36	0.0	0.0	7,983	7,983	PHOTOCELL: LIGHTING
Other Total	**1**	**1**	**28,494**	**28,494**	
Total	**2,450**	**837**	**15,070,906**	**12,070,985**	